CONTENT

I. Introduction

The Republic of Bulgaria took an active part in the preparation of the Convention on Nuclear Safety, having in mind the necessity for a document of international legislative nature in regard to the safety of the nuclear facilities.

On September 20, 1994 at the Headquarters of the International Atomic Energy Agency the Convention was signed by the Republic of Bulgaria. On September 14, 1995 the Convention was ratified by a law adopted by the National Assembly (the Parliament of the country) and was promulgated in the Official Journal (Durzhaven Vestnik – D.V.) No. 93/1996.

This report presents the achievements of the Government of the Republic of Bulgaria, its authorities and the Operator as well as their plans for the implementation of the obligations under the Convention on Nuclear Safety.

1. The Policy of the Republic of Bulgaria in the Field of Nuclear Energy

Bulgaria is a country which has a shortage of energy resources, so in the 60's a policy for the nuclear energy inducstry development was introduced. In the Government's "Programme 2001", approved in 1997, the main strategic goal of the nuclear energy industry is the enhancement of the safety of the nuclear facilities as well as its maintenance. In 1998 the Programme for the Development of Energy Industry till 2010 was accepted which presents the following requirements:

- reconstruction and modernization of all units of the Kozloduy NPP aimed at the enhancement of nuclear safety, reliability and automatization level;
- ensuring the safe operation of the Kozloduy NPP units 1-4 till the rest lifetime;
- solving the problems connected with the safe management of the spent fuel (SF) and the radioactive waste (RAW).

The construction of a new NPP with a capacity power of 600 MW will probably be carried out in the period after 2006-2008 in order to meet the electricity demands of the country.

2. Review and List of the Nuclear Facilities in the Country

The commissioned and operating nuclear facilities in the Republic of Bulgaria are situated on the Kozloduy NPP site as follows:

Nuclear Facility	Nuclear Facility Type	Commissioned
Unit 1	WWER-440/V230	start-up 1974
Unit 2	WWER-440/V230	start-up 1975
Unit 3	WWER-440/V230	start-up 1980
Unit 4	WWER-440/V230	start-up 1982
Unit 5	WWER-1000/V320	start-up 1987
Unit 6	WWER-1000/V320	start-up 1991
Storage for Spent Fuel	Pool type	1990

The total power of the six units at the Kozloduy NPP is 3760 MW. The experience gained till now is more than 99 reactor years. In past few years the Kozloduy NPP has generated about 45 % of the total electricity production in the country.

During the 70's a site for the construction of a second nuclear power plant was selected near the town of Belene. In 1980 the Ministry of Energy started its construction. Initially the construction of 4 units with WWER-1000/V320 reactors was envisaged with a possibility for exceeding this capacity with additional new facilities. The engineering works on the site and the construction of the infrastructure started at the end of the year 1980. The construction of unit 1 started in 1987. In the year 1991 the Belene NPP construction was stopped mainly due to lack of funds.

3. Safety Review of the Kozloduy NPP Operation

Units 1 - 4

The Kozloduy NPP units 1-4 have power reactors of the WWER-440/V230 type. Though their design was developed in the late 60's, they carry a number of positive features characteristic of units which are safe by their design. At the same time some discrepancies with the current requirements for ensuring safe operation were identified. For this reason during the 80's a number upgrading activities were carried out, based on the operational experience as well as on the recommendations of the Chief Designer. Since 1990 a systematic and step-by-step enhancement of their safety was started with the participation of international expert organizations. In 1997 the implementation of the Short-term Three-stage Programme for Enhancement of the Reliability and Safe Operation was completed. In 1998 the implementation of the measures from the Complex Programme for the further enhancement of the safety was started. This Programme contains certain technical measures, elaborated on the

basis of deterministic and probabilistic analyses. Their implementation will bring the safety to an acceptable level in compliance to the current international practice for reactors of this generation.

Units 5 and 6

The Kozloduy NPP units 5 and 6 are equipped power reactors of the WWER-1000/V320 type. The design of these reactors meets entirely the international requirements for nuclear safety. The main principle for NPP safety is applied: defence in depth with several physical barriers. The active safety systems have 3x100 % capacity, functional independence and they are physically separated. Their confinement is designed for full pressure (0.5 MPa).

Based on the analysis of the operational experience, the comparison with similar reactors of the PWR type and the enhanced international requirements for safety, a programme for modernization was elaborated and its implementation has already started. Generally the aims of the programme are to enhance both the safety and the availability of the units.

Management of the Spent Fuel

Since the start of the operation of the Kozloduy NPP till 1988 the spent fuel was transported to the former Soviet Union.

In 1990 the construction of a pool type spent fuel storage facility (SFSF) on the site of the Kozloduy NPP was accomplished. According to the design the SFSF is scheduled to be filled in 10 years and the assemblies can be stored in it for a period of 30 years. The state of the SFSF does not comply with the current requirements for safety and the re-valuated seismic characteristics of the site. In 1991 a programme for enhancement of the SFSF safety was elaborated which is now being up-dated.

Since 1988 till now the generated SF has been stored in the spent fuel pools at the reactors (SFP) and SFSF. By March 1, 1998 there are 4737 assemblies with SF from both types of reactors WWER-440 and WWER-1000 stored on the site which is about 768 t heavy metal.

In the period 1988-1997, when the country was in a process of transitioning to market economy, a detailed strategy on the final phase of the SF management was not elaborated. In 1998 a policy of the National Electric Company (NEC-PLC) on this problem was adoped. It envisages the following main measures of the safe management of RAW generated from the Kozloduy NPP:

- partial shipping back of SF to the state of origin - Russia;

- modernization of the SFSF and its compliance with the current safety requirements;

- investigation of the possibilities for increasing the capacity of the SFSF and the SFP by compact storing of the assemblies;

- construction of a new storage for SF for a period of not less than 50 years or storing in containers;

The plan for implementation of the policy of the NEC-PLC foresees the following main phases:

- by the year 2000 - accomplishment of the implementation of a programme for compliance with current safety requirements, finalizing of the equipment and licensing of the existing SFSF;

- by the year 2000 - conclusion of the negotiations for the partial return of the SF to the manifacturer, including solving the problem of the high level radioactive waste from its reprocessing;

- by the year 2005 - construction of a second transitional storage for SF and defining the long-term goals for SF treatment, including all techinical and economical aspects of the problem.

Management of Low- and Intermediate-Level RAW

The problem of the safe management of RAW at the Kozloduy NPP will be entirely solved in the next few years. The liquid and gaseous RAW are treated. The received concentrates - radioactive salt solutions, ion-exchange resins and filtres, are stored in special storages. The solid RAW, which volume can be reduced, are compressed in 200 l barrels and are stored on the Kozloduy NPP site. In 1991 an installation for treatment of intermediate- and low-level RAW was acquired, and a technical project for a facility for treating and a temporary storage for storing of the treated RAW for a period of 25-30 years was elaborated. Due to reasons of organizational and financial nature the facility will be commissioned probably during the year 2000. It is foreseen that the transitional storage for low- and intermediate-level RAW will be completed and commissioned by 2000.

4. National Programmes Related to the Nuclear Facilities

For maintaining and enhancing the safety and reliability of the nuclear facilities, the following activities are envisaged to be carried out:

- Implementation of a complex programme for enhancement of the safety of the Kozloduy NPP units 1-4. The programme was approved by NEC -PLC in 1997 and was open

for amendments and supplements. It is carried out in the framework of the annual planned outages and it is expected to be accomplished by the year 2002;

- Implementation of a programme for modernization of the Kozloduy NPP units 5 and 6. The programme will be carried out in the framework of the annual planned outages by the European Consortium (Siemens, Framatom, Atomenergoexport) and the Westinghouse company and will be completed by the year 2005;
- Implementation of a programme for updating of SFSF in compliance with the current safety requirements;
- Regulation of the activities for collecting and spending finances from "Safety and Storage of Radioactive Waste" and "Decommissioning of Nuclear Facilities" funds by the end of 1998;
- Establishment of a "National Institution on Safe Management of RAW" - by the year 2005;
- Elaboration of a plan and a technical project for decommissioning of units 1 and 2.

5. State Control

In 1957, when the Republic of Bulgaria became a state-founder of the International Atomic Energy Agency, the Committee on the Peaceful Use of Atomic Energy (CPUAE) was established and entrusted with the directing of the development of research and experimental activity in this area. By State Decrees in 1975 and 1980 the CPUAE was entrusted with authority for control over the nuclear and radiation safety in the operation of nuclear facilities, and for control, accounting for and transportation of nuclear material.

By the Act on the Use of Atomic Energy for Peaceful Purposes (AUAEPP) in the year 1985 the CPUAE was transformed into the Committee on the Use of Atomic Energy for Peaceful Purposes (CUAEPP). The CUAEPP was authorized as a regulatory body on nuclear safety and radiation protection, as it is formulated in the Convention on Nuclear Safety. According to the AUAEPP, the Ministry of Public Health, Ministry of Environment and Water, Ministry of Internal Affairs and Ministry of Agriculture, Forestry and Agricultural Reform as well as other state bodies carry out specialized control in the framework of their authority.

II. Article-by-Article Review

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 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."

The Kozloduy NPP is situated on the bank of the Danube river - about 4 km from the fairway. There are six power units in operation. A storage for spent fuel is constructed as well as a temporary storage for low- and intermediate radioactive waste. A complex of facilities for treating RAW and a temporary storage for containers with treated RAW is under construction.

The list of the nuclear facilities is presented in Annex 1 while the data of these facilities are presented in Annex 2.

6.1. Kozloduy NPP Units 1-4

General Information

The units with WWER-440/V230 type reactors are constructed in modules with 2 units each: 2 reactors are situated in one reactor building and they use jointly some systems for normal operation. The safety systems of each unit are separate and independent from the other one. Each unit has two 220 MW main generators.

The main mechanical equipment can be considered as standard design and it is produced by standard procedures. The design of the units has been done by regular industrial standards, only the design and the manifacturing of the reactor equipment and the pipelines of the primary circuit are in compliance with special requirements.

On the basis of the operational experience gained and on recommendations by the Chief Designer, the following measures, directed at the safety enhancement, were carried out till 1990:

- replacement of the safety relief valves of the pressurizer;
- seismic upgrading of the buildings, pipelines and equipment;
- annealing of the reactor pressure vessels 1 and 2;
- measures for reducing the thermal shock of the reactor pressure vessel in case of an accident;
- measures for reducing the neutron flux upon the reactor pressure vessel;
- replacement of the batteries of the systems for reliable power supply;
- replacement of the flammable electric cables of the safety systems.

Safety Assessment

In the period between 1990-1994 several missions of the IAEA for safety analysis of units 1-4 were carried out:

Assessment of Safety Significant Event Team, (ASSET) - carried out in 1990, 1992, 1993.

Safety Review Missions, (SRM) - carried out in 1991, 1993, 1994.

The reports of these missions are available in the IAEA.

The first missions - ASSET (November 12-23, 1990) and SRM (June 3-21, 1991) recorded the presence of a highly qualified personnel but at the same time some discrepancies in the safety culture, personnel training, maintenance of the facilities, quality assurance and management practice. Certain technical measures for enhancement of the operational safety and procedures were proposed. By Resolution of the Government of the Republic of Bulgaria in 1991 units 1 and 2 were shut down for the implementation of the recommendations. For a period of about 18 months specific measures were carried out for restoring the design safety level.

The next missions - ASSET (June 1-5, 1992) and SRM (April 26-30, 1993) established that some of the recommendations were carried out and others were included in a programme for safety enhancement, thus generally a considerable progress was recorded. It was recommended that more funds and efforts should be invested for carrying out the planned measures.

The ASSET mission from September 20 to October 1, 1993 inspected whether the discrepancies noted during the mission in 1992 had been eliminated. It was established that 6 out of 13 recommendations were implemented while the rest "were well addressed and there is a progress in their implementation". Additional efforts were recommended for enhancing the qualification of the maintenance personnel and for elaborating maintenance directives.

The last of the above-mentioned missions - SRM (July 12-14, 1994), established that almost all of about 60 technical problems were entirely or partially solved and only 5 of them are still under research. The situation was similar concerning the recommendations connected with the operational aspects - approximately 150 recommendations were implemented entirely from about 160. Additional information on the implementation of the Short-term three stage programme is presented in Annex 3.

In the period 1996-1997 a probabilistic safety analysis (PSA)-level 1 was carried out for units 1-2 and 3-4. The results of the study were discussed with experts from the IAEA during the (IPERS) mission in November 1997. A number of recommendations were made and their implementation is under way.

The CUAEPP inspectors and the specialized regulatory authorities carry out operative control over the assessment of the Kozloduy NPP operational safety. The span of this control is discussed under Article 14 of the Convention. In the period 1990-1998 the CUAEPP issued one year licences for operation after shut-down for maintenance, based on detailed inspections of the implementation of the planned upgrading measures, the general state of the units as well as different systems and components. The satisfactory safety level recorded serves as a ground for issuing of the licence for operation.

Planned and Carried Out Activities for Safety Enhancement

The Short-term three stage programme for ensuring the functional operation of the systems and equipment of the units was implemented in the period 1990-1997. It was elaborated in co-operation with the World Association of Nuclear Operators (WANO) and approved by the CUAEPP. Detailed studies of different aspects concerning the safety were carried out, for example an assessment of the reactor pressure vessels' characteristics (including an analysis of metal samples), analyses of the applicability of the principle "leak before break" for the main pipelines of the primary circuit, qualification of the systems' equipment related to the safety, etc. The measures carried out, lead to a considerable safety improvement. The main results from the implementation of the Short-term programme are presented in Annex 3. In connection with the remaining unsolved problems concerning a recorded or potential safety deficiency, a conception for reconstruction of units 1-4 was prepared. On this basis, in co-operation with Russian organizations, a Complex programme for implementation of further measures for safety enhancement of the units was elaborated.

The safety criteria in the Complex programme are defined in accordance with the recommendations of the IAEA and the requirements of the CUAEPP:

- frequency of the core damages lower than 1.E-4 for reactor per year;

- the measures for management of accidents and the means for localizing them should ensure substantial reducing, compared to the above-mentioned parameters of the probability for considerable radioactive releases into the environment.

Additionally the CUAEPP defined standards for the forecast maximum individual exposure of the population in case of design and beyond the design basis accidents.

In the elaboration of the Complex programme the experience gained in the Kozloduy NPP was used, as well as experience from the research of units of this type in Russia and Slovakia and the recommendations and results from the carried out PSA for the units.

The analyses were made in accordance with the methodology, established in the IAEA documents for safety assessment of NPP in operation ("A Common Basis for Judging the Safety of Nuclear Power Plants Built on Earlier Standards" - INSAG-8 and "Periodical Safety Review of NPPs in Operation" - 50-SG-012).

The following activities were carried out in the elaboration of the programme:

- deterministic analysis of the current state of the units' safety;
- PSA - level 1 in accordance with the IAEA recommendations;
- analysis of the operational experience;

The main results of the deterministic analyses were as follows:

- 54 normative and technical documents were analysed;
- the deviations of the original design from the requirements of the normative and technical documents (111 pcs.) as well as the recommendations of the IAEA (16 pcs.) were defined;
- 61 safety problems were defined, none of them requiring immediate action;
- 51 technical measures were proposed.

The results of the PSA show that the main accidents leading to the core melting are connected with: break of the elements of the primary circuit (Loss of Coolant Accident); main steam line break (MSLB); loss of external power supply (LOOP) as well as seismic impact. Nine problems on the safety were defined and 5 technical measures were proposed.

Based on the analysis of the operational experience 29 problems were defined and the relevant measures were planned.

The joint implementation of these analyses leads to results similar to those achieved during the periodical safety assessment recommended by the IAEA. On the basis of these results are identified areas of problems and a list of measures for their solving is prepared which represents the content of the Complex programme itself. It is accepted that the implementation of these measures does not require the creation of some special conditions (such as long-term shut-downs of the units) and it can be carried out within 4 years. A

evaluation of their economic effectiveness was made too. The continuation of the units' operation will allow the accumulation of funds necessary for their decommissioning. The implementation of some of the planned measures has started (see Annex 3).

The CUAEPP required the elaboration of a report approving the safety of the units after the implementation of the Short-term three stage programme as well as a justification of the new maximum design accident and the radioecological consequences from it, and an additional analyses for proving the reliability of the pipelines of the primary circuit. An expertize of the complex programme carried out by leading Western European companies is under way.

Intentions

The design lifetime operation of the units is 30 years. The research carried out during the past few years and the assessment of the rest lifetime of the main equipment show that this term is attainable. Taking into account the already implemented measures for enhancement of the operational safety as well as the measures which have to be implemented in the next 2-3 years, it is expected that the term for decommissioning of unit 1 and 2 would be in 2004-2005 while of unit 3 and 4 - not earlier than 2010-2012.

6.2. Kozloduy NPP Units 5 and 6

General Information

The units with reactors WWER-100/V320 are the third generation of the Soviet design for pressurized water reactors and are similar to the western designs for reactors of the PWR type by analogous ensuring the safety, design characteristics and construction. The units' design is in accordance with the standards established in the Basic Safety Standards-73, later up-dated with the Rules on Safe operation of NPP (RSO-04-74), Basic Safety Rules (BSR-82) and Standards on Radiation Protection (SRP-76) of the former USSR.

The basic concept of safety - defence-in-depth, is implemented by design projects including the redundancy, variety, independence, protection against failures and passive elements. The design basis of these units is discussed under Article 18.

Safety Assessment

Two missions of the IAEA (Operational Safety Analysis Review Team, OSART) in 1990 and in 1991 were carried out for assessment of the operational safety. They established a good functional order concerning the analysis of the operational events, the management of

operation, the programmes for control over the state of the equipment and the control over radiation protection. The organization of the operation needs improvement as well as the maintenance activities and the technical support. Additional recommendations were made concerning the interaction between the CUAEPP and the NEC-PLC. The recommendations were implemented in accordance with an elaborated programme.

The IAEA ASSET mission, carried out in November 14-25, 1994, reviewed over 400 operational events, 177 of them connected with the safety. Generally, the conclusions are:

- there are good criteria for reporting;
- there is a directive on reporting;
- there are no events which have not been reported;
- there are no events with radioecological consequences on- and off-site;
- there is a tendency towards reducing the number of events;
- the effectiveness of the control is improved.

The mission did establish a general tendency toward improvement of the operational safety.

The last mission (SRM), carried out from June 26 to July 1, 1995, reviewed the programme for modernization of units 5 and 6. It was established that the programme is elaborated in compliance with the existing assessments and analyses of the IAEA on the safety of the WWER-1000/V320 type reactors. Some of the defined by the IAEA deficiencies regarding the safety are not included in it, because they were either eliminated or in a process of elimination.

PSA - level 1 was also carried out for these units. In 1996 the International Peer Review Service (IPERS) mission of the IAEA was carried out aimed at an assessment of the methodology and the results of the analyses. In the framework of a contract for assistance to the CUAEPP, financed by the European Commission, a review of the corrected analyses was planned to be carried out by experts from Riskaudit.

Carried Out and Planned Activities for Enhancement of the Safety

In the process of commissioning of units 5 and 6 a number of deficiencies were found, some of them were eliminated before the commissioning of the units, others - in the process of operation. The main measures for safety enhancement, implemented till the year 1998, are presented in Annex 3. The development of the requirements for safety, the studying of the operational experience and the necessity for replacing equipment and systems due to expiring of their lifetime, brought about in the years 1992-1994 the start of planning technical measures for improving the units. With the active international assistance in 1994-1995 the

first version of the programme for their modernization was elaborated. The IAEA mission in 1995 approved the programme in principle and defined 7 additional measures. The last version of the programme for modernization was accepted with a positive evaluation by Riskaudit in 1997 and was approved by the CUAEPP.

In 1997 a tender was announced by the NEC-PLC for implementation of the programme. The implementation of the main part of the measures was consigned to the European Consortium "Kozloduy", including Atomenergoexport-Russia, Siemens-Germany and Framatom-France. The implementation of a number of measures was undertaken by Westinghouse- (USA). At present time the first stage of the implementation is under way. The main measures of the programme for modernization are presented in Annex 3.

Intentions

The design operational lifetime of the units is 30 years. Taking into account that the units were built in compliance with the current requirements for ensuring the safety, there is no doubt that it will be reached. The possibility to extend this lifetime in the future will be examined, depending on the analyses of the main equipment resource.

6.3. Spent Fuel Storage Facility

General information

The SF removed from the reactors is stored in pools situated near by the reactors. After 3-5 years storing, the SF is transported to a temporary storage (SFSF) situated on the territory of the Kozloduy NPP, nearby units 3 and 4.

The SFSF is of a pool type, situated in a separate building. According to the design the storage will be filled in 10 years and the fuel can be stored in it for 30 years. Additional data for the SFSF are presented in Annex 2.

Safety Assessment

The safety of the SFSF is ensured by different technical and organizational measures. The design includes double facing of the pools ensuring high thickness and reliable control over the leaks. The designer has carried out the relevant analyses for justification of the safety. The constructive and neutron-physical characteristics of the SF assemblies guarantee that they should keep their leak-tightness and integrity in a situation where the pools are entirely dried and there is air-cooling for a period of time, sufficient for the undertaking of restorative measures.

The technical design of the SFSF was elaborated in compliance with the soviet normative documents in the 70's and was approved by the Ministry of energy in 1980. The building and the pre-operational adjustment were completed in the beginning of 1990.

The Inspectorate on the Safe Use of Atomic Energy (ISUAE) of the CUAEPP has not issued a licence for commissioning of the storage due to registered design deficiencies. In February 1990 a licence for short-term storage of 960 assemblies from the reactors of WWER-440 type was issued. Till 1998 licences have been issued for short-term storage of additional quantities of SF based on safety justifications.

In the year 1991 a programme of measures for enhancement of the safety of SFSF was elaborated. In 1992 the new seismic characteristics of the Kozloduy NPP site were taken into account in the programme. The main measures of the programme were not implemented due to financial and organizational reasons.

Two independent ecological assessments of the SFSF were carried out: an expertize made by a team from the Risk-Engineering company as well as a complete report of the impact on the environment made by a group of specialists from the Sofia University "Kliment Ohridski". The results of these assessments do not show any considerable negative impact on the environment from the SFSF operation.

Safety Enhancement Activities

In the year 1997 a list of immediate measures was prepared for enhancement of the SFSF safety, more of which are envisaged to be implemented by the end of 1998. Under the PHARE programme a re-evaluation of the programme '91 was financed with a term of implementation December 1998. The results of this analysis will show what further activities to be undertaken.

In 1998 started the implementation of measures for the enhancement of the reliability of the systems and equipment as well as seismic stability of the SFSF. The main measures are:

- upgrading the reliability of the SFSF systems' power supply;
- upgrading of the reliability of the SFSF supply with demineralized water;
- upgrading the reliability of the SFSF supply with service water;
- seismic anchorage of the safety related equipment;
- seismic anchorage of the SFSF building.

6. 4. Facilities for RAW Treatment

Concerning the methods and means for RAW management during the design and building of the Kozloduy NPP units, Regulation No. 0-35 of the Ministry of Public Health and Ministry of Internal Affairs was used as a basis, defining the general requirements for work with radioactive substances. Some provisions from applicable normative acts of the former USSR were used too.

The generated from the NPP operation RAW are stored in auxiliary buildings (AB) - one for two units. In recent years the NPP generates annually average of about 400 m^3 liquid RAW, 360 m^3 solid RAW and 20 m^3 low- and intermediate ion-exchange resins.

By the middle of 1998 in the storage of the Kozloduy NPP there are about 6500 m^3 low- and intermediate solid RAW and about 7000 m^3 liquid RAW. The total radioactivity of the stored low- and intermediate RAW is about 370 TBq.

The high radioactive RAW (elements contaminated in the core) are stored in the disposal areas of units 5 and 6, foreseen in the design. Half of the available volume of about 200 m^3 for units 1-4 is already filled. In the storage for high radioactive RAW of units 5 and 6, which volume is 86 m^3, are stored about 5 m^3 waste.

The quantities expected after the decommissioning of the Kozloduy NPP units 1-6 are estimated of about 100 000 m^3 treated low- and intermediate waste.

Auxiliary Buildings (AB) - 1, 2 and 3

The liquid RAW after relevant concentrating in the systems for evaporation are stored in steel tanks. The AB-1 and AB-2 have 5 tanks with a volume of 500 m^3 each, while the AB-3 has 3 tanks with volume of 200 m^3 each. The solid RAW are stored in concrete shafts with a total volume of 1600 m^3 in the AB-1 and AB-2 and 1500 m^3 in the AB-3. The design of AB-1 and AB-2 does not foresee installations for treating the liquid RAW but an extension of the buildings after 5 years operation in order to increase the volumes. Such extensions were not built so the liquid RAW had to be evaporated to solid residue. Thus for the 24 years operation of units 1-4 about 4000 m^3 waste in dry state were accumulated in the tanks for liquid RAW.

The design of AB-3 foresees an installation for bituminizing liquid RAW and three tanks for still bottoms with volume of 200 m^3 each. This installation for bituminizing has not been installed due to lack of supplier's preparedness. So in the year 1988 an extension of AB-3 was built with 4 tanks with a volume of 750 m^3 each. When the concrete shafts of AB-1 and AB-2 were filled up, in the year 1980 a temporary surface storage for solid RAW was built on the Kozloduy NPP site with a total volume of 4000 m^3 (40 sections of 100 m^3 each). The

storage presents a system of reinforced concrete bunkers closed by reinforced concrete covers. By the middle of the year 1998 the storage was filled with solid and non-solid RAW.

Plant for RAW Treating and Storage for Treated RAW

Under construction is a compound of facilities and systems for treating the stored RAW, and their temporary storage. Westinghouse-USA is the supplier of installations for treatment of the liquid RAW, a compactor for solid RAW, an installation for inceneration of the contaminated oils, other facilities, equipment, preliminary designs and technologies. The construction of this compound is financed under the PHARE programme and from the NEC-PLC funds and its commissioning is planned for the year 2000.

The design technology envisages the following phases:

- removing of the liquid RAW from the tanks in the relevant AB by a system for dissolving the crystal state in the tanks for still bottoms;
- transporting of the dissolved still bottoms by a special tank-truck from AB-1 and AB-2 and by pipelines from AB-3 to the plant;
- concentrating the still bottoms by film evaporator;
- preparation of cement mixture with a capacity of 12 m^3 per day.

The solid RAW are delivered in containers and are sorted out by definite criteria, then they are put into 200 l barrels and are pressed by a mobile compactor with compressive force of 980 t. The big ones are preliminary broken to pieces. Every barrel is marked and scanned for defining its radioactivity and isotope content. The pressed barrels are put into a reinforced concrete container with a net volume of 5 m^3 and are covered with the cement mixture, containing the liquid RAW. The radioactivity and the total weight of the container are controlled and the content of each one is documented. The control of all processes is automated.

After the container is filled up, it is left for 24 hours for hard-setting the concrete mixture and then it is transported to the storage.

The design of the on-site storage for the treated RAW has already been done. The building is 72 m long and 37 m wide and it is built on a ballast pillow with a common foundation. A system for control and collection of the non-organized leaks is foreseen. Each transporting operation is carried out by cranes and manipulators by remote control. The containers are put in 4 rows in height, 8 rows in width and 30 rows in length in each of the two halls.

Planned Activities

The Kozloduy NPP policy is directed toward minimizing the volume of RAW at all phases, from their generating and treating as well as their reliable isolation from the environment. It is foreseen that after the commissioning of the new facilities the gradual removing of the stored up RAW in the available volumes and their treating according to the described above technology will start. It is envisaged that in 5-7 years all stored up RAW will be treated.

6. 5. The Belene NPP

The activities connected with the selection of the site as well as the design of the Belene NPP are commented in Article 17 and Article 18. In Annex 2 is presented additional information for the Belene NPP.

In recent years certain investigations were carried out and are being carried out at the moment concerning the possibilities for the construction to be continued. There is no decision taken regarding this question and there are no plans for continuing the construction for the present moment.

From the abovementioned facts follows the conclusion that the Republic of Bulgaria meets the requirements of Article 6 of the Convention on Nuclear Safety.

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 terms to licences;

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

7.1. State of the Existing Legislative and Other Acts in the Area of Nuclear Safety and Introduction of Relevant National Requirements

The content of the legislative and regulatory basis in the Republic of Bulgaria - acts and executive acts, are presented in Annex 4.

Content of the National Legislative Acts in the Field of Nuclear Safety

The basic act in the area of the use of atomic energy is the Act on the Use of Atomic Energy for Peaceful Purposes (AUAEPP).

In the first chapter of the AUAEPP - General Provisions, are presented the main principles for the use of atomic energy:

- atomic energy in the Republic of Bulgaria shall be used for peaceful purposes only;
- the use of atomic energy for the production of nuclear weapons or other nuclear explosive devices, as well as any means for mass destruction, is prohibited;
- atomic energy shall be used in accordance with the aims and the principles of nuclear and radiation safety, and the protection of the life of the people and the environment shall have priority over economic and other social needs;
- special nuclear material and nuclear facilities are State property;
- the mining, processing and production of nuclear material, the transportation of and trade with special nuclear material, and the use of nuclear facilities are State monopoly.

According to Article 18, paragraph 4 of the Constitution of the Republic of Bulgaria the State monopoly over the use of nuclear energy and the production of radioactive products can be established by an act. Such act is the AUAEPP where Article 2 paragraph 3 establishes the State monopoly in the mining, processing and production of nuclear material, the transportation of and trade with special nuclear material as well as the use of nuclear facilities. According to Article 2, paragraph 1 the special nuclear material and the nuclear facilities are State property. The rights over the above-mentioned activities and facilities are granted according to the conditions and procedures of the Act on the Concessions.

In Chapter II of the AUAEPP - Management of the Use of Atomic Energy, the Committee on the Use of Atomic Energy for Peaceful Purposes (CUAEPP) within the Council of Ministers is the State body pursuing the State policy on the safe use of atomic energy. In Article 13 of the AUAEPP the authorities of the CUAEPP are specified.

In Chapter III of the AUAEPP - State Control, the main rules connected with the exercizing of the state control over the safe use of atomic energy during transportation, storage

of and accounting for nuclear material are presented. This control is exercized by the CUAEPP and especially by the Inspectorate on the Safe Use of Atomic Energy (ISUAE).

The provisions of Chapter IV of the AUAEPP consider the civil liability for nuclear damage caused by a nuclear accident. Taking into account the Convention on Nuclear safety and the adopted in 1995 amendments of the AUAEPP the provisions establish the civil liability in the use of atomic energy by modern and internationally acknowledged procedures.

In Chapter V - Administrative and Penal Provisions, sanctions are envisaged for noncompliance with the obligations established by the act. The amendments in this Chapter made in June 1998, were aimed at updating the fines in compliance with the existing inflation.

In accordance with the AUAEPP a new section in the Penal Code of the Republic of Bulgaria has been added - Offences committed in the use of atomic energy for peaceful purposes. An amendment and a supplement of the Penal Code is planned which will extend the scope of the activities considered as offences by this section as well as the harshness of the penalties.

The additional provisions of the AUAEPP present legal definitions for a number of basic concepts in the field of the use of atomic energy.

The Rule for Implementation of the Act on the Use of Atomic Energy for Peaceful Purposes (RIAUAEPP) presents details on the Act's provisions.

In connection with the adopted amendments and supplements to the AUAEPP, in 1997 the CUAEPP elaborated a draft for a new Rule for Implementation of the AUAEPP. It is expected that after passing the obligatory procedure this draft will be soon put forward to the Council of Ministers.

According to Article 20 of the AUAEPP the Ministry of Public Health (MPH), the Ministry of Environment and Water (MEW), the Ministry of Internal Affairs (MIA) and the Ministry of Agriculture, Forestry and Agrarian Reform (MAFAR) exercize a specialized control in the framework of their authorities. The Ministry of Labour and Social Care, the Committee on Standardization and Metrology as well as the Civil Protection Directorate within the Ministry of Defence carry out specific functions in the control over nuclear facilities.

The normative acts, regulating the activities of the Ministry of Public Health and its specialized bodies for nuclear safety control, can be divided into two groups: general and special. The general normative acts, such as the Act on Public health (APH) and the Rule for Implementation of the Act on Public Health (RIAPH) regulate all activities of the bodies for State Sanitary Control. These activities also include the radiation protection.

According to Article 20 of the APH the Minister of public health establishes obligatory hygiene norms, requirements and sanitary rules on all questions concerning the hygiene, radiation protection and epydemiology. The State Sanitary Control bodies suspend the building, prohibit putting into operation and suspend the operation of facilities, as well as they discontinue the sanitary licences for putting into operation when there are breaches of the hygiene standards and requirements of the sanitary rules, including the ones of radiation protection.

The organizing of the State Sanitary Control is regulated by the Rule for Implementation of the Act on Public Health. The National Centre of Radiobiology and Radiation Protection (NCRRP) is the specialized body in the field of radiation protection.

In the framework of his authority the Minister of public health alone or jointly with other ministries or committees issues executive acts. They regulate in details the activities of the control over the radiation safety of the employees, working in ionizing radiation conditions as well as of the population.

The Act on Safe Labour Conditions regulates the rights and the obligations of the State, employers, employees and state employees concerning the ensuring of healthy and safe labour conditions. According to the Act such labour conditions are those that do not lead to any professional diseases and accidents during the working time. The ionizing radiation is considered as one of the most unhealthy factors. The Act envisages the minimal requirements for healthy and safe labour conditions to be defined by a regulation of the Minister of labour and social care and the Minister of public health.

According to the Act on Environmental Protection (AEP), Chapter 3, the Ministry of Environment and Water exercizes the State control over the state of the environment.

According to Article 19 of the AEP all activities of legal entities and physical persons, of state and municipal bodies can be evaluted in regard of their impact on the environment. Such evaluations are obligatory for:

1. Mining and processing of uranium ores;

2. Generation of electricity by Nuclear Power Plants(NPPs);

3. Storage, treatment and disposal of radioactive waste(RAW) and spent fuel(SF).

Regulation No. 4 of the MEW for evaluation of the impact on the environment specifies the procedures and the conditions for exercizing the above-mentioned evaluation.

The adopted Act for the Ministry of Internal Affairs specifies its main requirements:

- protection of the life, health and property of the population;

- ensuring the fire and accident protection;

- protection and defence of the state frontier, economic system, including strategic and significant sites;

- prevention of terrorist activities, etc.

These functions are specified in the tasks and activities of the national and territorial departments and structural units of the MIA. For example, Article 46, paragraph 1 (6, 8, 10, 12) regulatesthe activity of department "Security" ensuring the normal environmental situation in the country, counteractions to intentions and actions, endangering the security of strategic sites and activities, international terrorism and extremism, arms trade, illegal production and distribution of dangerous products or strategic raw materials.

According to Article 109 (3, 5) the fire departments of the MIA exercize permanent prevention measures for avoiding accidents and keeping state of alert necessary for undertaking the envisaged in the Act actions.

Regulation No. 8 on Physical Protection of Nuclear facilities and Nuclear Material, issued by the CUAEPP and the MIA, is an executive act regulating the MIA functions on protection and safeguard of the established regime of the nuclear facilities operation and transportation of nuclear material. The Regulation specifies the duties of the security service:

- collection of information on the organization of illegal activities which might lead to disruption of the technological processes and instructions, which should be enforced for admitting to and protecting the site;

- submission of the received information to the competent authorities which alone or jointly with other authorities could carry out relevant measures for limiting or eliminating the occurrence of dangerous consequences;

- control over official secrets.

The specific activities, connected with the security, are carried out in co-ordination with the organizations and persons who licensed for implementation of activities on the use of atomic energy for peaceful purposes according to the AUAEPP.

Ordinance No. 324/ 28.12.1994 of the Council of Ministers specifies the MIA activities connected with the physical protection of nuclear facilities and nuclear material. This ordinance also specifies the duties of the National Security Service (NSS) for ensuring the protection of strategic sites and activities for control over official secrets.

The Ministry of Agriculture, Forestry and Agricultural Reform (MAFAR) exercizes the veterinary sanitary control through veterinary offices, veterinary sanitary inspectorates, veterinary inspectorates at the frontiers and other offices. In the MAFAR inspectorates there are laboratories for chemical physics, microbiological and other examinations which are

included in the national system for emergency preparedness in case of an accident at the Kozloduy NPP.

Executive Acts in the Field of Nuclear Safety Issued by the CUAEPP

Regulation No. 2 on Cases and Procedures for Notifying the Committee on the Use of Atomic Energy for Peaceful Purposes on Nuclear Safety and Radiation Protection Related Operational Deviations, Occurrences and Emergency Situations. (Regulation No. 2 of the CUAEPP)

This regulation specifies the cases for notifying the CUAEPP on safety related events, during management, operation or use of nuclear material, nuclear facility, radioactive substances or any other ionising radiation sources. The terms and procedures for notifying the CUAEPP and the forms for event reporting are determined. The responsibility borne for a non-notification and late, inaccurate or insufficient notification on safety related event is specified.

Regulation No. 3 on Nuclear Power Plants Safety Assurance During Design, Construction and Operation. (Regulation No. 3 of the CUAEPP)

As it is stipulated in the regulation, a Nuclear Power Plant (NPP) is assumed to be safe, when through technical means and organizational measures is executed the non-exceeding of personnel and population exposure limits, the standards for content of radioactive substances in the environment during normal operation and design basis accidents. The regulation contains management and technical requirements, which execution is anecessary condition for ensuring the NPP safety during design, constructional and operational stages.

Two new regulations will be elaborated in the near future, namely: Regulation on Safety of Nuclear Power Installations and Regulation on Safety of the Installations for Final Disposal of RAW.

Regulation No. 4 on Accounting for, Storage and Transport of Nuclear Material. (Regulation No. 4 of the CUAEPP)

This regulation specifies the procedures for accounting for, storage and transportation of nuclear material. The fundamental principles of the physical protection of nuclear material during its utilisation, storage and transportation are specified (the State has the monopoly of the nuclear material extraction, processing and production, transportation and trade of the special nuclear material, and the use of nuclear facilities). The regulation does not apply for materials obtained from ore extraction and processing in the Republic of Bulgaria.

Regulation No. 5 on Licensing the Use of Atomic Energy. (Regulation No. 5 of the CUAEPP)

This regulation specifies the necessary documentation, terms, procedures and terms for the issuance of licences for atomic energy utilisation. Licences for atomic energy utilisation are issued by the Inspectorate on the Safe Use of Atomic Energy (ISUAE) within the Committee on the Use of Atomic Energy for Peaceful Purposes (CUAEPP) after receiving of the applicant's request in written form, specifying the activity connected with the use of atomic energy, for which the licence is requested. The request should be accompanied by the documentation, necessary for issuing a licence, which is determined by this and other normative acts on the use of atomic energy (including Quality Assurance Programme for the corresponding activity).

Regulation No. 6 on Criteria and Requirements for Training, Qualification and Licensing of the Personnel Employed in the Field of Atomic Energy. (Regulation No. 6 of the CUAEPP)

This regulation specifies the criteria and requirements for training, qualification and licensing of the personnel employed in the field of atomic energy, aimed at acquiring, maintening and enhancing the personnel professional qualification and ensuring the necessary licensing for safe use of atomic energy.

Regulation No. 7 on Collection, Storage, Treatment, Transportation and Disposal of Radioactive Waste on the Territory of the Republic of Bulgaria. (Regulation No. 7 of the CUAEPP)

This regulation specifies the terms and procedures for collection, storage, treatment, transportation and disposal of Radioactive Waste (RAW) by the organisations, generating RAW on the territory of the Republic of Bulgaria. This regulation is not in force for spent fuel and spent fuel treated waste.

Regulation No. 8 on Physical Protection of Nuclear Facilities and Nuclear Material. (Regulation No. 8 of the CUAEPP)

This regulation specifies the fundamental principles of the physical protection of nuclear facilities and nuclear material. It includes the organizational and technical requirements for ensuring the physical protection of nuclear facilities and nuclear material during its use, storage and transportation. The regulation concerns directly all physical persons and organisations which design, construct, commission or decommission nuclear facilities, as well as produce, store, use, import, export and transport nuclear material or ensure its physical protection.

All above-mentioned acts were issued before the last amendments of the AUAEPP and should be revised. In the beginning of 1998 a Programme for the development of the legislative and regulatory basis in for the period (1999-2000) was elaborated. This programme

is a part of the National programme for accepting the achievements of the European legislation, approved by the Council of Ministers together with Strategy for Accession.

7. 2. Legislative and regulatory basis establishing the system for licensing

The licensing process is regulated by the AUAEPP, RIAUAEPP as well as by Regulation No. 5 and Regulation No. 7 of the CUAEPP. According to the AUAEPP, Article 23, Paragraph 1, licences are issued for:

- siting, design, construction, commissioning, operation and decommissioning of nuclear facilities and other sites with sources of ionizing radiation;

- manufacturing of equipment, designs' and structures' modifications, delivery of equipment and other services, significant for the safety of nuclear facilities and other sources of ionizing radiation;

- ownership, production, import, export and trade, storage and transportation of nuclear material and radioactive substances.

The above-mentioned activities can be carried out after receiving a licence from the ISUAE. The activities, for which a licence is necessary, may be grouped and one licence may be issued for all activities or licences may be issued for each single activity. Separate kinds of activities may be exempted from licensing, under terms determined by the normative acts.

The ISUAE licence is a legal document, which:

- licenses the kind of activity using atomic energy according to the AUAEPP, Article 23, paragraph 1;

- specifies the requirements and the terms, which determine the execution of this kind of activity;

- sets the expiration date of the validity of the licence.

Licences are issued after a request in written form by the applicant who uses or will use atomic energy, carrying out some of the activities under Article 23 of the AUAEPP.

The licences contain:

- basis for licence issuing;

- licensing authority;

- licensed activity;

- special and general requirements and conditions to be complied with by the applicant;

- list of documents, on which basis the licence is issued;

- relevance to other licences;

- name of the recipient of the licence;

- date of issuing and expiration date of the validity of the licence;

- responsibilities during the execution of the specifiedactivity.

The special requirements and conditions towards the applicant may refer to additional training of the personnel, extended maintenance, inspections, testing and check-ups, frequency of preventive technical service, submitting of additional information, strengthening of the requirements for coolant reactivity and other limits and conditions for safe operation, including reactor power capacity.

The licences' general requirements and conditions include indirect warning for observing the requirements of the normative acts related to the nuclear safety and radiation protection.

The CUAEPP Regulation No. 5 specifies the necessary documentation, terms, procedures and terms for the issuing of a licence. Chapter 2, 4 and 6 of this Regulation determine the necessary documentation which should be submitted to the ISUAE for the issuing of a licence for activities related to nuclear facilities. If the normative acts require a licence or a consent permit of the specialized or other control bodies for exercizing activities related to the use of atomic energy, the ISUAE issues a licence only when the consent permit of these bodies is available (Article 4).

7. 3. Legislative and Regulatory Basis Establishing the System of Regulatory Inspections

The Act on the Use of Atomic Energy for Peaceful Purposes authorizes the Committee on the Use of Atomic Energy for Peaceful Purposes to implement the State control in the field of the use of atomic energy. This control is implemented on the basis of:

- issuing and bringing into line of the executive acts in the field of the nuclear safety and radiation protection;

- issuing of licences for execizing activities related to the use of atomic energy;

- exercizing of inspections for observing the licence's terms, prescriptions and normative acts in the nuclear facilities and other sites with sources of ionizing radiation;

- exercizing testing and expertize.

The ISUAE and the specialized control bodies implement the control over the nuclear facilities. The Directive on the inspection activities of the ISUAE (an internal act of the CUAEPP) determines the joint procedure for exercizing the inspection activities by the control inspectors, the procedures for elaborating and evaluating of the annual plan of the

CUAEPP control activities as well as for elaborating the documentation of the inspection activities and for analyses of the ISUAE inspection activities.

In accordance with Article 18 (2) of the RIAUAEPP and Section II of the above-mentioned Directive, the ISUAE elaborates the annual plan of the control activities, taking into account the proposals of the specialized control bodies. After the approval of the plan by the Chairman of the CUAEPP it becomes an obligatory document.

The Directive on the inspection activities of the ISUAE specifies in details the procedures, the terms and the duties of the different CUAEPP units in preparing the plan of the control activities, as well as the areas where the inspections of the nuclear facilities and other sites with sources of ionizing radiation are to be carried out.

The Directive on the inspection activities regulates the organization of the inspections to be carried out in the nuclear facilities as well as the acts which should be issued. The Directive determines the following types of inspections:

- routine inspections;
- topic inspections;
- complex inspections;
- extraordinary inspections.

The general purpose of the inspections is to control the implementation of the ISUAE licences' terms as well as the prescriptions of the control inspectors.

Routine inspections

The routine inspections are carried out by the on-site inspectors of the ISUAE in the Kozloduy NPP. Their activity does not have any separately elaborated programme but the inspections are carried out according to the existing internal directive. The other control inspectors can also carry out routine inspections. Subject of the control are mainly the limits and the terms for safe operation, the technical state of the systems and equipment which are related to the safety as well as the operational plant housekeeping.

Topic inspections

The topic inspections are carried out in accordance with the Plan of the ISUAE for control activities. The topic inspection covers different aspects of the operational safety (nuclear safety, radiation protection, storage and transportation of nuclear fuel and radioactive waste, qualification and training of the personnel, fire protection, etc.). The topic inspections are exercized under the methodology of the IAEA OSART missions. The exercizing of the topic inspections on radiation protection of the nuclear facilities is regulated by another internal act of the CUAEPP - Guide for topic inspections on radiation protection of nuclear facilities.

Complex inspections

The complex inspections include the whole range of problems connected with ensuring the nuclear facility safety (e.g. an inspection of the preparedness of an unit for start-up after planned annual outage, etc.)

Extraordinary inspections

The extraordinary inspections are carried out ad hoc by an inspector or a group of inspectors and are provoked by unexpected occurences in the controlled site.

The operative control of the Kozloduy NPP nuclear facilities is exercized mainly by the on-site inspectors of the ISUAE. The check-ups are specified in detail, on the type, span and procedure for performance by the Directive for implemention of the operative control by the ISUAE-Kozloduy.

The Directive on the inspection activity and the Directive for implemention of the operative control by the ISUAE - Kozloduy foresee accounting of the results and analysing of the inspection activities. The aim is to improve the control activities and to enhance the nuclear safety and radiation protection in the controlled sites.

According to the established practice, representatives from the specialized control bodies take part in the inspections when the subject and the range of the inspections require it. In compliance with the Annual plan for control activities the specialized control bodies also carry out inspections of the nuclear facilities independently.

The results of the inspections and the control exercized by the ISUAE and the specialized bodies are presented in the Annual Report of the CUAEPP which is submitted to the Council of Ministers, other State authorities, non-governmental organizations and the general public.

7. 4. Legislative and Regulatory Basis ensuring the Implementation of the Relevant Normative Acts and Licence Conditions

The implementation of the normative acts in the field of nuclear safety (Annex 4) is also ensured by sanctions - administrative, sanctions and penalties for committed offences.

Acts for ascertainment of offences and penal enactments are issued for committed offences in the field of the safe use of atomic energy. They are personal administrative penalties according to Article 2 of the Act on Administrative Prosecution.

Offences are ascertained by acts, issued by the control inspectors according the procedures in Chapter III, section II of the Act on Administrative Offences and Penalties

(AAOP). The act for ascertainment of administrative offences should contain the following obligatory details:

- name and position of the official issuing the act;
- date of issuing;
- date and place of commitment of the offence;
- description of the offence and circumstances under which it had been committed;
- the legal regulations being violated;
- name, place of work (employment), age, precise address, and identification number of the offender;
- names, precise addresses and identification numbers of the witnesses;
- explanations and objections made by the offender, if there are such ones;
- names, precise addresses and identification numbers of the persons, who have suffered property damages;
- list of written materials and confiscated items, if there are such, and to whom they are entrusted for keeping.

The penal enactments are issued by the Chairman of the Committee on the Use of Atomic Energy for Peaceful Purposes or by the Managers of the relevant bodies which have specialized control units or empowered by them officials (AUAEPP, Article 43, Paragraph 1).

The penal enactment should contain the following obligatory details which are specified by Article 57 of the AAOP:

- name and position of the official issuing the act;
- date of issuance and enactment number;
- date of the act on which basis the enactment is issued and name, position and place of work of the official issuing the act ;
- names, precise address and identification number of the offender;
- description of the offence, date and place of commitment, circumstances under which it had been committed, as well as the evidences which prove the commitment;
- the legal regulations being violated;
- type and amount of the penalty;
- items to be confiscated in favour of the State;
- amount of the reimbursement and to whom it should be paid;
- if penalty enactment is subjected to appeal, in what terms and in front of which court should the appeal be made.

The envisaged in the AUAEPP administrative sanctions - penalties, are imposed by the penal enactments. Chapter V of the AUAEPP specifies different in amount fines depending on

the type of the offence and of the offender. (Articles 39-42 of the AUAEPP). For example: Article 39, paragraph 1 envisages the imposing of a penalty of 100 000 up to 1 000 000 leva upon the official or citizen who fails to implement the prescription of the inspector. According to paragraph 3 for the same offence a penalty of 2 000 000 up to 10 000 000 leva is imposed upon legal entities.

The ascertainment of the offence, the issuing, the appealing and the execution of the penal enactments are carried out under the procedures of the AAOP (Article 43, paragraph 1). The AUAEPP, as a special act, determines the body empowered to impose penalty as well as the types of the penalties and the extent of the administrative penalties which could be imposed.

When it is established that the action is a criminal offence included in Section V of the Penal Code, the established administrative-punitive legal procedure is to be stopped and a prosecution proceedings are to be initiated.

Besides the acts for administrative offences and enactments for administrative penalties (punitive proceedings), other personal administrative acts are issued too:

- licences for exercizing activities related to the use of atomic energy for peaceful purposes (Article 22, paragraph 1 of the AUAEPP);

- order for revoking, amending or stopping of the term of licence (Article 25 of the AUAEPP);

- acts for inspection of nuclear facilities and other sites with sources of ionizing radiation (Article 28 paragraph 1 of the AUAEPP)

- prescriptions (Article 30 of the AUAEPP).

The exercizing of activities without licence or in deviation of the licence's conditions represents an offence according to Article 356 of the Penal Code (PC).

The issued licences can be revoked, amended or their term can be stopped temporarily by an order of the Head of the ISUAE when the envisaged in Article 25 paragraph 1 of the AUAEPP preconditions are available, namely:

- the requirements for ensuring the safety are not observed;

- the conditions of the licence are amended or not observed;

- new circumstances which may affect the safety have arisen.

The order of the Head of the ISUAE could be appealed before the Chairman of the Committee on the Use of Atomic Energy for Peaceful Purposes within 7 days of the notification (Article 25 paragraph 2 of the AUAEPP).

The obligatory prescriptions are issued by the control inspector on the basis of the inspection aimed at preventing or eliminating the infringements. The prescriptions are given

to the managers or to the empowered competent representatives of the legal entities and citizens who exercize activities related to the use of atomic energy. These persons notify the control inspector in the determined by the prescription time limit for the implementation of the prescription. It could be appealed before the Head of the ISUAE who issues an order. The order could be appealed before the Chairman of the Committee on the Use of Atomic Energy for Peaceful Purposes (Article 30 of the AUAEPP). The non-implementation of a prescription is an administrative offence which is ascertained by an act for offence. On this basis the body empowered can issue a punitive enactment and to impose some of the penalties provided for in Article 39 of the AUAEPP.

The issuing of acts by the regulatory body - the CUAEPP, the procedures and the conditions are provided for in:

- Act on the Use of Atomic Energy for Peaceful Purposes (AUAEPP);
- Regulation No. 5 of the CUAEPP for issuing licences related to the use atomic energy;
- Act on Administrative Offences and Penalties (Promulgated, Official Journal, No. 92/28.11.1969, amended No. 54/11.07.1978, No. 28/9.04.1982, No. 28/8.04.1983, No. 101/27.12.1983, No. 89/18.11.1986, No. 24/27.03.1987, No. 94/23.11.1990, No. 105/19.12.1991, amended and supplemented No. 59/21.07.1992, No. 102/21.11.1995, No. 12/9.02.1996, amended No. 110/30.12.1996, amended and supplemented No. 11/29.01.1998, amended No. 15/6.02.1998, in force - 1.01.1999 - amended No. 89/3.08.1998, amended No. 59/26.05.1998, supplemented No. 85/24.07.1998);
- Act on Administrative Prosecution (Promulgated, Official Journal, No. 90/13.11.1979, amended No. (/11.01.1983,N0. 26/5.04.1998, No. 94/23.11.1990, amended and supplemented No. 25/29.03.1991, amended No. 61/30.07.1991, amended and supplemented No. 19/6.03.1992, No. 65/21.07.1995, No. 70/8.08.1995, No. 122/19.12.1997, amended No. 15/6.02.1998, in force - 1.01.1999 - amended No. 89/3.08.1998);
- Penal Code (Promulgated, Official Journal, No. 26/2.04.1968, in force 1.05.1968, corrected No. 29/12.04.1968, amended and supplemented No. 92/28.11.1969, No. 26/30.03.1973, No. 27/3.04.1973, No. 89/15.11.1974, No. 95/12.12.1975, No. 3/11.01.1977, No. 54/11.07.1978, No. 89/9.11.1979, No. 28/9.04.1982, in force - 1.07.1982, corrected No. 31/20.04.1982, amended and supplemented No. 44/5.06.1984, No. 41/28.05.1985, No. 79/11.10.1985, corrected No. 80/15.10.1985, amended and supplemented No. 89/18.11.1986, corrected No. 90/21.11.1986, amended No. 37/16.05.1989, in force - 16.05.1989, No. 91/24.11.1989, in force - 24.11.1989, No. 99/22.12.1989, in force - 22.12.1989, No. 10/2.02.1990, No. 31/17.04.1990, No. 81/9.10.1990, in force - 9.10.1990, amended and supplemented No. 1/4.01.1991, No. 86/18.10.1991, amended No. 105/19.12.1991,

supplemented No. 54/3.07.1992, in force - 3.07.1992, amended and supplemented No. 10/5.02.1993, No. 50/1.06.1995; Resolution No. 19/12.10.1995 of the Constitutional Court of the Republic of Bulgaria - No. 97/3.11.1995; amended No. 102/21.11.1995, in force - 21.01.1996, amended and supplemented No. 107/17.12.1996, No. 62/5.08.1997, amended No. 85/26.09.1997; Resolution No. 19/21.11.1997 of the Constitutional Court of the Republic of Bulgaria - No. 120/16.12.1997; amended No. 83/21.07.1998, amended and supplemented No. 85/24.07.1998.

From the above-mentioned follows the conclusion that the Republic of Bulgaria meets the requirements of Article 7 of the Convention.

Article 8 - Regulatory Body

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

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

8.1. Statute and Authorities of the CUAEPP. Fundamental Legal Document Determining the Authorities of the Regulatory Body

The Committee on the Use of Atomic Energy for Peaceful Purposes as a State Body

The Committee on the Use of Atomic Energy for Peaceful Purposes is a state body to the Council of Ministers. Its staff is determined by the Council of Ministers (AUAEPP, Article 12. Paragraphs 1 and 2). The Committee on the Use of Atomic Energy for Peaceful Purposes (CUAEPP) pursues the state policy of safe atomic energy utilisation.

The juridical status, functions and authorities of the CUAEPP are determined by the Act on the Use of Atomic Energy for Peaceful Purposes (AUAEPP) and its Enforcement Regulations.

The staff of the CUAEPP (the State Committee) is determined by a Resolution No. 935 of the Council of Ministers from 22 October 1997. It includes the Chairman of the CUAEPP,

the Deputy-Chairmen of the CUAEPP, the Deputy-Minister and Senior State Sanitary Inspector of the Ministry of Health, Deputy-Minister of the Ministry of Environment and Water, the Deputy-Minister of the Ministry of Internal Affairs, the Deputy-Minister of the Ministry of Agriculture, Forestry and Agrarian Reform, etc., as well as Managers of authorities and organisations in which system atomic energy is used.

Advisory Councils to the CUAEPP

On the grounds of Article 14 of the AUAEPP, two Advisory Councils are established to the CUAEPP: Council on Safety of Nuclear Facilities and Council on Radiation Protection. The Councils are permanent and assist the Chairman of the CUAEPP on key issues in this areas. Their members are famous scientists and specialists in the use of atomic energy and are personally appointed by a Decree of the Council of Ministers. The functions, tasks and working procedures of the Councils are defined by an approved rule.

Functions of the CUAEPP

The Committee on the Use of Atomic Energy for Peaceful Purposes:

- takes part in the development of concepts and programmes, co-ordinates and finances research and developments in the field of atomic energy utilisation;
- determines the requirements for safe use of atomic energy and nuclear material accounting for, storage and transportation;
- determines criteria and requirements for training, qualification and capacity of the staff working in the field of atomic energy utilisation;
- collects and delivers to the corresponding authorities and organisations information about events concerning nuclear and radiation safety;
- co-ordinates the control over the safe atomic energy utilisation;
- determines measures and manages the restoration of environmental areas affected by radioactive sources;
- establishes the international collaboration of the Republic of Bulgaria in the field of atomic energy utilisation and takes part in the working process of international organisations in this field.

The above mentioned activities are carried out in co-operation with the other authorities, within the framework of their competency.

Functions of the ISUAE

The State control over the safe atomic energy utilisation and nuclear material accounting, storage and transportation is carried out by the Committee on the Use of Atomic Energy for Peaceful Purposes through the Inspectorate on Safe Use of Atomic Energy (ISUAE).

The Inspectorate on the Safe Use of Atomic Energy:

- controls the observance of the prescribed requirements on the safe utilisation of atomic energy and accounting for, storage and transportation of nuclear material and radioactive substances, by all physical persons and legal entities;
- issues licences for activities in the field of atomic energy utilisation;
- exercises operative control over the safe use of atomic energy, together with the specialised control bodies;
- licenses sources of ionising radiation;
- assigns research, investigations, expertise and other control related activities.

8.2. Structure of the CUAEPP as a Regulatory Body

Organizational Structure of the CUAEPP

As an authority, the Committee on the Use of Atomic Energy for Peaceful Purposes is governed by a Chairman, supported by:

- Deputy Chairman responsible for the international co-operation, European integration and quality assurance, co-ordination of science and technology development and the communications;
- Deputy Chairman responsible for the control and licensing activities on the safe use of atomic energy and the emergency planning and preparedness;
- Executive Secretary responsible for the administrative support;
- Legal Division;
- representatives of the CUAEPP in the Permanent Mission of the Republic of Bulgaria to the United Nations, SS and other international organisations in Vienna, Austria.

The approved staff of the CUAEPP is 77 permanently appointed persons. The organisational structure of the CUAEPP is shown in Figure. 8.1.

Sources for Financing the CUAEPP

As an authority, the Committee on the Use of Atomic Energy for Peaceful Purposes is a legal entity financed by the state budget.

Under Article 23 of the AUAEPP a Fund Nuclear Research and Nuclear and Radiation Safety is established, managed by the CUAEPP. The procedure for collecting and spending the recources of this fund is determined by the Regulation on Collecting, Spending and Managing the Resources of Fund Nuclear Research and Nuclear and Radiation Safety, approved by a Decree of the Council of Ministers.

Resources are collected mainly from the taxes for licensing of atomic energy activities. Using this funds the CUAEPP deals with tasks related to the pursuing of the state policy and control over the safe use of atomic energy. Financed by the Fund are the following activities:

- development of forecasts, concepts, programmes and rules and regulations related to the use of atomic energy, nuclear safety and radiation protection;

- conducting assesments, analyses and expertises related to the control and licensing activities of the CUAEPP and the control over the radiation contamination and the protection of the environment, including accident mitigation analyses;

- payment for scientific and technical survices, related to the pursuing of the state policy on the safe use of atomic energy;

- providing for the necessary equipment, including the maintenance and operational expenses - 32% of the income from licensing taxes and for motivation of the CUAEPP staff - 8%.

Functions of the CUAEPP Structural Units

The organisational structure and duties of the different CUAEPP structural units are described in the internal rules and regulations of the CUAEPP.

The Inspectorate on safe management of atomic energy consists of:

- Nuclear Safety Control Department;
- Nuclear Safety Assessment Department;
- Radiation Protection Department.

Nuclear Safety Control Department

This department exercises control over the nuclear safety of nuclear facilities in the following areas of control:

- commissioning;
- operation;

- decommissioning;
- quality assurance;
- maintenance and tests;
- modifications of structures and systems;
- physical protection of nuclear facilities and special nuclear material;
- deliveries and services to the operating organisation;
- transportation, storage and accounting for of special nuclear material.

Nuclear Safety Assessment Department

This department analyses and assesses the information submitted by the operating organisation or the applicant/licensee in the following areas of control:

- siting of nuclear facilities;
- nuclear facilities design;
- construction of nuclear facilities;
- commissioning of nuclear facilities;
- operation of nuclear facilities;
- modification of safety related structures and systems;
- qualification of nuclear facilities personnel and persons, exercising deliveries or services to the Operator.

Radiation Protection Department

Exercises control over the observance of the established requirements on radiation protection, in the following areas of control:

- use, ownership and registration of Sources of Ionising Radiation (SIR);
- production, trade, import, export, storage, transportation and repository of radioactive substances and other SIR (devices, apparatus and installations), including initial nuclear material;
- siting of nuclear facilities and other installations with SIR, including radioactive waste storage and conditioning facilities;
- design of nuclear facilities and other installations with SIR, including radioactive waste storage and conditioning facilities;
- construction of nuclear facilities and other installations with SIR, including radioactive waste storage and conditioning facilities;
- commissioning, operation and decommissioning of nuclear facilities and other installations with SIR, including radioactive waste storage and conditioning facilities;

- modification of radiation safety related designs, structures and technologies of nuclear facilities and other installations with SIR, including radioactive waste storage and conditioning facilities.

The average working experience of the ISUAE staff in the nuclear field is more than 10 years per person.

The ISUAE staff with the rights and duties of control inspectors as stipulated by the AUAEPP are promoted by an order of the CUAEPP Chairman.

Emergency Response Centre of the CUAEPP

The Emergency Response Centre fulfils the following functions:

- fulfils the duties of a National Station for contact with the IAEA in compliance with the Convention on Early Notification of a Nuclear Accident and the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency;

- organises, develops systematic guidelines and trains the CUAEPP operative duty staff;

- takes part in the activities of the CUAEPP Emergency Response Teams, maintains and operates the communication and computer equipment;

- analyses, records and stores radiation monitoring data from the country;

- receives, processes and distributes within the CUAEPP the operational data of the nuclear facilities;

- keeps in contact with the National Centre for Management in Crisis Situations and the Permanent Commission for Protection of the Population in Case of Disasters and Accidents to the Council of Ministers.

The External Relations Division, the European Integration and Quality Assurance Division, the Co-ordination of Research and Development Division and the International Nuclear Information System Centre are under the management of the Deputy Chairman responsible for the international co-operation, European integration and quality assurance, co-ordination of science and technology development and the communications.

The External Relations Division takes part in the implementation of the CUAEPP international activities.

The European Integration and Quality Assurance Division takes part in the organisation and co-ordination of the CUAEPP activities related to:

- practical implementation of the integration of the Republic of Bulgaria and the European Union in the field of atomic energy utilization;

- the support to the CUAEPP through the PHARE programme;

- quality assurance.

The Co-ordination of Research and Development Division takes part in the preparation, co-ordination and control of the execution of contracts financed by the Fund Nuclear Research and Nuclear and Radiation Safety and of international projects for technical support.

The International Nuclear Information System Centre provides the participation of the Republic of Bulgaria in the International Nuclear Information System according to the conditions of the contract for membership in the IAEA International Nuclear Information System.

Scientific and Technical Co-operation of the CUAEPP

After 1992, with the assistance of the European Community, the Bulgarian Regulatory Body was assisted by the Consortium of Western Regulators, which included AEA-Technology (United Kingdom), AVN (Belgium), GRS (Germany) and IPSN (France). Assistance is received also by the operating organisation from the World Association of Nuclear Operators (WANO). In the process of development and licensing of the Programme for safety and operational reliability improvement of WWER-440 (V-230) units of the Kozloduy NPP, the so called "2+2" schedule was created in the documentation assessment process related to issuing of licenses for implementation of the modifications. Co-operation with the Consortium of Western Regulators is foreseen also during the licensing of the measures of the Complex Programme for Safety Reconstruction of the Kozloduy NPP units 1-4 and the Programme for Modernisation of the Kozloduy NPP units 5-6.

On a number of nuclear safety issues, the CUAEPP receives technical support from Bulgarian engineering organisations and institutes.

The CUAEPP receives technical support from the IAEA, European Union, United States and Japan for getting acquainted with the methodologies and existing practices of the developed countries in the areas of control, licensing and inspection practices.

The CUAEPP is in co-operation with:

- the Cooperation Forum of WWER Regulators;
- the Working Group of Nuclear Regulators to the European Union;
- the Working and Consultative Groups of the IAEA;
- the United States Nuclear Regulatory Commission (US NRC);
- the Regulatory Body of the Russian Federation;
- the Regulatory Body of Ukraine.

8.3. The CUAEPP Position in the Governmental Structure

Legislative Basis

Under the Constitution of the Republic of Bulgaria, the Council of Ministers pursues the state internal and external policy in compliance with the Constitution and the laws. The Council of Ministers governs the implementation of the state budget, organises the management of the Governmental property, signs, approves and denounces the international contracts in cases envisaged defined by the law.

In fulfilling its functions the Council of Ministers has the right to establish bodies such as committees, commissions, agencies, councils, in order to pursue the state policy in a definite area.

The CUAEPP work is supervised by the Deputy Prime Minister of the Republic of Bulgaria who is the co-ordinator for the CUAEPP and the other organisations in the energy field.

The Acts and resolutions of the CUAEPP and its bodies issued within the framework of their competency are obligatory for all Ministries, other authorities, organisations and persons. The CUAEPP reports to the Council of Ministers issuing an annual report. The annual report is distributed among the National Assembly, all governmental authorities and public organisations.

The Committee on the Use of Atomic Energy for Peaceful Purposes prepares and presents after an approval by the Council of Ministers the report of the Republic of Bulgaria to the IAEA General Conference.

8.4. Relations of the CUAEPP with Bodies Engaged in the Promotion and Use of the Atomic Energy

In the Republic of Bulgaria the authorities engaged in the promotion and use of atomic energy are the Committee of Energy and the National Electric Company (NEC - PLC).

The Committee of Energy is a body to the Council of Ministers for the development, pursuing and control over the implementation of the state policy in the energy field, regulating and co-ordinating the relationship between producers, suppliers and end users of energy sources. The main functions and tasks of the Committee of Energy are determined by an ordinance of the Council of Ministers issued in August 1997. The Committee of Energy

pursues the state policy on the development of atomic energy and the enhancement of nuclear safety and radiation protection of the nuclear facilities.

The duties, functions and responsibilities of the NEC - PLC as an operating organization are discussed in the part under Article 9.

According to Article 13 of the AUAEPP, the activities in which the CUAEPP takes part together with the Committee of Energy and the NEC - PLC in the development of concepts and programs, coordination and financing of research and developments in the field of atomic energy utilization. The CUAEPP and the Committee of Energy are on the same hyerarchical level in the structure of the state executive power.

The CUAEPP is functionally, financially and legally independent from the Committee of Energy and the NEC - PLC. The decisions of this organisations are not obligatory for the CUAEPP. The Acts and resolutions of the CUAEPP and its bodies issued within the framework of their competency are obligatory for all ministries, other authorities, organisations and persons.

8.5. Recommendations of the International Regulatory Review Team Mission in the Republic of Bulgaria, 10-14 November 1997

The International Regulatory Review Team (IRRT) mission for review of the regulatory activities was carried out on the request of the Bulgarian Government. The purpose of the mission was to review the effectiveness of the CUAEPP and to exchange information and experience in the regulation of nuclear safety in the following specific areas: role and responsibility of the regulatory body; organisation of the regulatory body; regulations and guides; licensing process; requirements to the applicant/licensee; review and assessment during the licensing process; regulatory inspection and enforcement; radiation protection.

In the opinion of the experts of the International Regulatory Review Team in the Republic of Bulgaria the basic organisation and structures to regulate nuclear power in Bulgaria are existent, including a competent staff.

The main recommendations of the international experts were made in relation to:

- the existence of a strong, competent, independent and well resourced Regulatory Body;
- the exclusion of uncharacteristic activities (out of the scope of the nuclear regulatory activities) from the functions of the CUAEPP;
- the provision of adequate sallaries to the Regulatory Body staff, comparable with thoset at the Kozloduy NPP;
- recruitment and retention of competent and experienced staff;

8.6. General Plan for Improvement of the Regulatory Activities

For the fulfilment of the recommendations and suggestions of the International Regulatory Review Team, an Action Plan was approved, including:

- the content of the recommendation or suggestion;
- necessary measures for the implementation of the recommendation or suggestion;
- term for the implementation of the measure;
- responsible person for the implementation of the measure.

In the process of the planned reform in the state administration and in the process of implementation of the international recommendations, the CUAEPP will probably be transformed into an independent state authority. A bill of a Law concerning the administration is under review at the National Assembly of the Republic of Bulgaria. As a result of the approval of this law, the CUAEPP will probably be transformed into an Agency to the Council of Ministers. Regardless of the fact who the future agency will report to, the process of strengthening the Regulatory Body independence should continue.

In compliance with the practices of most of the countries and the recommendations made by the experts, the CUAEPP activities have to be focused on pursuing the state supervision and control in the following areas:

- safety of nuclear installations during siting, design, equipment manufacturing, construction, operation, maintenance, tests and modernization;
- safety of spent nuclear fuel (SNF) management, safety of management of radioactive waste (RAW) and in other phases of the nuclear fuel cycle, physical protection of nuclear material and nuclear installations;
- accounting for and control of nuclear material;
- review and revision of the purposes of the National Nuclear Programme;
- implementation of the obligations under the international conventions in the fields of nuclear safety, management of SNF and RAW (including the transportation of radioactive substances), non-proliferation of nuclear weapons (accounting for and control of nuclear material);
- quality assurance of specific equipment (vessels and pipelines of the primary circuit of the NPP);
- engineering aspects of the radiation protection in nuclear installations;
- emergency planning and preparedness in case of a severe accident in nuclear facilities with the maintaining of an emergency response centre;

- registration and control of sources of ionizing radiation for use in the industry, medicine and science;

- updating of the existing and development of new normative acts and regulatory documents in the above mentioned areas, approximated with the legislation of the European Union;

- management of the Fund Nuclear Research and Nuclear and Radiation Safety.

In fulfilment of its duties, the CUAEPP will direct its future activity to the following areas:

- effective inspection activities on safe use of atomic energy in compliance with the normative acts in force, international requirements and an approved plan;

- assessment and licensing of the programs for reconstruction and modernization of the Kozloduy NPP units 1-4 and 5-6 and other design modifications for improvement of the NPP safety;

- development and updating of the legislative framework in compliance with the practices and requirements of the developed countries;

- implementation of close co-operation with the IAEA and the Western European regulatory and expert organizations;

- development of an internal quality assurance system;

- improvement of the staff qualification.

From the above mentioned facts follows the conclusion that the Republic of Bulgaria meets the requirements of Article 8 of the Convention on Nuclear Safety.

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."

9.1. General Principles

In compliance with the Constitution of the Republic of Bulgaria, through the Act on the Use of Atomic Energy for Peaceful Purposes (AUAEPP), a state monopoly is established over the use of atomic energy. Article 2, Paragraph 1 of the AUAEPP reads that "special nuclear

material and nuclear facilities are property of the state". The Act on Concessions determines the possibilities and procedures for granting rights of use to legal entities.

9.2. Procedure for Use of Atomic Energy

For the execution of activities related to the use of atomic energy, a licensing regime is adopted (Article 22 of the AUAEPP).

According to Article 23, Paragraph 5 of the AUAEPP: "*The legal entities and physical persons issued with licenses should have enough authority, financial and material resources .... and appropriate organisational structure and personnel to implement their obligations to ensure the appropriate physical protection and nuclear and radiation safety provided for in the standards, regulations and licence conditions"*.

9.3. Responsibilities

By a Resolution of the Council of Ministers of 20 April 1995, all nuclear facilities at the Kozloduy NPP site are regarded as one nuclear installation with the NEC-PLC as an Operator under the provisions of the Vienna Convention on Civil Liability for Nuclear Damage. According to Article 5, Paragraph 1 of the Vienna Convention, the national legislation restricts the liability of the Operator of a nuclear installation for damages caused by any nuclear accident. For the Kozloduy NPP the bearer of civil liability under the Vienna Convention is identical with the license holder under the Convention on Nuclear Safety. This is included in Article 20, Paragraph 1 of the Statute of the NEC - PLC.

According to Article 15 of the AUAEPP, the operating organisation is responsible for the compliance with the safety requirements. The powers and obligations of the NEC - PLC are determined by the statute, the rules for organisation of the activities of the structural subdivisions and sections of the NEC - PLC, as well as in the job descriptions of the personnel.

The powers and obligations of the NEC - PLC are:

- enunciation, declaration and implementation of the policy for safety and quality assurance;
- providing the necessary material, financial and human resources for the implementation of the undertaken by the State responsibilities under the Convention on Nuclear Safety;

- execution of co-ordination and administrative control over the implementation of programs and activities concerning the safety.

A "Safety and Operation of the NPP" Department is established within the NEC - PLC for management of activities in the field of atomic energy. The Department is directly subordinated to the Senior Executive Manager and consists of three divisions. These divisions exercise control over the activity of the Kozloduy NPP and the interrelations with other divisions and departments of the NEC - PLC. The overall department staff is 22 persons. In carrying out its functions the department is guided by:

- AUAEPP and other normative acts of the Republic of Bulgaria;
- international conventions ratified by the Republic of Bulgaria;
- Statute and Rules of the NEC - PLC;
- internal normative documentation of the NEC - PLC;
- requirements and recommendations of WANO and the IAEA;
- Rule for the Activity of the "Safety and Operation of NPP" Department.

The main purpose of the department is the organisation and control of safety, operation, maintenance and modifications of nuclear facilities. It is guided by the National Policy in the field of nuclear energy formulated in the Strategy for Energy Development pursued by the Committee of Energy. It implements the NEC - PLC Policy on safety and quality assurance in NPP operation, radioactive waste (RAW) management and the environmental protection. The department maintains a relationship with the CUAEPP, other Ministries engaged and the international organisations. Also it controls the implementation of prescriptions and license conditions issued by the Inspectorate on the Safe Use of Atomic Energy (ISUAE).

The "Safety and Operation of the NPP' Department:

- proposes through the Board of Directors of the NEC - PLC to the Committee of Energy programmes and normative acts needed by the Government for development and implementation of the National Policy in the nuclear energy field;
- assists in providing of adequate financial and human resources for the Kozloduy NPP Branch;
- lays down the NEC - PLC Policy in the field of safety and quality assurance in NPP operation and RAW management;
- exercises administrative and internal control over the organisation and implementation of activities concerning the safety and the accident-free operation;
- takes part in the development and controls the plan for emergency protection of the personnel, the public and the environment on the Kozloduy NPP site within the depopulated area;

- organises analyses and independent inspections of nuclear facilities safety, using the results for improving the safety. Controls the elimination of the deficiencies identified and the implementation of new technologies and compensatory measures;

- takes part in the development of the internal normative acts of the NEC - PLC;

- ensures the observance of the safety requirements during transportation of fresh and spent nuclear fuel;

- carries out the responsibilities of the NEC - PLC, under the Convention on Nuclear Safety, the Convention on Physical Protection of Nuclear Material and other Conventions to which the Republic of Bulgaria is a contracting party;

- develops and implements a quality assurance system in all activities;

- prepares the necessary for public relations information concerning nuclear energy.

According to Article 5, Paragraph 2 of the Rule for the Structure and Activity of the NEC - PLC, one of the basic functions is "to develop, finance and implement programmes for enhancement of nuclear and radiation safety in compliance with the international requirements and this Rule".

In its Declaration of the Policy on Ensuring Safety, the NEC - PLC defines the safety ensurance of nuclear facilities as its first priority (for more details see Article 13 of the Convention).

9.4. Authorisation

The NEC - PLC - Kozloduy NPP Branch is an administratively, economically and territorially independent production unit, which makes its own balance and has its own bank accounts (Article 19 of the Statute). The Kozloduy NPP Manager is entrusted with the implementation of all activities and contracts (under the conditions of Article 21 and Article 22 of the Trade Act). The Kozloduy NPP Branch organises and manages its commercial activity in conformity with the Statute and the Rule for the Structure and Activity of the NEC - PLC. Within the framework of its subject of activity, the Kozloduy NPP can deal with local and international physical persons and legal entities, national and local state authorities, and national and international public organisations. These activities include the allowed business transactions, contacts, participation in and conducting of negotiations, agreements, submission and use of information (according to the law) in the field of nuclear energy, investments, operation, research and development activities, including the area of vocational qualification.

According to Article 20, Paragraph 2 of the Statute, as part of the NEC - PLC the Kozloduy NPP Branch is empowered as the Operator of the nuclear facilities under the

AUAEPP, and the Kozloduy NPP is the license holder. According to Article 20, Paragraph 3, the Kozloduy NPP Manager "assumes all the powers, duties and responsibilities for the correct and expedient management of the technological process at the nuclear power plant...".

By a Resolution of the Board of Directors of the NEC - PLC a special protocol between the Management of the NEC - PLC and the Management of the Kozloduy NPP Branch was approved which separates and describes in detail the responsibilities, rights and duties between the operating organisation and the licence holder.

9.5. Duties and Responsibilities of the Kozloduy NPP Branch

According to Article 14, Paragraph 2 of the Rule for the Structure and Activity of the NEC - PLC, the Kozloduy NPP Branch "ensures the nuclear and radiation safety and implements the programmes developed for nuclear and radiation safety improvement, in conformity with the international requirements".

In a statement concerning the safety policy, the management of the Kozloduy NPP Branch defines safety as the highest priority of its work (for more details see Article 10 and Article 13 of the Convention).

For ensuring safe operation, the Kozloduy NPP management:

- develops and implements an administrative structure, assigns responsibilities and powers within the structure and exercises the overall management;
- develops, introduces and supervises the implementation of the programs for administrative control (guiding documents for systematic implementation of planned work-schedules, procedures, inspections and revisions provided with adequate resources for their implementation);
- establishes a system for the accomplishment and control of the license conditions and terms of duration;
- establishes and maintains openness and correctness with the Regulatory Body, other state control bodies, organisations and the public, concerning the supervision, inspections and discussions on the fulfilment of the prescribed and universally accepted safety requirements.
- for exchange of experience and information, keeps in contact with the design, engineering, maintenance, mantling and construction organisations, and the manufacturers of equipment for nuclear power plants;
- substantiates the necessary resources and services before the NEC - PLC.

The organisational structure of the Kozloduy NPP Branch is shown on fig. 9.1. All subdivisions and sections of the Kozloduy NPP Branch have their own officially approved

organisational structures with clearly defined and documented power, subject of activity, responsibility and regulated interrelations. At the Kozloduy NPP Branch, the responsibility for safety is assigned in conformity with the existing structure of the operating organisation.

The Manager of the Kozloduy NPP Branch of the NEC - PLC is responsible for:

- overall implementation of the safety policy;
- providing the adequate resources for the implementation of the policy;
- assigning rights and responsibilities concerning the safety;
- execution of periodic reviews of the fulfilment and efficiency of the policy;
- maintaining the contacts with the Regulatory Body and the public.

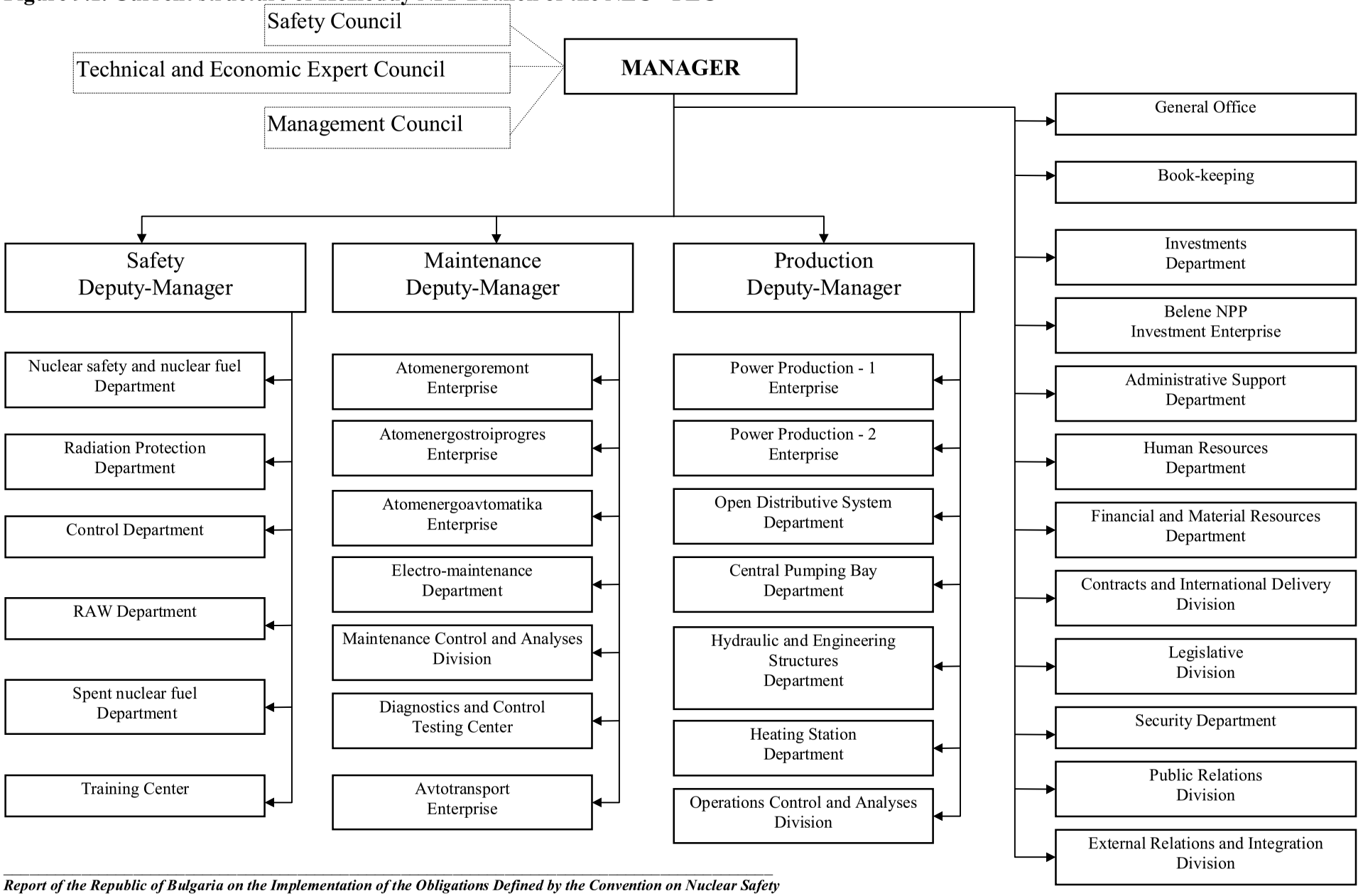
The First Deputy Manager of the Kozloduy NPP Branch of the NEC - PLC is the Deputy Manager on Safety. He/she is delegated with the power and responsibility for planning, organization, coordination and supervision of all activities in relation with the nuclear safety and radiation protection. Directly subordinated to the Deputy Manager on Safety are such Kozloduy NPP sections with mainly control functions in the areas of nuclear safety, radiation protection, labour protection and hygiene, surveilance of pressure equipment and pipelines, account and control of nuclear material, quality assurance, metrology and standardization, as well as the activities on reprocessing of RAW, storage of SNF and RAW, and personnel qualification.

The managers of the structural subdivisions and sections are responsible for:

- providing adequate conditions for policy pursuing in compliance with the authorities and duties, assigned to them by the Manager of the Kozloduy NPP Branch of the NEC - PLC;
- control of the conditions of the safety related systems and equipment, and if any difficulties occur, for carrying out of analyses and undertaking adequate corrective actions;
- establishing and maintaining healthy working conditions in the premises and providing the necessary individual and collective protective means;
- employing of personnel according to the job requirements and conducting its initial training, re-training, emergency training and instructions;
- co-ordination and control on the external contractors' cativities at the plant.

Safety Councils are established as consultative bodies to the NPP Manager and the managers of the electricity power production units composed of leading specialists and experts from the plant. Their objective is to analyse the safety and propose safety improvement measures. Special attention is given to safety substantiation of plant design modifications.

Figure 9.1. Current structure of Kozloduy NPP Branch of the NEC - PLC



The plant staff whose duties are in relation with safety and quality assurance is responsible for:

- carrying out their duties in conformity with the written instructions and procedures;
- recording of the results from the activities carried out;
- maintaining in good condition the installations and equipment of which they are in charge;
- keeping up their professional knowledge.

9.6. Regulatory Activity

The State as the owner of the nuclear facilities has established a Regulatory Body to the Council of Ministers - the CUAEPP. More details about the structure and functions of the CUAEPP are given under Article 8.

The relations between the license holder and the Regulatory Body are carried out within the framework of:

- official correspondence;
- supervision, inspections and revisions;
- meetings between the CUAEPP Management, Committee of Energy Management, NEC - PLC Management, and the Kozloduy NPP Management;
- unofficial joint activities (training courses, conferences, seminars, scientific visits, etc.).

On the Kozloduy NPP site, the ISUAE carries out different kinds of inspections described in detail in the text on Article 7 of the Convention. The inspection results are summarised in Acts approved by the Head of the ISUAE. The inspection procedure can be co-ordinated with the operating organisation and the inspection results are discussed jointly.

The licenses issued could be withdrawn, amended or temporary withdrawn by an Order of the Head of the ISUAE. This is explained in detail in the text on Article 7. The imposed administrative-punitive measures are described in the same Article.

From the above mentioned facts follows the conclusion that the Republic of Bulgaria meets the requirements of Article 9 of the Convention on Nuclear Safety.

Article 10 - Priority to Safety

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

10.1. Priority to Safety as a Fundamental Policy in the Atomic Energy in the Republic of Bulgaria

The priority to safety is defined as a basic principle in the General Provisions of the Act on the Use of Atomic Energy for Peaceful Purposes (AUAEPP). Article 3 of the Act requires: "*Atomic energy shall be used in accordance with the aims and the principles of nuclear and radiation safety, and protection of the life and health of people and the environment shall have priority before economic and other social needs*".

Article 14 and Article 16 of the AUAEPP define the obligations of all physical persons and legal entities that operate nuclear facilities or are involved in the design, delivery, construction or manufacture of installations, equipment and technologies, the provision of services on sites utilising atomic energy, to observe the nuclear safety requirements.

10.2. Policy of the CUAEPP

The Committee on the Use of Atomic Energy for Peaceful Puropses (CUAEPP) pursues the state policy on the safe use of atomic energy. This policy is defined by the AUAEPP, other acts of the National Assembly, the normative acts of the Council of Ministers and the acts of the CUAEPP.

This policy is implemented by the CUAEPP through the following activities:

- determining the requirements for safe use of atomic energy and the procedure for accounting for, storage and transportation of the nuclear material;
- determining the criteria and requirements for training, qualification and licensing of the work force involved in the use of atomic energy;
- analysing and inspecting all the activities;
- issuing licenses on the use of atomic energy;
- supervision of the licensed activities;
- implementing the international cooperation;
- informing the public.

The activities of the CUAEPP as a Regulatory Body cover all functional areas, including regulatory control, independent assessment and inspection of the implementation by the operating organisation of the obligations concerning the safety management (see the text under Article 7 and Article 8).

The question of the effective division of the functions between the Regulatory Body and the authorities and organisations involved in the promotion and utilisation of atomic energy is discussed in the text under Article 8.

10.3. The Operating Organisation Policy on Safety

In the NEC - PLC document called Policy for Ensuring Safety and Quality, the highest priority is given to the nuclear safety aiming at ensuring the protection of the NPP personnel, the public and the environment from the harmful impact of ionising radiation, during activities related to nuclear energy. The purpose of the policy is gaining public confidence that in the process of atomic energy utilisation, the safety has priority over the work-schedules for production and maintenance while the radiation risk is kept as low as reasonably achievable, lower than the specified by the national normative acts.

The policy of the Management of the NEC - PLC - Kozloduy NPP Branch on ensuring the safety during nuclear facilities operation, handling of fresh and spent nuclear fuel, collection, treatment and storage of radioactive and conventional waste is also expressed in the Declaration on Ensuring the Safety.

The policy of the Management of the NEC - PLC - Kozloduy NPP Branch is developed in accordance with the requirements of the AUAEPP, IAEA Safety Series No. 50-C-QA "Code on the Safety of Nuclear Power Plants-Quality Assurance", and is in the spirit of the IAEA documents INSAG-3 "Basic Safety Principles for Nuclear Power Plants" and INSAG-4 "Safety Culture".

10.4. Other Factors Related to Safety

The observance of the requirements of the national legislation is an obligatory condition for the safe operation of the Kozloduy NPP. These requirements are included in the internal documents of the structural units regulating the activities concerning safety and quality assurance. Also, during the development of the Kozloduy NPP internal documents concerning safety and quality assurance, international documents and practices, the IAEA standards and guidelines were used.

For ensuring the safety, during the whole process of operation of nuclear facilities, are guaranteed all the necessary financial resources for maintaining of systems and equipment in perfect conditions, documentation development, personnel training and qualification, ensuring good labour conditions in the compartments, providing for the necessary protective means, maintaining the emergency preparedness, and the implementation of the personnel health prophylactics.

Adequate staff with the corresponding competency is employed, the most trained and qualified specialists are put at the key positions. If needed, consultants from engineering organisations and scientific institutes are involved for support of the personnel.

The development, implementation and maintenaning of an integrated quality assurance system at the Kozloduy NPP in compliance with the national and international normative acts, helps towards the safe operation of the nuclear facilities.

10.5. Safety Culture and its Improvement

Article 3 of the AUAEPP specifies that the use of atomic energy shall be carried out in conformity with the objectives and the principles of nuclear and radiation safety. One of these principles requires the introduction of safety culture which shall establish such attitudes in organisations and individuals that the ensuring of safety is the highest priority.

The CUAEPP determines the requirements for licensing of the Kozloduy NPP personnel. The procedure and terms for licensing of the personnel are specified in the CUAEPP document Rules for Licensing of the NPP Personnel. As it is stated in the document, the objective of the licensing is to guarantee before the public that the individuals engaged in the operation of the Kozloduy NPP have the adequate knowledge and safety culture.

A State Licensing Commission is established for licensing of the personnel who is directly responsible for the safe operration of the NPP. During the examination process, special attention is dedicated to issues giving an impression of the safety culture of the individual, including motivation and comprehension of the responsibility of his job.

Actions are taken by the Kozloduy NPP management for giving priority to safety culture and the future development as an inherent characteristic of all individuals. For determining of the existing safety culture level, the practice of periodic self-assessment is implemented. The process of safety culture implementation includes:

- training of the personnel for each specific position;
- implementation of quality assurance system;

- organising of specialised lectures and courses on safety culture.

Since 1992 till now through the WANO, a twinning programme is carried out for co-operation between the Kozloduy NPP and the Bugey NPP-France. This programme has significant impact on the safety culture improvement of the Kozloduy NPP personnel.

The policy and practices of the operating organisation on establishing safety culture were subject to a comprehensive evaluation by the OSART (Operational Safety Advisory Review Ream) and ASSET (Assessment of Safety Significant Events Team) missions organised by the IAEA at the Kozloduy NPP.

Aa a conclusion it can be pointed out, that the legislative, regulatory and organizational measures for ensuring priority to safety meet the requirements of Article 10 of the Convention. Improvement of the activities on establishing a developed safety culture is needed.

A setback to the establishment of a developed safety culture can be the implementation of enforcement measures, including imposing fines on officials who have committed an error. This could discourage the personnel in identifying safety problems and deprive the operating organisation of a useful source of information.

The following measures have been undertaken:

- the AUAEPP has been amended and supplemented in the part of the administrative-punitive provisions, strengthening the sanctions against legal entities;

- a procedure has been developed, for determining by the CUAEPP inspectors the degree of violations;

- the organizational structures of the NEC - PLC and the Kozloduy NPP have been reviewed aiming at a clear diferentiation of the duties on ensuring the nuclear and radiation safety and increasing of the personal responsibility, especially of the management.

These measures are in conformity with the findings and the recommendations of the International Regulatory Review Team experts in 1997.

From the above mentioned facts follows the conclusion that the Republic of Bulgaria meets the requirements of Article 10 of the Convention on Nuclear Safety.

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."

11.1. Financial resources

According to Article 23 of the Act on the Use of Atomic Energy for Peaceful Purposes (AUAEPP) "*The legal entities and physical persons holders of licences should have enough authority, financial and material resources.... to implement their obligations to ensure the appropriate physical protection and nuclear and radiation ...*".

The National Electric Company (NEC - PLC) is responsible for providing for the corresponding financial resources, maintaining and ensuring safety of nuclear facilities, and the Kozloduy NPP Branch is responsible for their correct and effective utilisation.

Ways of Financing

The financial resources of the NEC - PLC come out of the electricity production. In August 1998, the Government of the Republic of Bulgaria adopted a three-year programme for a gradual increase increase of the price of electricity. The main purpose of the programme is to establish adequate conditions for the implementation of the investment policy of the NEC - PLC, including the measures for safety improvement, management of radioactive waste (RAW) and spent nuclear fuel (SNF), and decommissioning of nuclear facilities.

The corresponding normative acts concerning the implementation of the Vienna Convention on Civil Liability for Nuclear Damage and ensuring financial guarantees under its requirements, are under development.

According to Article 21 of the Statute of the NEC - PLC "*The financial interrelations between the management of the joint-stock company (NEC - PLC) and its branches are specified in the Act and this Statute, and are described in detail in the Rule for the Structure and Activity of the NEC - PLC*".

According to Chapter XI, Article 28 of the Rule for the Structure and Activity of the NEC - PLC:

"(1) The financial interrelations between the Central Office and the branches and enterprises are based on their approved Annual Production Programs or contracts grouped by periods, under the procedure specified in this Rule.

(2) The Annual Production Programmes shall be submitted and substantiated by the Managers of the branches and enterprises before a Commission lead by the Corresponding Executive Deputy Manager of the NEC - PLC.

(3) The Senior Executive Manager shall submit for approval to the Board of Directors the consolidated production programme of the company."

According to Chapter XV - Financing the Activities of the Central Office and the Branches, Article 51 "*The branches and enterprises carry out their activities within thw finances of the company. These activities are financed on the basis of forecast budgets for investment, operation and maintenance and are defined by the Annual Production Programmes*".

Following the established procedure, every year the Kozloduy NPP prepares an investment programme for the next year, in which are included the measures for safety improvement of the units. After the programme evaluation and approval, the NEC - PLC takes care for the planning and financing for its implementation.

In addition, a programme for scientific support is developed. Within the framework of this programme are carried out investigations, research and analyses concerning the planning of future activities in the field of nuclear energy.

Financing of the Safety Improvements

Until 1989 the financing of a great number of nuclear energy activities was centralised - directly from the state budget. In this way were financed new construction works, as well as maintenance and modernisation of the existing nuclear facilities.

In 1989 began the diversification of the sources for financing. At the beginning due to the low energy prices established by the Government, the operating organisation was subsidised by the State and practically the State was determining the funds for ensuring the safety. Additional financing sources were the credits granted by Bulgarian Financial Institutions and the European Union through the PHARE Project, and direct financing by the Governments of the United States of America, Great Britain, Germany, France, Switzerland, Japan, etc.

At the beginning of 1991 based on the results of the OSART (Operational Safety Advisory Review Team) Mission, the IAEA recommends the Bulgarian Government a number of areas on improvement of the Kozloduy NPP units 1-4. The Bulgarian Government

took a decision to finance the measures foreseen partly by the funds provided by the European Union through the PHARE Project. A Financial Memorandum was signed in July 1991 which foresees funds for:

- technical and expert support to the Kozloduy NPP by WANO;
- metodological support to the CUAEPP from expert organisations and the Regulatory Bodies of France, Germany, Great Britain and Belgium;
- development of a package of projects, commonly denominated as the Six-Months WANO Programme, for the implementation of measures concerning the housekeeping, the improvement of operational safety and conducting of safety analyses;
- functioning of a Project Management Team;

After 1993, financing for the safety improvements is provided also under the Financial Memorandum signed with the EBRD, as well as through contracts for gratuitous help from EDF-France and the Government of the United States of America.

For the Implementation of the three-stage short-term Programme on the Kozloduy NPP units 1-4, 129.1 million Ecu are spent as follows:

EU - PHARE	- 30.0 million Ecu (for equipment and analyses)
EBRD	- 24.0 million Ecu
EDF - France	- 12.7 million Ecu
Others	- 4.6 million Ecu
NEC - PLC	- 57.8 million Ecu.

A lot of additional activities and measures were funded through the PHARE Project, including 15.0 million Ecu for a technical support team of WANO and EDF. Five million Ecu were granted for the construction and design of the complex for reprocessing and storage of RAW and the development of multi-functional simulator for training of the Kozloduy NPP personnel.

In the middle of 1998 as a result of the approximation of the existing energy prices to the actual production costs, the financial situation of the NEC - PLC was sufficiently improved. As an example, the profit for 1997 of the NEC - PLC is 332 billion leva (DM 332 million). The economic prognoses are positive. It is expected that most of the improvements planned will be funded by the NEC - PLC itself.

The complete implementation of the programmes for reconstruction and modernisation of the Kozloduy NPP units 1-6 require sufficient funding and for that reason credits will be drawn from national and international financial institutions.

Sources for Financing the Decommissioning Programme and Management of RAW and SNF

Until the middle of 1998, the expenses of the NEC - PLC did not include the future costs of the safe management of RAW and SNF and for decommissioning of nuclear installations. The development of a procedure for collecting of funds in the established by the AUAEPP Funds on Safety and Storage of RAW and Decommissioning of Nuclear Facilities is at hand. It is expected that the regulations on the procedure for collecting, spending and control of the funds will be reviewed and adopted until the end of 1998 and will come into force at the beginning of 1999.

11.2. Human Resources

Legislative Framework

According to Article 15, Paragraph 2 of the AUAEPP *" The legal entities and physical persons using atomic energy: ...ensure the compliance with the safety requirements and the requirements for personnel qualification",* and Article 23, Paragraph 5 of the Act requires: "*The legal entities and physical persons holders of licenses should have enough ... personnel to implement their obligations to ensure the appropriate physical protection and nuclear and radiation safety ...*". In conformity with these provisions, Article 14 of Regulation No. 5 of the CUAEPP determines the condition that "*The organisation applies for a license for commissioning after ... ensuring a well staffed, trained and certified personnel".* Annex 1 of the Regulation requires that during the safety substantiation process, which gives the basis for licensing, shall be "*given information about the operating personnel of the NPP and be specified their functions, qualification requirements and the number sufficient for the safe operation*".

Responsibility for Training and Qualification

The basis of the training programme for the NPP personnel is the Bulgarian national education system. Its structure is shown in Appendix V.

The training of staff for the nuclear energy is carried out in several specialised schools and universities.

Specialists graduating 13 technical schools receive secondary technical education in a variety of specialities, including Power Plants and Grids, Nuclear Energy, Nuclear and Commercial Electronics, Operators of Power Installations and other applicable in the nuclear energy specialities.

The Energy Institute of the Joint Technical College to the Technical University - Sofia trains specialists with university education in a variety of specialities, such as Automation, Information, Thermal and Nuclear Energy.

The Technical University - Sofia trains in the specialities of Thermal and Nuclear Energy, Mechanical Engineering Technologies and Manufacturing Techniques, Industrial Engineering, Electrical Engineering, Automatics and System Techniques, Communication Techniques and Technologies, giving the possibility of obtaining Bachelor, Master or Doctor of Science Degrees.

The Sofia University - Kliment Ohridski trains specialists receiving a degree of either Bachelor, Master or Doctor in physics, chemistry, computer techniques and engineering physics - nuclear techniques and technologies.

Part of the employed personnel in the nuclear area are graduates of Russian and Ukrainian universities. Most of them are graduates of the Moscow Energy Institute, which trains in a variety of specialties related to nuclear power plant technologies.

For the provision of human resources, there is an established practice for giving grants to students undergoing training in specialities necessary for the Kozloduy NPP.

An essential factor for the training and qualification of the Kozloduy NPP personnel is the efficient on-the-job training. Responsible for the Kozloduy NPP staff training are the Kozloduy NPP Manager, the Managers of the subdivisions, the Heads of sections and the Head of the Training Centre. The diagram showing the interrelations of the Kozloduy NPP with the NEC - PLC and the State authorities in connection with personnel qualification and training, is shown in Appendix V.

The Training Centre of the Kozloduy NPP is situated on the site of the nuclear power plant. The construction of the Centre has begun in 1991 when the documents regulating its purpose and main functions were approved. In 1993 the construction was completed and the Training Centre began to function.

The Simulator Complex is under construction. It contains four simulators (full-scope, analytic and principal for WWER-1000 and multi-functional for WWER-440) as well as an engineering analyser for WWER-440. A short description of the simulators and the current construction status is given in Appendix V.

Qualification Requirements for Different Groups of the Personnel

The requirements for training, qualification and licensing of the personnel employed in the use of atomic energy are determined by the CUAEPP. It controls the observance of the requirements through the ISUAE.

A complete list of the documents regulating the qualification of the Kozloduy NPP personnel and the diagram showing the requirements for training and qualification at different levels is presented in Appendix V.

The fundamental document regulating the principles in management, organisation, control and implementation of the activities on management of the Kozloduy NPP personnel is the System for Recruitment, Selection and Requalification of the Personnel. As an executive body of the system, the Training Centre of the Kozloduy NPP has the following functions:

- organises, carries out (in co-operation with specialists from the Kozloduy NPP and the specialised educational institutions of the country), co-ordinates and reports the activities of the training process;

- provides assistance to the subdivisions and to the scientific support of the nuclear power plant in the use of the simulator complex for accident analyses;

- provides assistance to the subdivisions of the Kozloduy NPP in the use of the simulator complex for operations improvement.

From the point of view of the qualification requirements, the personnel is classified as follows:

- group A - licensed operating personnel, including Plant Shift Supervisor, Unit Shift Supervisor, Senior Reactor Operator, Safety Criticality Officer, Foremen of the shifts Reactor Equipment, Instrumentation and Control, Reactor Protection Systems, Radiation Monitoring, Senior operator of the Distributive System;

- group B - operating personnel, including foremen of the shifts (excluding those in group A), Senior Operators, Senior Foremen, Field Operators, Shift Foremen, Shift Workers;

- group C - maintenance and laboratory personnel;

- group D - managers and specialists of the subdivisions not included in groups A, B and C;

- group E - supporting personnel.

Licensing by the State Licensing Commission (SLC) is obligatory for all positions from group A and the following ones from group D:

- head of department or division (operating personnel);

- plant inspector, specialist or senior specialist on nuclear safety or radiation protection;

- head of section, directly responsible for nuclear safety;

- senior technologist or technologist of the nuclear installation;

- dispatcher in the National Dispatching Centre.

The qualification requirements for each position at the Kozloduy NPP are described in details in the corresponding job descriptions. According to the Labour Code, the qualification requirements are mandatory for the signing of an employment contract.

Job descriptions contain:

- requirements for education, speciality, qualification and licensing for a specific position;

- the necessary knowledge in the fields of atomic energy utilisation, nuclear safety and radiation protection;

- knowledge and experience for the position in question;

- functions and duties of the position.

Job descriptions of the personnel directly involved in the use of atomic energy are approved by the CUAEPP.

A specific feature of the Kozloduy NPP is the requirement that the Plant Shift Supervisor, Unit Shift Supervisor, Senior Reactor Operator, Safety Criticality Officer, etc. should have university (high technical) education.

The personnel training is carried out under educational and training programs and plans developed in conformity with the job descriptions and the normative acts in force. The plans and programmes are developed on the basis of the necessary knowledge, experience and attitude of the worker required for the fulfilment of his/her duties. For the purposes of personnel training, are developed educational means (courses, lectures, manuals for on-the-job training, scenarios for simulator training) and supporting technical educational aids (slides, diagrams, posters, models, etc.).

At present, the simulator training of the operators is carried out at the Training Centre of the Novovoronezh NPP - Russia (reactor operators of units 1-4) and at the Training Centre of the Zaporozhie NPP - Russia (reactor operators of units 5 & 6).

The NPP personnel is licenced by the Administrative Licensing Commission (ALC). For positions listed in Article 9, Paragraph 1 of Regulation No. 6 of the CUAEPP, license from the SLC is needed. Personnel licensing is carried out in compliance with the requirements of Regulation No. 6 of the CUAEPP and the Rule for Licensing and Verification of the Knowledge of NPP Personnel.

The personnel from groups C, D and E is admitted to work after successfully passed examinations in front of the respective commissionand the personnel from groups A and B have to undergo successful on-the-job training under the supervision of an experienced specialist.

All persons licensed for a specific position have to undergo periodic requalification before the corresponding commission in compliance with the requirements of Regulation No. 6 of the CUAEPP and the Rule for Licensing and Verification of the Knowledge of NPP Personnel.

Appendix 5 presents the implementation model of the Kozloduy NPP system for personnel training and gives some additional explanations concerning model implementation.

From the above mentioned facts follows the conclusion that the Republic of Bulgaria meets the requirements of Article 11 of the Convention on Nuclear Safety.

Article 12 - 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."

Article 11 of the Convention presents the requirements in force regarding the training and qualification of the nuclear installations personnel.

12.1. Activities on Prevention

It has been accepted that together with other measures, the activities on prevention are of the utmost importance for the reliability of the human factor, connected with the psycho-physiological and professional selection of personnel. The approach used in the Kozloduy NPP for taking into account the role of the human factor during the operation of the units is based on the following document: Policy on the Provision of Safety and Quality. Declaration of the Management of the Kozloduy NPP, 1995. On this basis have been created the relevant information systems for management and control of personnel and a system for the analysis of human errors.

Selection of Personnel

The following specified goals are set in the document: "System for management of personnel in the National Electric Company(NEC-PLC)":

- elimination of random selection of personnel;

- defence of the job position with professionalism and culture in the work for implementation of the safe and accident free operation of the facilities;

- clear formulation of the criteria for professional qualification and setting the path for qualificational and positional progress in the hierarchy.

For the implementation of these goals in 1995 a structural section was created for preliminary selection of personnel.

In order to create a good psycho-physiological atmosphere and motivation for the personnel, specific work has been done in the following directions:

- consolidation of the structure for the purpose of a clear definition of functions, rights, responsibilities and relations;

- elaboration of the personal job description;

- adequate remuneration corresponding to the assigned responsibilities.

The control and protection of the Kozloduy NPP personnel's health are based on the Act on Public Health, the Code of Labour and the Act on the Safe Conditions of Work.

In accordance with Regulation No. 3 of the Ministry of Health of 1987 (amended and supplemented 1994) the Kozloduy NPP workers should undergo compulsory prophylactic medical check-ups in the following manner:

- preliminary, when starting work at the NPP;

- periodical, once every 6 months for the employees working in the controlled area and once a year for the rest of the personnel.

The Ministry of Health and the Ministry of Labour and Social Policies carry out independently control for the protection of the Kozloduy NPP personnel's health.

Conditions for Work of the Personnel

An updated model for health monitoring of the operating and maintenance personnel of the NPP is in a process of implementation.

The elaboration of a new medical record for the NPP staff is envisaged which includes:

- personal radiation passport;

- personal health record of every employee in the NPP;

- medical record due to accidents.

A software programme has been elaborated for a medical register of the NPP personnel as part of the Unified National Medical Register of persons with professional radiation exposure in Bulgaria.

An amendment and a supplement have been elaborated for regulation No 3 of the Ministry of Health regarding the compulsory medical prophylactic check-ups of the NPP

personnel. A new List of the Restrictions for Health Reasons for work in the controlled area and on site at the Kozloduy NPP has been elaborated. In 1997 the Act on the Safe and Healthy Conditions of Work was approved and in this connection the following activities were carried out:

- elaboration of a criteria for assessment of the health risk at the NPP;
- elaboration of a methodology for internal dosimetry;
- elaboration of a directive for personal decontamination and medical assistance during radiation events in the NPP;
- establishing and furnishing of a psycho-physiological laboratory for examination of the psycho-physiological suitability of the personnel;
- establishment of a Service for Labour Medicine at the Kozloduy NPP, the main purpose of which is to provide and maintain healthy and safe conditions of work and improving the health and labour efficiency of the employees.

Regulation No. 13/19.09.1997 has been issued by the Ministry of Health and the Ministry of Labour and Social Policies regarding the work of the Services for Labour Medicine. Ordinance No. 87/12.03.1997 of the Council of Ministers for the establishment of special bodies for the elaboration and ensuring of healthy and safe working conditions has been issued too.

Design

A significant element of the prevention measures is the presence of a design, containing technical measures, limiting the possibilities of personnel errors and mitigating their consequences.

CUAEPP Regulation No.3, article 21 reads as follows: *" The NPP design shall provide for measures excluding or mitigating the consequences of faulty actions on the part of the personnel which might result in the worsening of the consequences from the failure of any device."*

The elaborated designs of the Kozloduy NPP units envisage redundancy, taking into consideration the principle of the single failure, automatic control, protective systems (which cannot be switched off) and interlocks and so on, according to the requirements of the normative-technical documentation in force in the former USSR at that time. Units 1-4 meet partially the requirements of Regulation No.3, since the safety concept envisaged in the design has an accent on the wide scope training and high professional qualities of the operating personnel. In the framework of the short-term three stage programme have been implemented measures towards the fullfillment of this requirement. Additional protective systems and

interlocks in the safety related systems have been implemented; in force is an automatic ban on interference of the operator during the actuation of the automatic safety systems; units 3 and 4 have acquired an additional system for safety function control, while this system is in a process of implementation for units 1 and 2. In the units 5 and 6 design are applied modern principles for prevention of human errors. In the programme for modernisation, on the basis of additional analyses and the accumulated operational experience, are planned a number of measures for additional mitigation of the possibility of personnel errors and for improving the man and machine interface.

The establishment of an integrated information system for the Kozloduy NPP is envisaged, with the view of accumulating and processing of data and giving advice to the personnel.

12.2 Taking into Account the Human Factor

The influence of the human factor on the safety of the NPP is on all levels - design, assembly, operation. For the qualitative and quantitative assessment of the human factor are used statistical methods, monitoring, analysis of incidents or accidents, models of human actions and others. The basic element acting towards mitigation of the effect of human errors is the presence of a system of prognosis, registration and analysis of the personnel actions and undertaking corrective actions.

System in Force

On the basis of CUAEPP Regulation No.2 and methodological documentation of the IAEA is implemented a system of analysis of human errors in the Kozloduy NPP. The causes for human errors are analysed according to the ASSET methodology of the IAEA. The types of errors and the relevant corrective actions are presented as follows:

- reliability of work (instructing of the personnel by the direct manager is envisaged);
- outside effects (instructing of the personnel by the direct manager is envisaged and measures for elimination of causes);
- preparation for the task (additional training of the staff by specialists in the problematic field is envisaged, which can be ended with an examination depending on the specific situation).

In connection with the discovering of hidden weaknesses in the personnel training, the following topics are reviewed:

- weaknesses in the personnel training before carrying out the tasks;

- decrease in the level of training during work.

The following are regarded as root causes for errors:

- weaknesses in the programme for control of the training (a review of the relevant document where the weakness is detected is foreseen);

- weaknesses in the programme for maintaining the level of qualification (review of the work connected with the analyses of the causes, determination and implementation of corrective actions).

Safety Analyses. Research on the Role of the Human Factor

On the basis of the existing operative information and data on the Kozloduy NPP units is performed an analyses of the impact of the human factor on their operation. Relevant measures and suggestions are made on the basis of these analyses which later on are implemented in the units. When analysing the human errors the personnel is divided into three groups: operational, maintenance and management.

The most frequently encountered suggestions and measures are:

- increasing the qualification;
- additional examinations;
- further elaboration of the directives;
- measures for enhancement of the maintenance and repair work;
- measures for enhancement of the work of external organizations.

A research project financed by the CUAEPP fund "Nuclear Research and Nuclear and Radiation Safety" called "Analysis of the impact of the human factor upon the progress of accident situations in nuclear facilities" based on data from the operation of the Kozloduy NPP is in a process of implementation. On the basis of this research will be prepared proposals for supplements to the relevant types of directives with the view of enhancing the work of the different groups of personnel.

In the framework of the analyses of the human factor connected with the operation of the Kozloduy NPP units were carried out a number of research projects of the human activity outside the site which can have an impact on the level of safety of the Kozloduy NPP. These research projects were carried out in accordance with CUAEPP Regulation No. 3 which forsees in the safety justification the inclusion of a section on the assessment of the impact of industrial, transport and other enterprises on the safety of the NPP. In the framework of the research are analysed in detail all existing human activities outside the NPP site, namely incidents in industry, transport services, civil and military aviation, agricultural aviation and

special facilities (military installations). A qualitative assessment has been carried out of the total risk for the Kozloduy NPP site from the researched human activities.

In the framework of the carried out for all Kozloduy NPP units PSA are taken into account all human actions when modelling the units' performance under different initiating events.

A directive has been elaborated for the analysis of the human factor and the undertaking of corrective actions, on the basis of which the corrective measures are specified, implemented and controlled.

12.3. Management of the Kozloduy NPP Personnel

Following the internationally accepted corporative approach for personnel management, the Kozloduy NPP has adopted and implements a policy for the further use of the intelectual, creative and organizational abilities of every person, instead of using means of administrative and economical nature for enforcement.

The following measures have been carried out for this purpose:

- work in the field of attracting employees and in their progress;
- providing conditions for the rational distribution of the duties;
- providing possibilities for showing of personal initiative;
- justified and adequate remuneration.

The implementation of this approach began in 1991 with the development of a " System for recruiting, selection, training and increasing the qualification of the personnel"

12.4. Role of the Regulatory Body

In regard to the human factor the CUAEPP works in the following main directions:

- reviews and licenses the measures for enhancing the safety of the Kozloduy NPP units taking into consideration the possibility of individual errors and their impact on the functional status of the equipment and the safety of the unit. Before implementation of new systems and equipment it requires the availability of directives for operation and procedures for work, carrying out of functional tests and qualified personnel.

- independently analyses events caused by human errors. makes assessment of the root and direct causes as well as of the suggested corrective measures and undertakes additional prescriptive measures;

- carries out control over the training and qualification of the personnel;

- through the fund Nuclear Research and Nuclear and Radiation Safety(NRNRS) finances independent research and analyses connected with the role of the human factor in the NPP operation.

The psycho-physiological and medical status of the personnel is controlled by the specialised bodies of the Ministry of Health.

From the abovementioned facts follows the conclusion that the Republic of Bulgaria meets the requirements of article 12 of the Convention on Nuclear Safety.

Article 13 - Quality Assurance

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

13.1. Policy on the Quality Assurance

The policy on the quality assurance in the field of atomic energy declared by the National Electric Company (NEC- PLC) (see text under article 10), has as its main goal ensuring the nuclear safety and radiation protection, by means of providing high quality in all activities and on all levels of its hierarchy.

A system for quality assurance (QA) is implemented for proper planning, implementation and assessment of the achieved results.The ensuring of the safe and accident free operation of the nuclear facilities is carried out by means of compliance with the existing regulations.

The Board of Directors of NEC - PLC delegates authority and responsibilities to a manager, provides the necessary resources for ensuring the safety, controls the implementation of the periodical reviews of the performance and effectiveness of the introduced policy. The managers from all levels of management have a constant responsibility to provide the necessary conditions for implementation of the policy on quality assurance in accordance with the delegated authorities and responsibilities.

All employees are required to be familiar and comply with their authorities and responsibilities connected with the ensuring of the safety and quality assurance in accordance with their job descriptions.

Structural units are created for implementation of the policy in the NEC-PLC, departments and divisions with a clearly defined and registered activities, authorities, responsibilities, limits of the authorities, internal and external relations with the established relevant structural units in the branches of NEC-PLC, carrying out the operation, the technical maintenance and control of the safety and quality.

According to the recommendations of the 1991 IAEA OSART mission, the management of the Kozloduy NPP adopted a systematic approach for implementation of a system for quality in its own subdivisions.

Since 1993 the management of the Kozloduy NPP has adopted a policy for creating a unified, integrated system for QA, which can unite the existing systems in its structural subdivisions.

13.2. Historical Review of the Measures for Quality Assurance

Initially, when constructing and operating nuclear facilities in the Republic of Bulgaria, programmes for quality assurance in their modern sense of understanding were not developed. As an equivalent there was a highly developed system of standartization, regulated by standartization documents issued by the state, the administration and by companies together with a multistage system for control at all levels of activities like design, manufacturing of equipment, construction, commissioning and operation.

In the structure of all the participants in these activities existed specialized units for control of the quality (Technical control over the quality). There also existed a specialized structural unit (Directorate for investment control) which carried out the control over the construction - deliveries, design ensuring, construction and mantling, tests, personnel training and commissioning. All activities connected with the construction and commissioning of the nuclear facilities were carried out in accordance with the normative acts for investment activity in force.

The independent control carried out by the specialized state control bodies-for state technical supervision, fire protection, sanitary inspection, control over metals and welding, metrology and others was regarded as a secondary type of control and did supplement the function of the investor's control. The tests for approval and commissioning of nuclear

facilities were carried out under the control and acceptance of a specially appointed by the government commission (State Start-up Licensing Commission).

The organization of work thus described did function in this manner until the end of the year 1990. Some elements are still functioning to this day having undergone insignificant changes.

The operational experience shows that this system has been functioning very effectively. During the operation of the Kozloduy NPP units, no errors in the design and construction were detected which could have been a consequence from the lack of programmes for quality assurance.

13.3. Normative Basis

According to CUAEPP Regulation No. 3 article 24: "*A quality assurance programme is developed for NPPs covering the construction and operation of NPPs, and determining the activities of the constructor, designer, construction and erection organizations, the equipment manufacturers, superior organizations and the personnel".*

At the moment of issuing this regulation the Kozloduy NPP units 1-4 were in operation, unit 5 under pre-commissioning adjustments and unit 6 under construction and mounting respectively.

In 1993 the CUAEPP issued a Regulation for amending and supplementing of Regulation No. 5, where article 7a introduces additional requirements for submission of a programme for quality assurance in order to receive a licence, namely: "*Every written request for the issuing of a licence for carrying out activities discussed in this chapter is accompanied, apart from the documents mentioned in the relevant sections of this chapter, with a: .... 2. Programme for quality assurance, ... ".* In the same regulation there is a requirement for the presence of administrative and organizational procedures and structures for quality assurance by legal entities and physical persons for carrying out of independent activities by contracts with the NPP.

The standards from the ISO 9000 series have been implemented in the Republic of Bulgaria as state standards. The IAEA quality assurance documentation is implemented too. They are used as reference guides in developing documentation on the system for quality in the Kozloduy NPP.

In addition when developing documentation on the QA system other documents in force in the Kozloduy NPP are used also, included in a specified list.

13.4. Quality Assurance in Design

In designing the Kozloduy NPP, the quality of the designs was ensured through compliance with the requirements of the existing normative documents regarding the mechanism of the different systems and components and the choice of materials. Special attention has been paid on the design requirements for carrying out and control of the welding. A constant multilevel control was carried out over the design itself, as well as during the implementation of the designs, with view of detecting errors and discrepancies. For this purpose, apart from the specialized units for control of the construction, functioned also specialized units for "constant author's supervision".

There are internal regulations and rules developed and in force in the organizations carrying out the designs, setting the procedures for design and distribution of responsibilities. The quality assurance is guaranteed also by the presence of a number of standartization documents, unifying the components and constructive elements used, as well as the methods for calculation of the constructions.

At the present moment the activities connected with the design are carried out in compliance with the programmes for quality assurance.

The systems for quality assurance (QA) contain procedures and directives, regulating the order of implementation of the engineering activities, methods and means by which they are carried out. The quality assurance is guaranteed by the accurate definition and documentation of the requirements for the implementation of the activities, determining the applicable for the specific case normative documents and the strict following of the relevant requirements, the application of verified software and methodologies, the implementation of adequate inspections at every stage of the work and attracting specialists with the necessary qualification.

The periodical inspections on the functioning of the programmes for QA (by internal and external organizations) contribute towards the development and improvement of these programmes.

13.5. Quality Assurance in Construction and Commissioning

The following distribution of the responsibilities existed during the construction of units 1-6:

- the Council of Ministers did appoint an authorised person with high qualification, having the right to make management decisions and responsible for the whole construction activity till commissioning (construction manager);

- the Ministry of Energy did create a structural unit (Directorate for Investor's Control), monitoring the activities during the construction;

- on the part of the organizations from the former USSR, there were representatives from the Chief designer (Atomenergoproekt), Chief constructor (Gidropres) and the Scientific supervisor (institute "Kurchatov") as well as representatives from the enterprises-suppliers of the main equipment, under whose control were carried out all the activities.

The control and the quality assessment were carried out according to the requirements and the criteria of the russian and bulgarian normative technical documents in force at that time. For the especially important installations, control on the quality was carried out also by the operative personnel. For ensuring the quality in the implementation of the activities, the personnel of the construction and mounting organizations underwent specific training and on the basis of an examination before an administrative or state commission received a certain degree of qualification. The activities were carried out under programmes recorded in a written form describing the types of work, time for their implementation and a list of the controlled parameters and their control schedule. All results from the intermediary and final control were recorded and later served as evidence and basis for commissioning of the facility.

At present this organisation of work continues to be in force being further developed with the requirement for a Programme for quality assurance, which is an obligatory condition for the issuing of a licence by the CUAEPP for commencing of the activities.

13.6. Quality Assurance in Operation. System for QA for the Kozloduy NPP

Untill 1991 the operation was carried out on the basis of the requirements of the normative and technical documents (design, equipment documentation and others) further developed in detail by NPP internal documents listed and approved by the plant management. The documents used by the personnel in implementing all activities connected with the operation were prepared based on these requirements, namely:

- directives and operational programmes;
- directives for ensuring of safety;
- training programmes and schedules for personnel training;
- documents for organizing the operational and repair activities;
- documents for maintenance of the installations.

The design modifications were carried out, based on technical decisions. The events were recorded and analysed. Periodical reports were prepared reflecting the condition of the operation.

The quality of the operation was ensured through prevention control-internal and external. Internal inspections were carried out on the part of the managing personnel for compliance with the requirements by the relevant responsible officials. A system for such inspections was established. The external control was carried out by the state control bodies for nuclear safety and radiation protection, industrial safety, technical supervision, sanitary control, fire protection, etc.

An internal and external control for the elimination of the discrepancies found followed.

Implementation of Systems for Quality in the Kozloduy NPP Subdivisions

The policy of the management of the independent Kozloduy NPP subdivisions is presented in written form in a "Programme for Quality Assurance" and "Manual on Quality" which define the following objectives:

- final objective, which is reaching maximum productivity with ensuring the safety;
- responsibilities regarding the safety of the NPP and establishing the safety as a leading criterium in the management;
- personal responsibility of management and personnel for quality assurance.

The organisational structure, set in the programmes for quality assurance in the separate subdivisions foresees:

- responsibility of the directors for implementation of QA systems;
- establishing Counsels for Safety for units 1-4 and units 5-6 as consultative bodies attached to the managers on the questions of safety and quality assurance;
- establishing independent organizational units on QA.

The programmes for quality assurance for units 1-4 an units 5-6 cover all activities connected with the safe generation of electricity from nuclear fuel by all units and the responsibility carried out by their management.

The programme for QA in "Treatment of RAW" plant covers all activities connected with the management of SNF (spent nuclear fuel) and RAW (radioactive waste).

The programme for QA in Atomenergoremont (AER) covers the activities on repairment of equipment, production of spare parts and non standart equipment.

The main goals and objectives are formulated in the programmes for QA, the ways of implementation, organizational structure which ensures fullfillment of the set objectives and

distribution of responsibilities in carrying out of different activities. The main principles of quality assurance are:

- attaining and maintaining the level of quality in operation;
- quality control;
- analysis and elimination of deviations.

The development and implementation of the programmes for QA are carried out according to the following pattern:

- the management of the subdivision states its policy in regard to the quality in a written form;
- the structural units which are responsible for coordination and development of the management documentation of the QA system are established;
- every independent subdivision develops a plan for drafting and implementation of a system for QA;
- the main documentation regulating the span of implementation of QA and the methods for achievement and control is developed and implemented;
- the management documentation for QA is developed after assessing the existing situation (if necessary) according to the established plan;
- the annual tasks of the subdivision are determined in Order No.1.

The data on the history of implementation of the systems for QA in the independent subdivisions is given below.

Subdivision	Decision on implementation of a system for QA	Date for approval of a plan for implementation	Number of QA documents implemented by June 1998
units 1-4	01.07.1992	01.07.1992	26
units 5-6	05.05.1992	12.05.1997	27
TRAW plant	15.11.1996	27.10.1997	27
AER	21.05.1993	09.06.1994	25

In accordance to its importance the QA documentation is divided in 3 levels:

- level 1 - programme documentation determining the strategy and formulating the final goals, which have to be attained;
- level 2 - organizational documentation, determining the organizational structure of each subdivision, the functions, rights and responsibilities of its structural units and the

interrelations between them, and management documentation determining the general rules and requirements towards the implementation of the separate types of activities;

- level 3 - working documentation, determining the order for implementation of separate specific activities and/or operations: directives for operation, repair technologies, training programmes, etc.

Each independent subdivision carries out internal inspections for assessment of the effectiveness of the work in the subdivision, the relevance of the linked with the quality activities and results with the requirements set in advance and the sufficiency of these requirements for achieving the obejectives set.

The QA programmes are carried out according to an order set in a written directive, having the power of management documentation for QA in the subdivision.

Establishment of an Integrated QA System in the Kozloduy NPP

In 1993 the Kozloduy NPP management declared its intentions for the ensuring of safety in a special document called "Policy on ensuring the safety and the quality. Declaration of the Kozloduy NPP management". The declaration contains the following main sections:

- main principles in the policy of the management;
- distribution of responsibilities for the implementation of the policy;
- means for the implementation of the policy;
- relations with the regulatory body.

The integrated system for QA unifies the existing systems in the existing structural subdivisions and expands the span of the activities on management, safety control, accident planning, physical protection and all other activities on the Kozloduy NPP site.

The QA organizational structure is established on 2 levels:

- at the Kozloduy NPP there is a division on "Quality Assurance", subordinated to the Deputy Manager on Safety;
- the respective subdivisions have sections called "Quality Assurance" subordinated to the managers of department "Technical Support".

The division on "Quality Assurance" has the following tasks:

- development of general documentation for QA;
- inspections on the condition of the quality in the different subdivisions of the NPP;
- rendering of methodological assistance to the subdivisions in developing and implementing their own QA systems;
- participation in the personnel training on quality assurance.

The sections on "Quality Assurance" have the following tasks:

- developing and implementing internal QA management documentation;

- developing and implementing internal documentation on the control of quality in carrying out activities connected with the safety;

- control on the compliance with the internal documentation on ensuring and control over the quality;

- participation in personnel training for quality assurance;

- control over the quality of work of the external organizations.

In 1996 started the development of a system for management of the configuration as a part of the integrated system for quality. By the middle of 1998 were developed 6 management documents, including a plan and a programme for establishment of a system for management of the configuration. The preliminary implementation is envisaged to be completed by the end of 1998, after which will begin the implementation of systems for management of the configuration in the main subdivisions.

The management of the Kozloduy NPP takes the necessary measures for training of the personnel occupied with activities on QA.

Quality Assurance Regarding Activities by External Organizations

The relations with external organizations rendering services to the Kozloduy NPP are regulated by a "Directive for control over the work of external organizations" where the requirements towards the activities which require a licence according to the CUAEPP Regulation No. 5 are pointed out.

The directive regulates:

- signing of contracts;

- assessment of the contract in regard to the safety and the quality;

- conditions for admitting the external organizations for work;

- distribution of responsibilities between the contractor and the structural units of the Kozloduy NPP for ensuring of the control over the safety and the quality;

- acceptance of the completed work.

The form and the content of the documents necessary for the implementation of the directive and the requirements towards the QA programme for the external organizations are shown in annexes to the directive itself.

Quality Assurance in Upgrading

The QA programme for management of the upgrading, sets requirements towards the implementation of the activities so that the:

- different modifications are studied and their interrelations and the impact on the design in general are assessed;

- design is carried out according to applicable norms and standards for safety, without surpassing the safety limits;

- modifications are analysed and assessed from the point of view of safety;

- enhancement of the reliability of the equipment and the distribution of the units.

For example, for the design for upgrading of units 5-6 is developed a Programme for quality assurance, approved by the executive director of NEC-PLC. The programme is compulsory for implementation by the Kozloduy NPP, NEC-PLC and the main contractors. In the framework of the programme are developed and implemented manuals and directives for carrying out of different activities-providing input data, independent inspection of the design, etc.

13.7. Regulatory Control

The inspection of elements of the QA system in force is included in the span of the ISUAE inspections, which elements are directly linked with the topic of the inspection. Some typical examples are: compliance with the procedures in force, correspondence of the qualification of the employee to the activity performed, verification of the presence of relevant documents and/or records, control on the existence of discrepancies, tracking of the undertaking of correctional measures and the performance by the operating organization of revisions of the external subcontractors in connection with the quality assurance.

A separate division operates in the CUAEPP since March 1998, part of which responsibilities is management of the quality of the regulatory activity. In the framework of a contract financed by the PHARE programme, a manual for assessment of a QA programme for a holder of a licence and for an auditor's inspection for its implementation is being developed in the CUAEPP. A joint inspection by representatives from the CUAEPP and the regulatory bodies from Belgium and Great Britain is envisaged for the Kozloduy NPP, for assessment of the quality assurance programmes in force.

13.8. Planned Activities by the Kozloduy NPP for Development of the System for Quality

The following activities are planned for improving the system for quality assurance:

- introduction of the requirements for quality regulated by the new IAEA manuals and the new bulgarian state standards in compliance with the ISO 9000 series in the internal documentation on quality;

- establishment of a system for management of the configuration in the power generation subdivisions;

- development of documentation for performing assessment of the systems for quality of external organizations;

- extending the existing system for NPP personnel training on QA for activities connected with the safety.

From the above mentioned facts follows the conclusion that the Republic of Bulgaria meets the requirements of article 13 of the Convention on Nuclear Safety.

Article 14 - Assessment and Inspection of the Safety

"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 the 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.".

14.1. Safety Assessment

Process of Licensing and Safety Analysis Reports

The process of licensing includes all main stages of the life cycle of the nuclear installations: site selection, design, construction, commissioning, operation and decommissioning. The decisions on the issuing of licences are based on the review and assessment of information on the level of nuclear safety, contained in the documentation

presented by the applicant. An inseparable part of this documentation is the report on safety justification of the nuclear facility.

Article 23 of the CUAEPP Regulation No. 3 requires in addition to the technical design the developing of a special section "Technical Justification of Safety in Construction and Operation of NPP", drafted by the chief designer. A similar section is developed for the reactor plant by the chief constructor and the scientific supervisor.

CUAEPP Regulation No. 5 contains the detailed requirements for the structure and content of the reports for safety justification at the various stages of licensing. The safety of the site is justified in advance in a partial report, including basically an analysis and assessment of all characteristics connected with the site and determining the depending on them design basis of the nuclear installation. The safety of the design is described in a preliminary report for safety justification (Preliminary Safety Substantiation Report). The final report for safety substantiation (Final Safety Substantiation Report) is drafted taking into consideration the results from the construction and commissioning of the nuclear installation. The analysis and assessment of a certain spectre of initiating events and their subsequence are part of the PSSR and the FSSR. This spectre of events has to be determined on the basis of the probability safety analysis.

According to CUAEPP Regulation No. 5 a separate PSA is not required formally to be submitted. However, the "ISUAE manual for usage of the probability safety analysis" states that in the process of licensing the documentation submitted by the applicant/holder of licence should include a PSA for the stages "construction" and "operation".

The existing safety reports on the design of Kozloduy NPP units 1-4, prepared in the 70's and 80's are with a limited volume and do not correspond to some requirements for the demonstration of safety, applied in the western countries. In the last years the operating organization has made considerable efforts towards the improvement of the safety of the units. In these specific measures the safety has been demonstrated, but this has not been done systematically.

There is an ISUAE prescription for the performance of a profound assessment for the current condition of the safety of these units. The manual "Structure and Content of the Safety Substantiation Report (SSR) for operating units 3-4 with WWER-440 type 230 reactors" developed according to a PHARE programme project, contains detailed advice towards the methodology of the assessment, safety justification and the structure and content of the report. According to this manual, a major part of the SSR is occupied by the essential for the substantiation of safety aspects like:

- description of the current condition of the units and the practices of management and operation;

- review of the operational experience including the results from tests, incidents, modifications, radiological effects and processes of ageing of the materials;

- analysis of transitional and accident regimes;

- comparison of the condition of the units and operational practices with the requirements of the present day standards;

- description of the planned measures for maintaining and enhancing the safety.

The Kozloduy NPP has taken measures to perform the first draft of the "Safety Substantiation Report" for units 1-4, according to the CUAEPP requirements, which is planned to be completed in the beginning of 1999.

The following safety reports exist for the Kozloduy NPP units 5-6:

- technical substantiation of safety (TSS), developed in designing the units;

- TSS for the reactor of WWER-1000/320 type reactor unit for Kozloduy NPP units 5-6;

- TSS, developed after commissioning, containing updated information.

A common deficiency of these documents is that they have been developed according to outdated normative requirements. A development of new reports for the technical substantiation of safety is envisaged, specific for each unit, after completion of the upgrading of these units and in accordance with the existing international practices in the developed countries.

The CUAEPP "Directive for Performing of Periodical and Systematical Assessment of the NPP in Operation" contains detailed requirements on the conditions, order and terms of performing such an assessment as well as the structure and content of the report documentation. A review of the performed assessments and the main results from these assessments are presented in the section on article 6 of the Convention.

14.2. Inspection of Safety

Inspection of Safety

The CUAEPP Regulation No. 3 contains several general requirements regarding the ensuring of the correspondence of the technical condition of the nuclear installation to its design and the limits and conditions of operation.

According to article 18: *"The safety related NPP systems and devices are subject to inspection after repair and to periodical check-ups throughout the whole operational period".*

According to article 80: "*Untill commissioning in regular operation:*

- a check of consistence between the construction of the NPP and the design shall be made;

- all start-up and adjustment works shall be completed (tests of individual systems and equipment included);

- complex tests of the NPP shall be carried out (including attaining reactor criticality and commercial operation)

According to article 98: *"Prior to commissioning and periodically, in conformity with the requirements of the rules, norms and instructions of the NPP, a check shall be made of the normal functioning of the safety systems, control of basic metal and weld connections of equipment and pipings, check of instrumentation which ensures thw safe operation limits".*

According to article 104: *"Upon completion of maintenance works the equipment and the systems affecting the NPP safety shall be checked for operability and for conformity to the design characteristics, the executed works and the check results being documented".*

For the corresponding detailed requirements, the operating organization in coordination with the CUAEPP uses some of the documentation of the Federal Supervision of Russia on nuclear and radiation safety as well as documentation from the NRC (USA), the IAEA and others.

The performance of complete and systematic internal inspections of the safety with the help of analysis, observations, tests and inspections, guarantees that the technical state and conditions of operation of the nuclear facilities correspond to the design, the safety requirements, limits and conditions of operation. The results from these inspections are used also for feedback from the operational experience, undertaking of corrective measures for elimination of discrepancies and assessing the effectiveness of the implemented policy. The purpose of the performed assessments on the condition of safety is to show the causes for discrepancies, to gather useful information and make conclusions in order to stimulate the personell to detect and inform about deficiencies.

The main requirements towards the order, method, volume and periodicity of the metal control of equipment and piping in the NPP during operation are presented in a CUAEPP document called: "Directive for operational non-destructive control in NPP. Main requirements".

According to the abovementioned documents the main programmes for inspection of the technical state, which are used by the operating organization are:

- programmes for planned preventive maintenance, carried out when shutting down of the unit for refuelling;

- programmes for requalification of pressure vessels and piping;

- programmes for in-service inspection of equipment and piping in the primary circuit;
- programmes for in-service inspection of equipment and piping in the secondary circuit;
- programmes for the corrosion control of the equipment;
- specific programmes for assessment of the irradiation ageing of the reactor pressure vessels;
- programme for control of the loading cycles of the reactor installation;
- programme for control of the loading cycles of the nuclear fuel;
- programmes for the functional tests of the systems important for the safety.

All working programmes are reviewed in the process of licensing by the CUAEPP and their implementation is checked by the inspectors before every start-up of a unit. The activities on the implementation of the programmes are carried out by a qualified personnel mainly from the operating organization. Part of the in-service metal control, certain maintenance works and other specific activities are carried out by licensed external organizations.

The requirements towards the control which include periodicity, type and volume of inspections, tests, calibration of the systems and equipment are contained in the Technical Specifications Book. The implementation of the schedules for control is checked also by inspectors from the operating organization. The operative and management personnel of the NPP carry out constant control on the compliance of the limits and conditions of operation, contained in the Technical Specifications Book. The Technical Specifications Book and every change in it are approved by the CUAEPP.

Inspection of Safety According to Other Specific Programmes of the Operating Organization

In addition to the abovementioned facts, the Kozloduy NPP performs the following programmes regarding the inspection of safety:

- programme for in-service radiation control of the environment;
- regulation for the radiation technological control of the units;
- extended programme for additional research and activities for the enhancement of the security on site;
- programme for seismic control of the equipment and constructions on site.

Similar programmes for monitoring of the environment are carried out by the specilaised bodies of the Ministry of Environment and Water and for the exposure of the population, by the Ministry of Health.

The administrative management of the Kozloduy NPP records the results from the implementation of the programmes for monitoring of the environment and for the exposure

and at certain intervals informs the CUAEPP and other competent authorities about the summarized results from the monitoring.

The results from the performed inspections are reflected in the programmes for upgrading of the units. The implementation of the upgrading in the Kozloduy NPP, regarding systems and components important for the safety is subject to licensing by the CUAEPP. All aspects of safety resulting from the upgrading are checked in advance by the Councils on safety which advise the Kozloduy NPP management on the licesed measures for ensuring the safety.

The CUAEPP inspection of safety is carried out in a number of cases with the help of consultants, including such from the IAEA or from technical expert organizations from western european countries under PHARE programme projects.

Planned and Prescribed Programmes and Measures for the Inspection of Safety

The following programmes for the Kozloduy NPP have been planned by the operating organization or prescribed by the CUAEPP:

- monitoring of the professional exposure of the personnel working constantly or periodically in the restricted area;
- monitoring of the radiation factors at the working places of the personnel in the restricted area and on site;
- monitoring of the health condition of the personnel;
- control and management of the lifetime of the systems, equipment and installations important for the safety.

International Programmes Regarding the Assessment and Inspection of Safety of the Kozloduy NPP

For the years 1991-1997 the assessment and inspection of safety of the Kozloduy NPP have been the subject of the following international programmes:

- 6 months WANO (World Association of Nuclear Operators) programme;
- programme for reassessment of the characteristics of the site (IAEA project);
- programme for comparative research of seismic analysis and tests of the NPP (IAEA project).

From the abovementioned facts follows the conclusion that the Republic of Bulgaria meets the requirements of article 14 of the Convention on Nuclear Safety.

Article 15 Radiation Protection

"Each contracting party shall take the appropriate steps to ensure that in all operational steps 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 the prescribed national dose limits".

15.1. National Policy in the Field of the Radiation Protection in the Operation of NPP

The national policy in the field of the radiation protection in the operation of the Kozloduy NPP is stated in the following way:

- the state regulates the use of atomic energy. (Article 7 of the AUAEPP);
- atomic energy shall be used in accordance with the aims and the principles of ... and radiation safety, and the protection of the life and health of people and the environment shall have priority over economic and other social needs. (Article 3 of the AUAEPP);
- the government bodies, in the framework of the authority delineated to them by law, authorise and control the import, manufacture, usage, storage, transportation and deactivation of ... nuclear material and other sources of ionising radiation (Article 12 g (1) of the Act on Public Health);
- the Minister of Public Health shall set forth compulsory hygiene norms, requirements and sanitary rules related to all aspects of hygiene, radiation safety and epidemiology (Article 20 of the APH)
- the healthy and safe conditions of labour in installations, manufacturing, processes, activities, working places and working equipment are ensured through the design, construction, reconstruction and upgrading while commissioning or during their operation (Article 3 (2) of the Act on Safe Conditions of Labour);
- the ensuring of healthy and safe conditions of labour requires measures on (Article 4 of the ASCL):
  - elimination of the risk on the life and health;
  - assessment of the risk which cannot be eliminated
  - activities on the elimination of the risk at the source of its origin;

- application of a unified common policy on prevention, encompassing the technology, working places and the organization of work, the working conditions and the social interactions;
- usage of the collective means for protection with preference to the individual means for protection;
- presentation to the wroking persons of the necessary information in regard to the ensuring of healthy and safe conditions of labour;
- marking the existing dangers and sources of harmful for the health and safety factors.

- the reduction of the risk for human health and for the environment and its relation to suffered damages and missed benefits shall be the basis for determining the state policy on ecology. (Article 2 of the EPA (Environmental Protection Act)).

- the assessment of the impact on the environment shall be made mandatory. (Article 20 (1) of the EPA).

15.2. Legislatory and Regulatory Basis in the Field of Radiation Protection

The main acts in the field of radiation protection are: the Act on the Use of Atomic Energy for Peaceful Purposes, Act on Public Health, Environmental Protection Act and Act on the Healthy and Safe Conditions of Labour. The main executive acts are:

- Basic Standards of Radiation Protection. The purpose of this document is to determine the standards for protection of persons from the harmful effects of ionizing radiation, however not impeding the useful activities connected with the use of their sources. The categories of exposed persons and the basic exposure limits are determined. These are obligatory for all legal entities and physical persons, carrying out activities connected with sources of ionizing radiation;

- Regulation No. 0-35 of the Ministry of Public Health and the Ministry of Internal Affairs for work with radioactive substances and other sources of ionizing radiation. It has been developed on the basis of the Act on Public Health and determines the main requirements for ensuring the radiation safety. It describes the complex of protective measures for decreasing the total exposure for the different categories of persons;

- CUAEPP Regulation No. 2 - the content of the regulation has been presented under Article 7;

- CUAEPP Regulation No. 3 - the content of the regulation has been presented under Article 7;

- Joint CUAEPP and Ministry of Internal Affairs Regulation No. 4 - the content of the regulation has been presented under Article 7;

- CUAEPP Regulation No. 5 - the content of the regulation has been presented under Article 7;

- CUAEPP Regulation No. 6 - the content of the regulation has been presented under Article 7;

- CUAEPP Regulation No. 7 - the content of the regulation has been presented under Article 7;

MEW Regulation No. 4 for assessment of the impact on the environment. Subject of the assessment of the impact on the environment are the projects for new installations and the projects for expansion and transformation with change of the functional purpose of the installations as well as for the installations in operation cited in the EPA.

- Regulation No. 7 of the MEW and MPH regarding norms and standards for determining the quality of the surface waters;

- Regulation for the order of determining and imposing of sanctions for damaging or contamination of the environment above the permissible limits;

- Regulation for the establishment, operation and development of the National Automated System for constant control of the γ-radiation background in the Republic of Bulgaria. Organization of the establishment, maintenance and operation of the National Automated System for constant control of the γ-radiation background in the Republic of Bulgaria. The Automated System is being established bearing in mind the specificity of the meteorological conditions in Bulgaria and the existing nuclear installations sited in the country as well as such sited in neighbouring countries. According to the regulation:

- the Ministry of Environment and Water establishes and maintains the National Automated System for constant control of the γ-radiation background.

- the CUAEPP informs the international institutions about the radiation background in the country according to the international obligations of the Republic of Bulgaria.

National Plan "Environment-Health"

The national plan "Environment-Health" was established in 1998. It coordinates and directs the activities of two ministeries - the MEW and the MPH. Among the priority tasks is the research of the impact of the Kozloduy NPP upon the environment and the population and determining a set of measures for the protection of the biosphere from contamination.

15.3. Analysis of the National Standards of Radiation Protection

The basic standards of radiation protection of the Republic of Bulgaria (BSRP-92) are based on the IAEA Basic Safety Standards 9 Series published in 1982. The main requirements for radiation protection are:

- no exceeding of the set basic limits of exposure;
- elimination of any unjustified exposure;
- decreasing of the exposure to the absolute minimum, regarding the actual social and economic conditions.

For the purposes of the radiation protection the BSRP-92 specifies three categories of exposed persons:

- category A - persons working temporarily or constantly with sources of ionising radiation, exposed to professional exposure and persons involved in accident related and salvage activities;
- category B - separate persons or limited group of the population including persons from both sexes over 18 years old;
- category C - the population of the country as a whole.

The limit of the effective exposure from both external and/or internal exposure for one year is determined as follows:

- category A - 50 mSv;
- category B - 5 mSv;
- category C - 1 mSv.

Note: The limit of the exposure for persons from category B is applied only for exposure from the source for which they have been so categorized. For all other radiation effects are applied the limits for category C.

The limit of the equivalent exposure for the different human organs and systems for one year is determined in the following way:

- category A - 500 mSv. Only for the eye lense 150 mSv;
- category B - 50 mSv;
- category C - 10 mSv. Only for the skin 50 mSv.

For category A is introduced a control limit for the effective exposure for one year: 20 mSv. In every case of exceeding the control limit, the control bodies and the exposed person are notified in written form.

For women in reproductive age (up to 45 years) is introduced an additional limitation: the individual exposure for any two subsequent months should not exceed 1/6 of the annual exposure.

Persons under 18 and inclusive, will not be allowed to work with sources of ionising radiation. Persons from 16 to 18 years of age are permitted to work with sources of ionising radiation only for the purpose of training. For this group of persons is applied the exposure limit for category B. For persons from 18 to 21 years of age inclusive, the individual effective exposure for one year should not exceed 20 mSv.

The planned increased personnel exposure during an accident above the established limits is permitted only when it is practically impossible to be avoided and there is a necessity for people to be saved and the elimination of the development of the accident.

The person who is exposed to a planned increased exposure in the course of the elimination of an accident has to be informed in advance about the expected exposure, the type of work to be done and the radiation risk and has to give his/her consent in written form. This person has to receive official information about the actually received exposure.

The following cases do not allow increased exposure:

- the person is under 21 years of age;
- the person is a woman in reproductive age (up to 45 years);
- the person has received an exposure during an accident or accidentally, has exceeded the annual permissible exposure and is in a process of compensation.

Secondary or derivative limits are established for the purposes of the radiation control.

A development of a new set of basic standards of radiation protection is envisaged which shall be close to the maximum to the requirements of Publication 60 of the international Commission on Radiological protection and the international basic safety standards, published by the IAEA in 1996 and a Directive of the Council 96/29/ Euratom of May 13 1996.

15.4. Control Bodies in the Field of Radiation Protection. Structure and Functions

Committee on the Use of Atomic Energy for Peaceful Purposes

The structure and functions of the CUAEPP as a regulatory body have been described under Article 8.

Ministry of Public Health

The bodies within the MPH, implementing the state sanitary control in the field of radiation protection are:

- five medical sections on radiation hygiene within the Hygiene Epidemiological Inspection (HEI) in the towns of Vratsa, Rousse, Varna, Bourgas and Plovdiv.

- National Centre of Radiobiology and Radiation Protection (NCRRP).

All activities connected with the use of ionising radiation are subject to state sanitary control. The Ministry of Public Health permits and controls the import, export, production, use, storage, transportation and deactivation of nuclear material and radioactive substances.

The Ministry of Public Health establishes obligatory hygienic standards and requirements regarding all questions on the radiation protection and in a case of a radiation accident - additional hygienic standards and requirements according to the situation.

The specialized body for state sanitary control in the field of the safe use of atomic energy is the NCRRP. It performs control, diagnostic, profilactic, accident prevention, scientific application and training qualification activities in the field of the radiation protection. The following departments function in the NCRRP:

- Radiation Protection;
- Radiation Control;
- Radiobiology;
- Medical Radiological Protection and Epidemiology.

Ministry of Environment and Water

The main function of the MEW is carrying out the control over the state of the environment. All the components of the environment (air, water, sediments, soil, vegetation) and the potential sources of pollution (including radiation contamination) are subject to control.

Within the MEW there is a National Centre for Environment and Stable Development (NCESD) which assists in the the implementation of the state policy on protection of the environment. It is a specialized body for performing of monitoring and laboratory analysis activities.

In the division "Laboratory analysis activities" within the NCESD there is a laboratory for radiological control of the environment. The laboratory carries out control and laboratory analysis activities and provides methodologically and metrologically the laboratories for radiological control within the Regional Inspectorates on Environment and Water (RIEW).

In the division "Monitoring of the Environment" within the NCESD there is a section called "Physical Impact and Radiation State". The section processes, analyses and publishes information on the radiation state of the environment in the country.

In the towns of Bourgas, Varna, Vratsa, Montana, Pleven, Plovdiv and Stara Zagora, within the RIEW function 7 laboratories for radiological control of the environment. The laboratories carry out control and laboratory analitical activities and provide the necessary information on the radiation state of the environment in the relevant controlled area of the country.

The Ministry of the Environment and Water organizes and operates a National System for Monitoring and Control over the State of the Environment and introduces an Automated System for Constant Control of the radiation background in the Republic of Bulgaria.The Central Monitoring Station is situated in the NCESD within the MEW and there are Regional Monitoring Stations at RIEW-Varna and RIEW-Vratsa. There are also Monitoring Stations installed and functioning at the Civil Protection Directorate and the CUAEPP.

The Ministery of Environment and Water organises public discussions of the presented reports on the assessment of the impact upon the environment from:

- mining and enrichment of uranium ores;
- electricity generation in NPPs;
- storage, treatment and depot of RAW and SNF.

The competent authority comes forward with a decision which is made public through the mass media or through some other appropriate method.

15.5 Structure of the Department on Radiation Protection at the Kozloduy NPP

The Deputy Manager on Safety at the Kozloduy NPP has under his authority a department on Radiation Protection consisting of:

- division "Radiation Control of the Environment";
- division "On site Monitoring";
- division "Automated Information System for External Radiation Control".

Within units 1-4 function the following sections:

- Council on Safety;
- Radiochemistry;
- Personal Dosimetry;
- Operational Radiation and Dosimetric Control;
- Systems and Equipment for Radiation and Dosimetric Control;

- Sanitary and Communal Services.

Within units 5-6 function the following sections:

- Council on Safety;
- Radiochemistry;
- Radiation Safety;
- Unit Radiation Control;
- Unit Equipment for Radiation Control;
- Unit Laboratories for special technological control and radiation protection; personal dosimetry; general dosimetry; film dosimetry; thermoluminiscent dosimetry; whole body counter.

15.6. Generalized Data of the Radiation Impact Upon the Kozloduy NPP Personnel

The main factors of the radiation impact upon the personnel are connected with the radiation parameters of the working conditions in the premises:

- the γ-exposure dose rate;
- density of the flow of β-particles;
- density of the flow and the equivalent dose rate of neutrons;
- concentration and radionuclide content of the radioactive gases and particulates in the air of the premises;
- surface contamination with radioactive substances of building constructions, equipment and working attire of the personnel.

The research of the factors, carried out determining the total exposure, show that the major part is occupied by the external exposure with predominating γ-exposure. The β-exposure has a part in the total external exposure but only in separate cases and not more than 10 %. The contribution of the thermal neutrons is not more than 0.3 % of the exposure.

The main methods for calculating the dose from external exposure are the film and the thermoluminiscent individual dosimetric control with a level of sensitivity of 1mSv and 0.5mSv respectively. For the purposes of the operative dosimetric control are used electronic dosemeters and ionising cameras with direct reading.

The internal exposure from incorporated nuclides (fission products and irradiation products) is measured by wholebody counters with "shade" protection and geometry of calculation "linear scanning". γ-emitters are detected with a minimal detectable activity in the limits of 125 Bq (for Co 60) and 250 Bq (for Cs-137) for whole body.

The analysis of the results of the research carried out in the last years in the controlled area show that the main factor of radiation impact upon the personnel is the external γ-exposure. The average individual exposure dose of the NPP personnel for the last 10 years is within the limits of 2.5 mSv – 8.7 mSv per annum.

The average individual dose from internal exposure due to the presence of radioactive particulates in the air of the working premises is determined at about 1.5 mSv per annum. The doses from internal exposure determined through direct measurements constitute not more than 10 % from the total exposure.

15.7. Generalized Results of the Radiation Impact Upon the Environment

As a result of the operation of the Kozloduy NPP, the following emmisions were released into the atmosphere in 1997:

- radioactive noble gases - 100 TBq/GW.a
- I - 131 – 1.44 TBq/GW.a
- radioactive particulates – 0.92 TBq/GW.a

In the year 1997 were released in the Danube river 162 197 m^3 discharged water with the total radioactivity of 2.4 GBq (excluding tritium). The total radioactivity of the Tritium has been assessed at 29 TBq.

The γ-exposure dose rate on the boundaries of the site as well as at all the control posts around the Kozloduy NPP is within the limits of the natural radiation background and does not differ from the one at other populated areas in the country.

In a number of samples have been identified long living radionuclides (mainly Cs-137 and Sr-90) with a technogenic origin. The absolute values of the measured radioactivity as well as their correspondence show as their origin the global fallout and the transboundary contamination from the Chernobyl NPP accident;

The comparison of the 1997 data with that from past years and with data before the commissioning, shows that there are no major changes of the radiation state resulting from the operation of the Kozloduy NPP.

The collective effective annual exposure dose of the population within the 30 km. area as a result from the emissions of particulates from the Kozloduy NPP in 1997 has been assessed at 8.E-3 manSv. The individual effective doses in the 30 km. area around the Kozloduy NPP are in the range of 8.8.E-7 – 1.7.E-8 Sv. The maximum value 8.8.E-7 Sv represents 0.09 % of the permissible dose for the population and 0.04 % of the dose resulting from the background exposure.

The calculations made for the exposure dose of the population within the 30 km area around the Kozloduy NPP determine a collective dose from the liquid radioactive discharges in 1997 at 4.2.E - 8 manSv.

The data received for 1997 on the exposure dose as a result from the discharged in the Danube river treated water are totally comparable with the data from the past few years and confirm the conclusion that there is practically no impact upon the environment and the population.

As a result it can be stated that the additional exposure dose for the population in the 30 km. area resulting from the operation of the Kozloduy NPP can be altogether disregarded.

As a whole the radiation state in the sanitary protection area and the 100 km. monitored area around the Kozloduy NPP does not differ from the radiation state in the other parts of the country.

From the abovementioned facts follows the conclusion that the Republic of Bulgaria meets the requirements of Article 15 of the Convention on Nuclear Safety.

Article 16 - Emergency Planning

"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."

16.1. Legislative and Regulatory Basis on Emergency Planning and Preparedness

Act on the Use of Atomic Energy for Peaceful Purposes. Concerning the emergency planning issues Article 13, paragraph 1 (6) of the AUAEPP states the following: *The Committee on the Use of Atomic Energy for Peaceful Purposes shall determine the remediation measures and for areas of the environment that have been adversely affected by radioactive sources, as well as the implementation of such measures*. The operator's obligations are set in Article 15, (3) as follows: "*The legal entities and physical persons involved in the use of atomic energy shall organise and carry out rescue and remediation operations on their own sites."*

Article 19 makes provisions for the obligation on immediate notification of emergencies while using atomic energy:

"*(1) The legal entities and physical persons engaged in the management or use of nuclear material, nuclear installations, radioactive substances or other ionising radiation sources shall forthwith notify the Committee on the Use of Atomic Energy for Peaceful Purposes of the operational changes which have taken effect, as well as of any accident conditions relevant to nuclear and radiation safety and of the accounting for, storage and transportation of nuclear material.*

(2) The Committee on the Use of Atomic Energy for Peaceful Purposes shall notify the competent authorities of the events and the accident conditions that occurred, relevant to the nuclear and radiation safety.";

Act on Public Health. Article 15, paragraph 2 defines the obligations in case of emergency conditions, i.e. "*In the event of a radiation accident the Minister of Health shall establish the necessary additional hygienic norms and requirements in accordance with the situation for the purpose of protecting the population*. The duties of the state sanitary control bodies "*participating in the commissions on nuclear accidents and emergencies and on liquidation of consequences of such events"* are set in Article 22a, paragraph 3;

Council of Ministers Ordinance No. 31 on Increasing the Country's Preparedness for Actions in Case of Natural Disasters and Large Industrial Accidents of 23.06.1989 (non-promulgated)

The Ordinance (Article 3, paragraph 1) establishes the development of a National Emergency Plan on Actions in Case of Strong Earthquakes, Natural Disasters and Large Industrial Accidents. The Civil Protection Directorate is entrusted with the tasks on ensuring

methodological assistance to Ministries, authorities and installations aiming at the increase of their preparedness (Article 3, paragraph 3). The duties for performing systematic inspections and analyses of the public preparedness for action in case of critical situations, the establishment of a system for collection of information and analysis of the arisen emergency situations, the development of training programmes, etc. are also regulated. Article 18 states the following: The Council of Ministers "*following a proposal of the Civil Defence headquarters of the Republic of Bulgaria recommends to the media, the press, the radio and the television to contribute to the systematic distribution of knowledge among the public on the ways of action and self-protection in case of strong earthquakes, natural disasters, large industrial accidents and fires";*

The Act on Assistance in Case of Public Disasters and the Act on Local Administration regulate the duties of the state authorities and the local administrative bodies on liquidation of the consequences in case of disasters, accidents and catastrophes. The Act on Municipal Budgets regulates the financing of these activities when they are carried out by the municipalities.

The Civil Defence organisation and activity is determined by the Civil Defence Decree No. 265/1978. According to the Decree the management of the Civil Protection on a national level is performed by the Council of Ministers.

Rule on the Organisation and Activity Related to the Prevention and Liquidation of the Consequences from Disasters, Accidents and Catastrophes (promulgated in the D.V. No. 13/1998)

The organisation, the general functions and objectives of the state authorities, the local administrative and local self-governmental bodies, companies associations and private businessmen aiming at prevention, mitigation and liquidation of the consequences from calamities, accidents and catastrophes are regulated by this Rule. The duties on preventive activity and protection are assigned to the state and local governmental bodies, as well as to the companies and private businessmen who use dangerous substances and materials, carry out activities in dangerous conditions or create potential hazard to the workers, staff, public and environment (Article 1). The general management of the activity is performed by the Council of Ministers, which establishes the Permanent Commission on Protection of the Population in Case of Disasters, Accidents and Catastrophes (Permanent Commission). The Deputy Prime Minister of the Republic of Bulgaria is the Chairman of the Permanent Commission and he approbates the list of names of the members to the Prime Minister for approval. The Head of the Civil Protection Directorate is the Deputy Chairman of the

Permanent Commission. Members of the Permanent Commission are Heads or Deputy Heads of Ministries or other authorities, related to its functions. The Permanent Commission's activity is assisted by Headquarters lead by the Commission's Secretary. The Civil Protection Directorate represents the Headquarters of the Permanent Commission. Representatives of other Ministers and authorities related to the emergency planning are involved too. A Scientific-Co-ordinating Council and Experts Councils are established to the Permanent Commission. Permanent commissions - departmental, regional and municipal are set up at each managing level. The Chairmen of the departmental commissions are the Heads of the authorities (Ministers), of the regional and municipal commissions - the regional managers and mayors, and of the site commissions - the site managers. The organisational scheme of the Permanent Commission is presented on Figure 16.1.

The Rule defines the order for announcement of a disastrous situation: "*Article 24. (1) A disastrous situation on the country's territory is announced by a Council of Ministers decision based on a proposal of the Chairman of the Permanent Commission, and part of the territory of the Republic of Bulgaria, it is announced by the Chairman of the Permanent Regional Commission.*

(2) 1. by the Chairman of the Permanent Regional Commission when the area of disastrous condition covers more than one community in the region;

2. by the Chairman of the Permanent Municipal Commission, when the area of disastrous condition covers the whole or part of the community's territory."

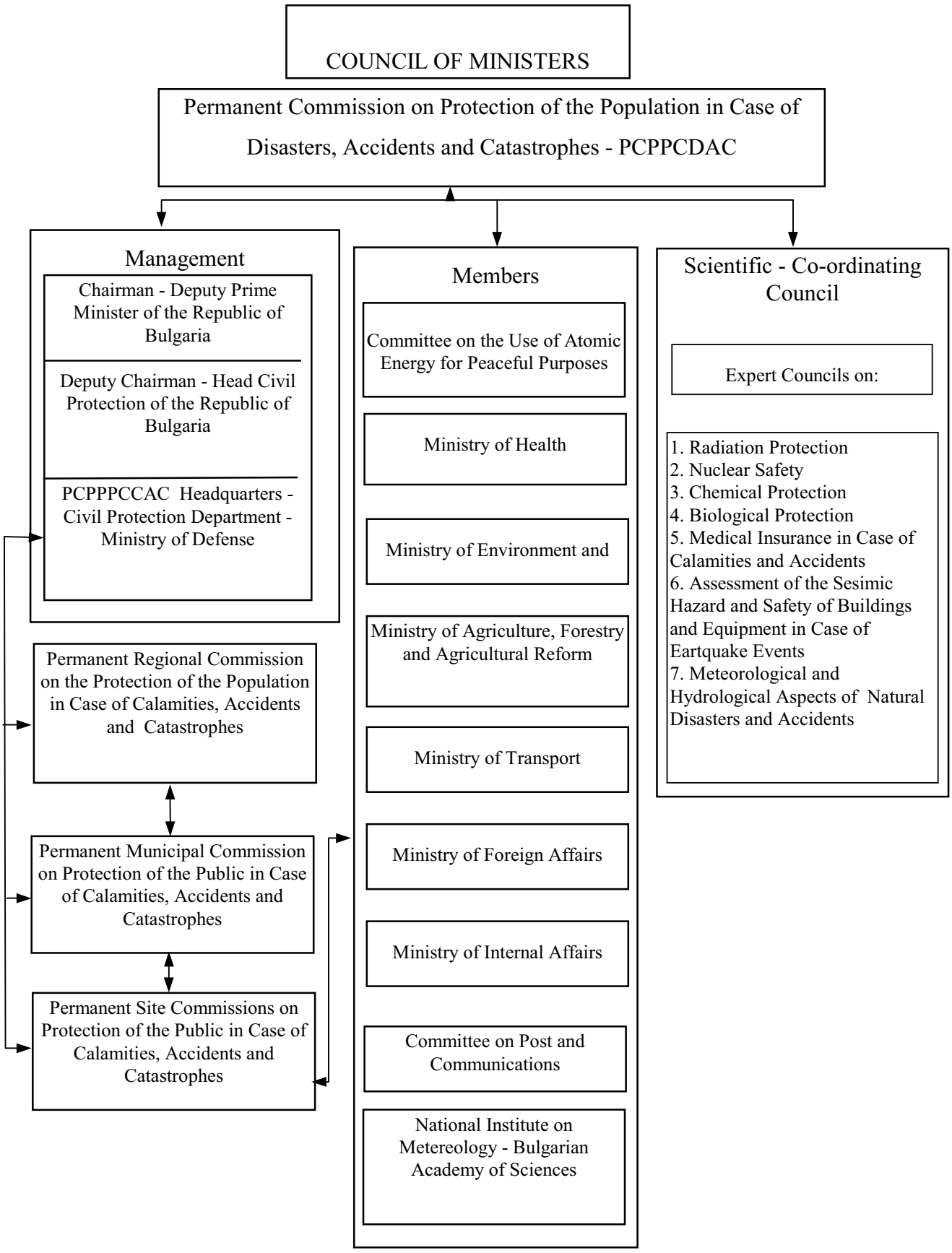
The Permanent Commission performs its managing functions through the National Centre on Management of Emergency Situations, set up at the Civil Protection Directorate and operating 24 hours per day. On a co-operation agreement between the Civil Protection Directorate and the Committee on the Use of Atomic Energy for Peaceful Purposes, the Emergency Centre duplicates the connection with the IAEA from 5 p.m. until 8 a.m. An instruction on the main duties of the duty operator when receiving messages has been developed.

Regulation No. 2 of the CUAEPP

"Article 4. (1) The organisations managing or using nuclear material, nuclear facilities, radioactive compounds or other sources of ionising radiation inform the CUAEPP about the cases by telex, telegram or other type of telecommunication.

(2) The notification is performed 1 hour after the occurrence of a nuclear or radiation accident when the consequences may occur outside the depopulated area.

Figure 16.1. Organisational Structure of the Permanent Commission on the Protection of the Population in Case of Disasters, Accidents and Catatrophes



(3) The notification is performed in a period of time, defined in paragraph 2 in case of any accident, where a possibility of transboundary distribution of radioactive substances exists. This information should contain the necessary data, stated in the Convention on Early Notification in Case of a Nuclear Accident."

The requirements applying to the consignee and the carrier in case of an incident during transportation of radioactive substances are defined in detail by Regulation No. 46 on Transport of Radioactive Substances of the Ministry of Public Health and the Committee on the Use of Atomic Energy for Peaceful Purposes. Measures aiming at isolation of the radioactive site and prevention of contact between the people and the spread radioactive substances are set.

The duties of the safety and health bodies concerning the development of emergency response in case of extraordinary situations are defined by the Ministry of Labour and Social Policy Regulation No. 3/27.07.1998 on the functions and objectives of the officials and the companies' specialised services related to the activities on protection and prevention from professional risks (promulgated D.V. No. 91/1998).

Council of Ministers Resolution No. 53 on Increasing the Country's Radiation and Chemical Protection, the Nuclear and Radiation Safety of the Kozloduy NPP and Other Nuclear Reactors (non-promulgated)

According to this Resolution the competent authorities are committed to develop guidelines on the duties of the Ministries, authorities, business organisations, regional and municipal authorities concerning the notification and protection of the population, material assets and the environment in case of radioactive contamination. Their duty is also to develop standards for the permissible content of technogenic radionuclides in the air, water, foodstuffs and fodder, and for the public exposure (internal and external), depending on the season, age, nutrition regime and the actual radiation situation. Following this Resolution ten laboratories for gamma-spectrometric analysis were established in 1988. Nine of them are regional ones in the cities of Sofia, Bourgas, Varna, Vratza, Blagoevgrad, Pleven, Plovdiv, Rousse and Haskovo, and one central laboratory in Sofia. These laboratories are established within the territorial divisions "Radiation Hygiene" of the Hygiene-Epidemiological Institute of the Ministry of Health, Regional Inspections on Environmental Protection and Water of the Ministry of Environment and Water, and the Regional "Hydrology and Meteorology" Departments of the Bulgarian Academy of Science. The Civil Protection Directorate carries out the methodological management of the laboratories' activity and obtains information from them regularly.

Resolution No. SB-6/07.07.1992 of the Permanent Commission

In case of radiation incidents and accidents the Permanent Commission establishes a system for public protection in case of a radiation emergency situation. A "Temporary Instruction on Interconnection between the Specialised Bodies and Teams of the Permanent Commission in Case of a Radiation Accident" and an "Instruction on Putting into Effect the System for Public Protection in Case of a Radiation Emergency Situation" were developed for its functioning. The updating of the system and its broadening by new teams is foreseen.

The issues concerning the organisation, individual member's obligations and financial insurance of the emergency preparedness in case of accidents (including radiation), natural calamities and catastrophes are regulated additionally by the Act on Assistance in Case of Public Disasters, Act on Local Self-Government and Local Administration (promulgated in the D.V. No. 77/1991), Act on Healthy and Safe Conditions of Work, Civil Defence Decree No. 265 (promulgated in the D.V. No. 14/1978), Act on Ministry of Internal Affairs, Act on the Municipal Budgets (promulgated in the D.V. No. 33/1998), Council of Ministers Ordinance No. 431/1997 on Definition of the General Functions, Structure and Number of the Regional Administration (promulgated in the D.V. No. 112/1997), Council of Ministers Ordinance No. 212/10.11.1993 on the Organisation of the Twenty-four-hour Duty on Notification in Case of Calamities and Large Industrial Accidents (promulgated in the D.V. No. 98/1993), Council of Ministers Ordinance No. 27/04.06.1984 on the Liquidation of the Consequences of Calamities and Large Industrial Accidents (promulgated in the D.V. No. 48/1984), Council of Ministers Ordinance No. 45/ 30.12.1988 on the Approval of Legislative Documents on the Civil Protection of the Republic of Bulgaria, Regulation No. 0-35 of the Ministry of Health and Ministry of Internal Affairs on the Work with Radioactive Substances and Other Ionising Radiation Sources (promulgated in the D.V. No. 60/1974).

International Conventions and Agreements in the Field of Emergency Planning Signed by the Republic of Bulgaria

- Convention on Transboundary Contamination from Industrial Accidents;

- Agreement between the Republic of Bulgaria and the Russian Federation on Co-operation in the Field of Preventive Activity for Prevention and Mitigation of the Consequences from Industrial Accidents, Catastrophes and Natural Disasters and Liquidation of their Consequences;

- Agreement between the Governments of the Republic of Bulgaria and Romania on Co-operation in the Field of Civil Protection (approved by a Council of Ministers Resolution No. 542/04.06.1996);

- Memorandum on Agreement on the IAEA Project RER/9/050 "Approximation of the Emergency Planning in Case of a Radiation Accident at a Nuclear Facility in the Countries of Central and Eastern Europe" (written adherence in November 1997);

- Agreement between the Governments of the Countries of the Central European Initiative on the Forecasting, Remediation and Prevention of the Consequences of Natural Disasters and Industrial Accidents (approved by a Council of Ministers Resolution No. 160/30.01.1997 and its entering into force is expected);

- Contract on Co-operation in the Field of the Preventive Activity and Liquidation of the Consequences of Natural Disasters and Industrial Accidents, between the Countries of the Black Sea Economic Co-operation, signed by the Head of the Civil Protection Directorate in April 1998 (its entering into force is expected);

- Convention on Early Notification in Case of a Nuclear Accident;

- Convention on Assistance in Case of a Nuclear Accident or Radiation Situation.

16.2. Emergency Planning

Emergency Planning Objectives and Levels

The development of emergency plans aims at reduction of the risk from accident occurrence and mitigation of its consequences, prevention of strong deterministic effects and reduction of the risk from occurrence of stochastic effects to a reasonably achievable level. The emergency planning is carried out on the level of nuclear facility operator, governmental bodies and on international level.

Accidents' Classification

The following classification of accidents is used in the National Emergency Plan:

- general accident - discharge or possibility of such one, requiring the performance of immediate protective measures outside the limits of the site;

- local accident - significant reduction of the safety level for the population and/or the site personnel;

- preparedness - decrease of the safety level or unclarified events, requiring preparedness increase or analysis.

Emergency Planning Areas

For most of the types of accidents the emergency planning zones are as follows:

- territory of the site;

- area for preventive protective measures - corresponding to the accepted 3 km depopulated area of the Kozloduy NPP;

- area for urgent protective measures. Emergency plans are developed for this particular area aiming at providing shelter, evacuation, iodine prophylactics, etc. This area corresponds to the accepted 3 km area for emergency planning at the Kozloduy NPP;

- area for long-term protective measures. Preliminary preparation of effective implementation of the protective measures on dose limitation from long-term exposure as a result of deposition and consumption of contaminated foodstuffs is carried out on this territory. In Bulgaria this area is defined as belonging to the emergency planning area, without definition of its dimension (it depends on the gravity of the accident).

Organisation of the Emergency Planning

Each site that uses atomic energy develops emergency plans in conformity with the requirements of the CUAEPP Regulation No. 5, Article 39, Ministry of Health and Ministry of Internal Affairs Regulation No. 0-35, Article 30 and Rule on the Organisation and Activity Related to the Prevention and Liquidation of the Results from Disasters, Accidents and Catastrophes.

The following plans have been developed and approved:

- "Plan on Performance of Rescue and Other Urgent Activities and Protection of the Public and National Economy in Case of an Accident at the Kozloduy NPP" - Part VI of the National Emergency Plan;

- Emergency plans for sea, air, river, railway and land transport of spent and fresh nuclear fuel (in compliance with the Ministry of Public Health and Committee on the Use of Atomic Energy for Peaceful Purposes Regulation No. 46);

- Emergency plan for the Kozloduy NPP site.

- Emergency plans of the local administrative and local self-governmental bodies, Ministries and authorities have been developed in accordance with Part VI of the National Emergency Plan.

- Part VII "Action in Case of Transboundary Contamination" of the National Emergency Plan is under preparation.

16.3. National Emergency Plan

The last updating of the National Emergency Plan was approved by a Resolution No. SB-3/22.05.1996 of the Permanent Commission.

The duties, responsibilities and rights of the Ministries and authorities involved in the activities in case of a radiation accident are regulated in details in the National Emergency Plan. A temporary instruction on the co-operation between the specialised bodies and teams of the Permanent Commission in case of a radiation accident at a nuclear facility inside or outside the borders of the Republic of Bulgaria has been developed as an annex to the National Emergency Plan.

The National Emergency Plan contains 14 chapters and 42 annexes on the different activities, assessments, references and data. From forecasting the results of a possible accident have been defined the following measures:

- counteraction pathways;
- organisation of the internal and external radiation control;
- planning and organisation of the protective measures in the emergency planning areas;
- ensuring operation of the control system;
- use of protective measures, means for iodine prophylactics and organisation of the medical assistance;
- preparedness of the population living in the emergency planning area for life and work in conditions of increased radiation.

Radiation Reconnaissance and Radiation Control

A procedure on performance of reconnaissance and radiation control has been developed and the following systems have been established:

- national automated system for constant monitoring of the radiation background in the Republic of Bulgaria. The system comprises of 26 control sites and a mobile station, equipped with meteorological stations;
- departmental system for external monitoring of the Kozloduy NPP, including also meteorological stations;
- sites for radiation surveillance and notification of the local administrative and local self-governmental bodies by the Civil Protection Directorate;
- departmental monitoring sites to the Ministry of Health, National Institute on Meteorology and Hydrology - Bulgarian Academy of Sciences, etc.;
- system of laboratories for qualitative and quantitative gamma-spectrometry analysis.

Public Protection Measures

In case of a severe accident the Kozloduy NPP organises and performs differentiated protection of the population living in the emergency planning zone by sheltering it in protection facilities or specialised compartments, evacuation, utilisation of individual protection means, performance of iodine prophylactics and sanitary-protective activities, limitation the use of contaminated foodstuffs and water, and implementation of other limitation measures.

A "Criteria on Decision Making Concerning the Implementation of Public Protective Measures in Case of an Accident in the Nuclear Reactors" have been developed aiming at conducting public protection activities.

On a signal for a radiation accident at the Kozloduy NPP the population living in the emergency planning area is sheltered in the coverts, built and equipped specially for this purpose, anti-radiation shelters and air-tight premises of the residential and business area. Instructions on the preparation of the residential and business premises for utilisation as shelters have been distributed among the population.

The inhabitants of the area contiguous to the emergency planning one takes shelter according to additional procedures given by the Permanent Commission on Protection of the Population in Case of Disasters and Accidents.

According to the plan the evacuation is performed in the several stages:

- concerning the inhabited areas, located on the distribution track of the radioactive cloud after clarification of the real radiation situation;

- concerning the rest of the population living in the emergency planning area, evacuation is carried out depending on the situation;

- concerning the population living outside the emergency planning area selected evacuation is performed depending on the extent of the radiation contamination and on a Permanent Commission's decision.

In the inhabited areas the evacuation activities are lead by the local administrative and local self-governing bodies. The evacuation activities are managed according to the evacuation routes passing the radiation control check points, traffic control posts, integrated check points located on the emergency planning area border, etc.

The long-term surveillance of the wind rose has been used as a criterion for the selection of evacuation routes. Two options for evacuation of the population and the Kozloduy NPP personnel from the Kozloduy NPP emergency planning zone and its contiguous one are developed.

The evacuation of the Kozloduy NPP personnel takes place on the order of the Head of the Emergency Measures at the NPP in accordance with the Kozloduy NPP emergency plan.

Instructions on taking of iodine pills by the population have been developed. The chemical compound (potassium iodine) is stored by the self-governing bodies. The beginning and duration of taking pills is defined by the Ministry of Health. The Civil Protection Directorate, the local administrative and local self-governmental bodies are responsible for the storage and distribution of the potassium iodine pills. Each package has enclosed an instruction on pills use in Bulgarian.

Except the iodine pills, for the protection of the Kozloduy NPP personnel and the population living in the emergency planning area there are individual means for protection of the respiratory organs (civilian gas masks with iodine filter, respirators, children's gas masks and children's protective cameras). Periodical replacement of the individual protective means is foreseen after the guarantee period runs out. The protective means are kept at people's houses.

Pre-medical, medical and specialised medical aid for the Kozloduy NPP personnel is organised. The injured staff receives sanitary and medical aid from the Kozloduy NPP sanitary teams and the site medical service. Afterwards these workers are transported to the interim station for injured people. If necessary, from that point they are evacuated and receive specialised medical aid and are hospitalised. A radiological team and a team on burns are trained for this purpose.

The emergency teams, envisaged to work in the emergency planning area are also equipped with gas masks, respirators, protective clothes, protective socks and gloves.

There are individual means for the protection of the respiratory organs of the population living in the contiguous zone of the emergency planning one.

Periodical replacement and renewal of the distributed means, including the outdated is foreseen.

Farm Animals and Crop Protection

The protection of farm animals is carried out by sheltering and evacuation of the animals of the radioactively contaminated zones. Procedures have been developed for this purpose.

The animals and the crops are protected according to the type and season. The animals and the crops contaminated with radioactive compounds is assessed by the of the National Veterinary Service to the Ministry of Agriculture, Forests and Agricultural Reform and by the Hygiene-Epidemiological Institute to the Ministry of Health. For this purpose the results

obtained form the tests performed at the laboratories for gamma-spectrometry analysis of other Ministries and authorities are also used. Instructions on foodstuffs treatment and consuming in case of a radiation situation have been developed for the public.

Food and Water Supply

Procedures on food and water supply for the population are foreseen. Isolation of the facilities of the water supply system in the emergency planning area is also foreseen. The Ministry of Territorial Development and Public Utilities organises mobile and stationary water supply stations ensuring pure drinking water for the emergency teams, the evacuated population and the farm animals.

Plan Activation Order

After a radiation accident occurrence at the Kozloduy NPP the emergency plan is implemented by the emergency measures manager, who takes the responsibility for compliance with all measures stated in the plan.

The National Emergency Plan implementation is carried out on a Council of Ministers decision proposed by the Chairman of the Permanent Commission.

On the Permanent Commission Chairman's order the plans of the Ministries, authorities and regions are implemented by their corresponding managers (the Chairmen of the Permanent Departmental Commissions).

Following the orders of the Chairmen of the Permanent Regional Commissions of Montana and Lovetch the mayors of the municipaities, the boroughs in the emergency planning area and those of Vidin, Montana, Vratza and Pleven set into readiness the territorial forces and establish a team for rescue and emergency activities; organise the location of the integrated raddiation control check points and conducting of strict radiation control; organise and manage the activities related to the evacuation of the population and farm animals from the emergency planning area and their settlement in the primary, and if necessary, in the reserve areas.

The order and responsibilities on collection and submission of information on the quantity, content and distribution of the released radioactive substances, analysis, radiation situation assessment and a proposal for a decision at an early stage of the radiation accident are described in an Annex to the National Emergency Plan.

International Commitments

The Republic of Bulgaria has signed the Convention on early Notification of a Nuclear Accident. The Committee on the Use of Atomic Energy for Peaceful Purposes is assigned as a competent authority on the fulfilment of the obligations under this Convention and for this reason there is an Emergency Response Centre as a part of its organisational structure (see Article 8). According to the bilateral agreements on Exchange of Information on the Nuclear Facilities and Notification of a Nuclear Accident between the Governments of the Republic of Bulgaria and Romania, Turkey and Greece, the Committee on the Use of Atomic Energy for Peaceful Purposes has submitted the required information and has established the necessary means of notification.

A copy of the notification text is consigned by the Ministry of Foreign Affairs to the diplomatic missions accredited in the Republic of Bulgaria.

Public Relations

In case of an accident at the NPP the population is periodically informed about the situation development and receives directions on the appropriate behaviour and actions through the mass media. The content of the broadcasted information and the instructions is defined by the official Permanent Commission speaker and the relevant Commissions and local governmental bodies.

The Bulgarian National Radio and Television ensure the possibility for on-line information in air by direct channels at any time of the day or night.

Except by the radio and television broadcasts, the population living in the emergency planning zone is informed by the local radio-transmissions immediately. For this reason after an accident occurs instructions, examples on behaviour and personal protection prepared beforehand are immediately broadcast. These materials are stored at the radio stations of each of the areas in danger. The transmission is broadcast with the approval of the Permanent Regional Commission. This Commission can also update the information in accordance with the situation development.

Measures on Training and Acquainting with the Emergency Plans

The measures on training and acquainting with the emergency plans include the following:

- conducting of regular training of the Kozloduy NPP workers and personnel, population living in the emergency planning area on civil protection issues. Information on the

consequences, protection and public behaviour in case of an emergency at the NPP is periodically disseminated by distribution of booklets, brochures, posters, radio and television;

- conducting of annual training of the executive staff of the permanent site, municipal, regional commissions and the Permanent Commission on the implementation of the plans;

- conducting of annual training of the Kozloduy NPP personnel and the population living in the emergency planning area with the participation of the management bodies.

The training on civil protection is carried out on several levels:

- training of the officials of the local self-government and local administration bodies, as managers of the corresponding permanent commissions, on public protection in case of disasters and accidents;

- training courses for the specialists of the Civil Protection bodies on the territory of the Republic of Bulgaria and seminars abroad;

- training of the population on behaviour and actions in case of disasters and accidents.

The Civil Protection Directorate participates in the international programmes on increasing the nuclear and radiation safety. Several projects are on the way related to the delivery of specific equipment (dosimeter apparatus, communication means, etc.).

During the last two years the Republic of Bulgaria actively participates in international training activities on emergencies at nuclear power plants “INEX” (International Nuclear Exercises), organised by the Organisation on Economic Co-operation and Development.

16.4. Kozloduy NPP Emergency Plan

The emergency plan of the Kozloduy NPP is the basic guidance on action in case of an emergency at the NPP. The plan has been developed on the basis of the “Rule on the Organisation and Activity Related to the Prevention and Liquidation of Consequences from Disasters, Accidents and Catastrophes”, the Convention on Assistance in Case of a Nuclear or Radiation Situation and the IAEA recommendations.

The objective of this plan is to create an organisation that guarantees the maintaining of constant emergency preparedness of the Kozloduy NPP personnel for carrying out localisation, rescue and other urgent activities in case of an accident at the Kozloduy NPP.

The emergency plan sets an organisation different from that existing during normal operation and defines also the order of activities in case of:

- beyond design accidents;

- events which may lead to accident’s development not foreseen in the design;

- extraordinary events as a result of a human activity outside the Kozloduy NPP site, natural disasters, fires, etc.

The radiation accidents, characterised by deviations from the limits for radiation impact on the personnel and the environment as defined in the legislative documents are a subject to review and classification. Events without direct radiation impacts (non-radiation accidents) causing actual or potential precondition for significant decrease of the safety level of the facilities, personnel, and the environment, are also under consideration.

Emergency Response Organisation

The management of the facilities' operation is carried out by twenty-four-hours operational shifts seven days a week. These shifts are managed by the plant shift supervisor. He is responsible for the implementation of urgent measures in case of an emergency, other natural and natural disasters, as well as first aid to the injured personnel.

The Kozloduy NPP staff is trained and instructed to report to the plant shift supervisor about each condition or event that may lead to safety level decrease. This fact enables prompt classification of the events and implementation of corresponding measures in time. By actuation of the emergency plan an emergency organisation is imposed at the NPP, which includes also parts of the organisational structure during normal operation.

The imposition of the emergency organisation is accomplished on two levels, depending on the emergency conditions:

- Level A - in all emergency conditions;
- Level B - in "local accident" or "general accident" conditions only.

This emergency organisation is also based on organised and permanently maintained emergency shifts, ensuring unhindered establishment of the emergency structures. The emergency teams are created based on the permanent staff of the Kozloduy NPP.

The specific duties of the different positions according to the Emergency Plan and the order of their fulfilment are stated in separate instructions and procedures.

The following groups and teams are included in the emergency organisation structure:

Management Team

The management team reports to the Head of Emergency Activities and is mobilised in all emergency situations. The Main Control Room team lead by the plant shift supervisor performs the management team's functions until the last management team arrives. The officials who can carry out the functions of Head of Emergency Activities are enumerated in

the Emergency Plan. They are the Plant Manager, Deputy Plant Manager on Safety, Deputy Manager on Production and the of Head Nuclear Safety and Nuclear Fuel Division.

The main tasks of the management team are as follows:

- organisation of the receiving of information on the condition of the failed unit and of the operating ones;
- management of the emergency assessment activities;
- preparation for decision making on implementation of measures aiming at accident limitation and localisation, as well as public and personnel protection;
- preparation of orders of the Head of Emergency Activities for shut down or continuation of the operation of the rest of the units.

Team 1

It is established by the shift and reserve shift personnel. It has the following main duties:

- performance of the Kozloduy NPP operation according to the existing operational documents;
- performance of safety functions monitoring;
- performance of a preliminary assessment of the initial emergency events and determination of the emergency situation;
- implementation of the Emergency Plan according to the determined emergency situations and levels in case of accidents, natural and natural disasters, fires, etc.;
- management and fulfilment of the Emergency Plan's activities until the emergency structures' establishment;
- notification and information of the personnel, the population and the competent state bodies on local and national level;
- organisation and implementation of the urgent emergency measures aiming at protection of the personnel;
- performance of activities on accident management;
- performance of personal monitoring of the shift staff;
- performance of urgent emergency and remediation activities.

Team 2

This team reports to the Head of Radiation Monitoring. The main obligations of the team are as follows:

- performance of radiation monitoring, recording keeping of the results and duly reporting to the Head of Emergency Activities;

- data analysis carried out by the specialised technological monitoring;
- performance of an assessment of the radioactive source;
- carrying out of forecasts on the radiological consequences at an early or intermediary emergency stage;
- preparation of proposals for personnel protective measures;
- organisation and control of the activities related to the planned increased exposure of the emergency staff;
- performance of control and ensurance of the implementation of the mandatory measures on individual protection until the elimination of the emergency;
- setting of fences, markings and signs for radiation danger;
- assessment of the necessity for performance of decontamination activities.

Group for Analyses and Forecasts

The group for analyses and forecasts is established during an emergency as a consultative body to the Head of Emergency Activities. It is not authorised to make decisions for execution by the staff or other emergency structures. The main duties of the group are as follows:

- obtaining information and monitoring of the facilities condition;
- carrying out of periodical classification of the emergency situation during the emergency development;
- performance of the necessary engineering analyses;
- preparation and proposal of measures on the emergency management;
- ensuring of the necessary support to the Team 1 staff;
- carrying out of consultations with external supporting organisations.

Group on Technical and Information Support of the Emergency Management Centre

The Group on Technical and Information Support of the Emergency Management Centre is established during the accident and is located at the Emergency Management Centre (EMC). It comprises of specialists on telecommunications, computer information systems, engineering facilities maintenance and a doctor. The group's main duties are as follows:

- ensuring of communication connections;
- ensuring of reliable operation of the EMC information system;
- maintaining of the necessary operational conditions for the emergency teams;
- ensuring of pre-medical aid to the emergency team personnel.

The structure of the emergency response authorities includes also the following services related to the implementation of the Emergency Plan:

- Regional Fire and Emergency Department;
- Specialised Police Security Team;
- Medical Service;
- Road transport.

The EMC is built at the Kozloduy NPP site. Its objective is to ensure the necessary conditions for the management bodies operation. The centre has a connection with the regional and national bodies - the Kozloduy Municipal Council, the Regional Council in Montana, the Central Dispatcher Department of the National Electric Company PLC. and the Permanent Commission. The EMC has an independent electronic central telephone exchange (100 users), short wave and FM radio stations. The external power supply is backed-up one and there is independent supply by a diesel generator (35 kW). It is equipped with an independent filter-ventilation system which has the capacity to operate also in total isolation with independent water supply and sewerage system backed-up with service water. Entry pass control regime is established and the possibility of decontamination of people is foreseen. The EMC is equipped with means for technological, radiation and meteorological monitoring, programme and technical means for assessment, prognosis and visualisation of the situation. Each EMC working place has the necessary technical and operational documentation. The EMC has an emergency store, medical station, and a store for foodstuffs and water.

The conditions for announcement of the end of the emergency situation are described in detail in Item 8 of the Emergency Plan.

Emergency Training

The training activities are carried out according to a programme developed and approved in advance. The scenarios developed for the training activities are used in the training performance of all shifts. The objective of this training on response actions in case of an emergency is to control and maintain the personnel preparedness for adequate actions in case of an emergency at the Kozloduy NPP.

During the plant emergency training of all stations the following is checked:

- operational preparedness of the shift staff for correct and strict actions in case of an eventual radiation accident;
- preparedness of the Management Team, Analyses and Forecasts Group and the teams for fulfilment of the current plan in case of an emergency situation;

- speed and accuracy of the activities, organisation, co-ordination and interaction between the emergency structures;

- functioning of the systems for communication, notification and management in case of a non-radiation and radiation accident;

- preparedness and possibility for duly sheltering of the personnel with a subsequent transportation to the town of Kozloduy;

- technical condition and working capacity of the foreseen emergency-technical protective means;

- co-operation and co-ordination with the external organisations and authorities;

- functional and practical value of the developed plan on the personnel protection in case of an eventual accident at the NPP;

- preparedness and abilities of the NPP personnel for quick orientation and cool actions in case of an emergency situation;

- specific knowledge and skills of the NPP personnel, its practical capabilities for actions in case of a complicated emergency situation.

The plant training activities are performed according to a programme prepared by the Management Team in advance. This programme is detailed and comprehensive and describes the specific activities at each step of a certain scenario. For this purpose a group is appointed by the Head. The precise day and time of the training are not specified in the programme. They are defined by the plant Manager or his Deputy. The plant training activities are organised and carried out by the Management Team. After each plant activity in ten days time the Management Team analyses and points out in a report the activities on elimination of the weaknesses and shortcomings identified.

The assessment of the emergency training is made by an expert commission, established for this purpose by the plant Manager. This commission can include representatives of the Committee on the Use of Atomic Energy for Peaceful Purposes, Civil Protection Directorate, Committee of Energy and National Electric Company - PLC.

The updated Emergency Plan of the Kozloduy NPP was adopted by a technical council on 29.07.1998, with the participation of the regulatory and state authorities. It is under approval at the present moment.

16.5. Planned Activities

Two drafts of documents with high hierarchy level have been developed for the emergency planning purposes.

Act on Civil Protection. This Act is in a process of adoption by the National Assembly. It is expected to regulate the Civil Protection issues in the Republic of Bulgaria as a system of humanitarian measures on protection of the public and property, as well as for support of the population in times of peace and war.

Regulation on Emergency Planning and Preparedness in Case of a Radiation Accident. The Regulation has been developed by the CUAEPP. Its objective is to establish the responsibilities of the state bodies, local administrative bodies, local self-governmental bodies, nuclear facilities' operators and legal entities on the planning of activities in case of an accident at the Kozloduy NPP with discharges of radioactive substances into the environment or in the case of a transboundary transference of radioactive substances on the territory of the Republic of Bulgaria. The Regulation will update the criteria for decision making on implementation of measures for protection of the population in case of a radiation accident, as well as the requirements to the emergency plans and the National Emergency Plan. It is also consistent with the IAEA Project RER/9/050. The Regulation has been approved by the Ministries and the authorities related to emergency planning. The document is to be submitted to the Council of Ministers for approval.

The maintaining of constant emergency preparedness for action in case of a radiation accident at nuclear facilities is legally regulated, clearly defined and a purposefully implemented state policy in the Republic of Bulgaria. The emergency plans are constantly updated taking into account the international safety standards and practice on approximation of the emergency planning.

From the above mentioned facts follows the conclusion that the Republic of Bulgaria meets the requirements set in Article 16 of the Convention on Nuclear Safety.

Article 17 - Siting

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

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

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

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

(iv) for consulting the 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."

17.1. Legislative and Regulatory Basis

There have not been special normative acts at the early stage of activities on siting of nuclear facilities in the Republic of Bulgaria. The documents and good practice valid for siting of standard energy installations have been used, taking into consideration the NPP specificity. The normative acts of the former USSR from the 60s have been implemented. These provisions are supplemented by Article 20 of the Act on Public Health and Paragraph 6 (3) of Article 21 of Regulation No. 7 of the Ministry of Health concerning the hygiene requirements on health protection of the inhabited environment. In addition the available IAEA documents are used. The experience gained together with the legal procedure existing at that time foreseeing numerous stages of study and approval by practically all state institutions, ensured adequate siting.

During the 70s the siting was performed according to the following main soviet normative acts:

- Standard CPK - 1571 - 0/1973 on site selection for construction of power plants (thermal power plants and nuclear power plants);
- Directive No.2688-27 of 1973 on the content of the seismic information;
- Interim standards WSN 15-78 on design of nuclear power facities in seismic regions.

Later the IAEA documents No. 50-SG-S1 to S12 became the basis of the Regulation No. 3 and Regulation No. 5 developed by the Committee on the Use of Atomic Energy for Peaceful Purposes, regulating the requirements on siting stage and the procedure of its licensing. These provisions are supplemented by the Act on Environmental Protection providing for environmental impact assessment of the installations, as well as by the "Basic Standards on Radiation Protection", where the public and occupational exposure levels are regulated.

Article 5 of Regulation No. 3 of the Committee on the Use of Atomic Energy for Peaceful Purposes states: *"The NPP safety is ensured mainly by: 1. the selection of an*

appropriate site". According to Article 8 of Regulation No. 5 of the Committee on the Use of Atomic Energy for Peaceful *Purposes "(1) The organisation applying for a license for siting aiming at construction of a nuclear facility based on the researches performed develops general characterisation of the nuclear facility and the appropriate sites, and submits "Safety Analysis Report" as well. (2) Referring paragraph 1 the "Safety Analysis Report" contains the following data and substantiation: 4. protection against discharges of radioactive substances into the environment during normal operation and maximal design basis accident ...; 5. characterisation of each site in extent defined in Chapter III of Annex 1; 6. comparison of the proposed sites from nuclear safety and radiation protection point of view".* Chapter III of Annex 1 of this Regulation describes in detail the content of the information necessary for assessment of the site's suitability - geography, demography, human activity, meteorology, hydrology and hydrogeology, geology, geotechnics, seismics. Paragraph 1 of Article 9 of the Regulation states that: *"License for siting is issued only when the safety assessment related to the site complies with the requirements defined ... and is proved that: ... 2. the site characteristics, events and phenomena that may influence the design are defined; ...".*

17.2. Siting for NPPs in the Republic of Bulgaria

Kozloduy NPP Site

The limited reserves of energy resources in the Republic of Bulgaria represent a motivation for the nuclear energy development. A report on the expedience of construction of a nuclear power plant was prepared at the beginning of 1965. The results cited in this report show that the nuclear power plants are competitive to the thermal power plants on imported fuel and to the imported electricity indicators.

Energoproject PLC (Sofia) performed the research on selection of a NPP site based on the technical and economical substantiation with the assistance of specialists from the former USSR. The assessment methods and criteria of the former USSR in force at that time were mainly used.

In 1966 the governments of Bulgaria and the former USSR signed an agreement on the construction and operation of a nuclear power plant of 800 MW capacity rate based on these research activities. A contract on technical assistance on siting and development of the technical specification for design was signed the same year also.

Thirty-two sites from the whole country were considered at the preliminary research stages. Water supply was considered as an essential factor at that time. Detailed technical and economical comparisons were made of 8 sites during the joint work with soviet specialists.

The results obtained from the studies carried at that time gave a definite conclusion, that the NPP should be constructed on the Danube river bank, which ensures the lowest operational expenses.

According to the legislative basis in force at that time the statements of the Committee on the Use of Atomic Energy for Peaceful Purposes to the Council of Ministers, the Bulgarian Academy of Sciences, etc. were required for the continuation of the NPP construction activities.

In April 1967 the Kozloduy site was considered as the most suitable one. The same year a contract for the development of a technical design was signed with the former USSR.

According to the rules and data on seismic regional characterisation of the territory of the Republic of Bulgaria in force during the 70s, the seismicity of the Kozloduy region was categorised as 5^{th} grade on the MSK-64 scale. After the earthquake at Vrantcha (Romania) investigations on re-qualification of the site started. The maximum ground acceleration (PGA) of 0.1 g was defined and on this basis complete control over the building structures, the equipment and the pipelines was carried out. In 1978-1979 the projects on antiseismic strengthening of units 1 and 2 were developed. Also a system for industrial antiseismic protection by the "Kinematrix" company was implemented in 1980.

In 1990 a mission of IAEA experts took place at the Kozloduy NPP and Belene sites. An Extensive Programme on Additional Studies and Activities for Increasing the Safety of the Kozloduy NPP and Belene sites" (further on referred to as a programme). Its objective was to supplement the performed and on-going surveys, research and evaluations on the impacts of the external conditions, as well as the possible impacts of the NPP over the region and its population. The programme includes performance of surveys, researches and assessments in the field of seismology, and seismic ensuring, meteorology, demography, hydrology, radiation safety and human activity (Annex 6).

The analyses were carried out by the Bulgarian Academy of Sciences and the Energoproject PLC as part of the IAEA Project BUL/9/012. The work was performed in accordance to the IAEA programme for the 1990-1995 period. The activities were managed and controlled by the IAEA experts following a methodology approved by them and all developments were reported and discussed.

The new seismic characteristics of the site were specified in 1992. They are used for assessment of the seismic capacity of the existing building structures and units' systems, spent fuel storage facility and radioactive waste treatment plant. These characteristics were approved by the IAEA experts during special review missions on the seismic safety of the Kozloduy NPP and Belene NPP sites and concluded in the IAEA-TA-2460 Report and IAEA-

TA-2496 Report. In 1994 an IAEA review team revised the results of some activities aimed at fulfilment of the IAEA recommendations made in June 1990 (IAEA-TA-2460 Report). The mission experts pointed out that significant development on demonstration of the existing safety margins in all fields was achieved.

As a result of the implemented programme the following main activities were carried out:

- updated NPP emergency plan was developed;
- system on industrial antiseismic protection was modernised;
- system of accelerographs on seismic control over the equipment and buildings was established;
- local seismologic network was established;
- automated system on meteorological surveillance was set up;
- automated system on external monitoring was set up.

(The establishment of an automated system on meteorological surveillance at the Belene site was recommended).

The seismic strengthening of the building structures, systems and components of the units 1 to 4 is being carried out. The necessary strengthening of units 5 and 6 is included in the Modernisation Programme.

The results obtained from the studies performed in different fields of the programme confirm the fact that the Kozloduy NPP site cannot be overflooded, even if the Zhelezni vrata dam on the Danube river is ruptured. The research on the dispersion characteristics of water and soil aimed at analysis of the possible radionuclides migration pathways show that every time radionuclides reach the acquifer the water layer contamination could cover only a one kilometre zone for a period of 200 years. The studies of the impact of the human activity and infrastructure on the site's region show that there are no sources endangering the NPP safety. No extreme natural phenomena such as hurricanes, tornado, tidal waves, etc. are observed.

An air corridor free of flights was ensured over the NPP site in 1991, aiming at prevention of aircraft collision.

On the adoption of the Act on Environmental Protection and Regulation No. 4 of the Ministry of Environment and Water, the following reports on environmental impact assessments were prepared:

- units 5 and 6 - operational stage;
- radioactive waste treatment plant - design stage;
- storage of the conditioned radioactive waste - design stage;
- extension of the auxiliary buildings 2 and 3 - design stage.

According to a resolution of the Ministry of Environment and Water, the development of an environmental impact assessment report of the Kozloduy NPP complex is foreseen.

Belene Site

The studies on selection of a second NPP site started at the beginning of the 70s in parallel with the analyses on the possible extension of the Kozloduy NPP. A complex of factors was analysed based on the former USSR normative acts in force at that time. Twenty sites were investigated until 1979 and divided according to their location into the following three groups:

- on the Danube river bank (14 sites);
- on the Black sea coast (7 sites);
- in the interior of the country (4 sites).

Several potential sites were excluded along the investigation process because of the negative factors. Nine sites - 4 on the Danube river bank, 4 on the Black sea coast and one in the interior of the country were defined. The sites selected on the Black sea coast were not coordinated with the competent authorities. In compliance with the additional studies on the geology, seismicity, engineering preparatory measures, organisation of the electricity transfer, buffer zone, radiation characteristics, etc. three sites, located on the Danube river bank were considered as the most promising ones.

The following main conclusions were drawn from the analyses performed on the rest of the sites:

- group of potential sites, located on the Danube river bank are well studied from engineering and geological point of view; drilling investigations were performed in a 200 x 200 m net with the necessary complex and laboratory studies; the geological structure of the three sites is analogous;

- underground water level is from 0.00 to 3.00 m from the surface and directly depends on the hydraulic connection with the Danube river;

- Belene site is located on a large crust, where there are no active faults. The other two site are located near the Upper-Ablan fault zone; all sites are situated in a region with equal seismicity and according to the map of seismic characterisation of Bulgaria with a seismic coefficient of 0.15 corresponding to 8^{th} grade on the MSK-64 scale;

- according to the territorial parameters Belene site is the most appropriate one, located 7.5 km from the Romanian border, as the rest of the sites are respectively 1.5 - 1.6 km. The demographic parameters of the Belene site are more favourable than the average for the whole country;

- concerning the engineering works on the site, NPP general plan development and the set up of regional communications, the Belene site is the most favourable.

On 20 March 1981 the Belene site was approved for construction of a second NPP by a Council of Ministers Ordinance No.9.

On suspending the Belene NPP construction, in 1990 two independent expertises on the site's seismic stability were required by the Bulgarian Government. The first one was accomplished by Westinghouse (USA) together with EQE (San Francisco). The second expertise was performed by Siemens in co-operation with the Institute on Earthquake Engineering and Seismology (Skopje).

The analysis carried out by Westinghouse defined a seismic coefficient a = 0.21 g, calculated by using the conservative approach. The analysis performed by Siemens defined a seismic coefficient p = 0.163 g. A coefficient a = 0.20 g was used in the Technical Project. The specialists from the Skopje Institute stated that the Belene site was one of the most appropriate sites in Bulgaria from seismic and tectonic point of view.

On a proposal by the IAEA (Project BUL/9/012) a programme on the performance of additional investigations was developed aiming at clarification of the site data (Annex 6).

The results obtained from these studies were submitted to the IAEA, revised and approved, except the seismic stability analyses. The developments on seismic stability were elaborated further and presented to the IAEA at the end of 1994. The general conclusion made by the IAEA experts was the following:

"The conclusions derived from the results of the review performed in June 1990 confirm that from seismic, tectonic and seismic hazard point of view there are no parameters that may eliminate the construction of a NPP. The additional measures pointed out as a result of this discussion could supplement the already accomplished work and will demonstrate in a confident way the site's seismic stability concerning the proposed main design seismic parameters."

The results obtained from this set of research activities on geology, tectonics and seismicity of the site and the region were discussed and confirmed by the last and final IAEA mission that took place in Sofia in 1997. The necessity of additional geological data on the existence of local seismic centres, assumed by scientists of the Bulgarian Academy of Science is taken into account. Such data could clarify whether the accepted maximal amplitudes of the seismic characteristics are conservatively increased and could not initiate neotectonic phenomena.

17.3. International Agreements

Bilateral agreements exist between the Government of the Republic of Bulgaria and the Governments of Romania, Greece and Turkey on the early notification of a nuclear accident and exchange of information on the nuclear facilities. According to these agreements the Contracting Parties notify each other when construction of new nuclear facilities are envisaged and also provide the necessary technical information on these facilities.

From the above mentioned facts follows the conclusion that the Republic of Bulgaria meets the requirements of Article 17 of the Convention on Nuclear Safety.

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 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."

18.1. Regulatory Basis

The design and construction of the Kozloduy NPP units were performed in different periods of the nuclear energy technology development and under the following specific conditions:

- design and construction were carried out continuously from 1967 until 1990. The normative requirements on safety assurance have been amended several times during the whole work process;
- construction was performed on the basis of approximated designs;

- political framework limiting the delivery of technology and equipment mainly from the former USSR and the countries members of the former Council for Mutual Economic Assistance (COMECON).

Regulation No. 3 of the Committee on the Use of Atomic Energy for Peaceful Purposes is the main document in force in Bulgaria that regulates the general requirements on safety during design, construction, and operation of a NPP. This Regulation provides for:

"Article 3. A NPP is considered safe when ... it is ensured that the defined public and occupational dose limits from internal and external exposure and the standards on radioactive substances content in the environment are not exceeded during normal operation and design basis accidents";

"Article 12. Safety systems should be provided for in the design of a NPP, aiming at:

1. reactor emergency shut down and its maintening in subcritical condition;

2. emergency heat removal;

3. maintening of the radioactive products in the defined limits";

"Article 25(2) The core and the other systems should be designed in such a way that excludes exceeding of the defined limits for fuel rods damage ...";

"Article 28. At least two independent systems ... for control over the reactivity are foreseen and it is desirable to be based on different principles";

"Article 35. The whole primary circuit equipment and pipelines should resist the static and dynamic loads and temperature effects without damages ... in case inadvertant energy transfer into the primary circuit coolant ...";

"Article 44(1) Control safety systems should be provided for fulfilling the automatic actuation of the protective, localising and supply systems, as well as control of their operation.

(2) The automatic control systems ... prevent or liquidate the protection systems through conditions leading to fuel rods damage over the design limits."

"Article 58. Localising systems on keeping the released radioactive substances during an accident within the design basis limits should be provided for at the nuclear power plants."

The licensing regime established by the Act on the Use of Atomic Energy for Peaceful Purposes guarantees the fulfilment of the requirements (see the chapter under Article 7 of this Convention). Licenses are required also for the following stages: design, construction and commissioning. The necessary documentation, conditions, order and deadlines for issuing a license are defined in Regulation No. 5 of the Committee on the Use of Atomic Energy for

Peaceful Purposes. The documents proving the compliance with the safety principles and criteria are submitted at every stage. According to Regulation No. 5:

"Article 10(1) The organisation applying for a license on design of a nuclear facility based on the preliminary investigations performed, submits a Safety Analyses Report";

Article 11(1) The organisation applying for a license on construction based on the technical project developed, submits a Safety Analyses Report".

18.2. Design Basis of the Kozloduy NPP Units 1 and 2

The design of the Kozloduy NPP units 1 and 2 was developed at the end of the 60s (1967-1968) in compliance with the general industrial standards and branch rules in force at that time in the former USSR. The design basis measures envisaged for protection against emergencies correspond to those accepted during that period and to the principle of limited primary circuit coolant leakage related to this type of reactors. This principle is based on the assumption that appropriate materials and necessary production quality, combined with the necessary measures on operational metal control, practically eliminate the probability of ruptures of large pipelines (over 100 mm.) or sudden destruction of the primary circuit equipment. For providing for the substantiation of this principle the following is taken into consideration:

- material of the primary circuit pipelines - austenitic steel, stable against brittle destruction;
- material of the reactor pressure vessel - high strength Cr-Mo steel with high radiation and thermal resistance, as for steady-state and transient temperature conditions;
- quality assurance during construction, production and installation of the equipment, based on the state system of normative and technical acts;
- operation of the units by highly qualified personnel.

The following design and construction decisions were approved:

- absence of cuts under the inlet nozzles of the main circulation pipelines in the reactor pressure vessel;
- limitation to a minimum the number of cuts in the non-isolable part of the primary coolant system;
- insertion of on flow constrictor at the connection places between the pipelines and the main circulation pipelines;
- installation of cut-off devices at the connection places of the instrumentation pipelines;

- installation of throttled seals in the mechanisms of the reactor's control and protection system.

Based on these assumptions the coolant leakage from the primary circuit through a cross-section with equivalent diameter of 32 mm was accepted as the maximum design basis accident.

Specialised emergency systems are foreseen in the design aiming at keeping the maximum design basis accident under control. According to the specialised legislative framework developed later these systems are classified as safety systems.

The emergency systems of units 1 and 2 have the following functions:

- emergency shut-down of the reactor to subcriticality;
- ensurance of the emergency electrical supply;
- emergency cooling of the reactor core in case of coolant leakage;
- limitation and liquidation of the radiation consequences of the maximum design basis accident accepted.

The principle of redundancy was used in the emergency systems design.

The radioactive substances localising system was designed according to the defined scale of the maximum design basis accident. The criteria accepted on prevention of fuel damage in case of a maximum design basis accident ensure that even if the safety valves are opened and radioactive substances are discharged into the environment, the population dose limitswill not exceed the permitted values.

The high reliability of the fuel assemblies is accepted as a precondition for the ensuring of the safety of these units.

The designed reactor cores have negative power reactivity coefficient. The temperature coefficient of the reactivity is almost zero at the beginning of the initial fuel loadings and during further operation - negative one. These factors significantly mitigate the unfavourable consequences in case of potential accidents caused by inadvertent reactivity increase.

The analyses of the design performed later on, show that a number of positive and even advanced solutions have been used. These solutions are characterised by the:

- relatively low reactor thermal power;
- relatively low energy potential of the primary circuit coolant;
- low specific power factors of the reactor core;
- high thermal reliability indicators;
- reactor's stability against main parameters deviations from their nominal values (self-regulation);

- high primary circuit leak-tightness (leak-tight main circulation pumps, Belleville isolation armature, etc.);

- stable natural coolant circulation, enabling up to 12 % removal of the nominal thermal power;

- huge water reserve along the secondary circuit, due to the presence of horizontal steam generators in six circulation loops. This allows residual heat removal for several hours without steam generators feeding;

- long period of time until preventive intervention by the operator, aiming at a decrease of probability of faults;

- operation simplicity.

A set of improvements aiming at compensation of part of the discrepancies from the current requirements at units 1 and 2 were accomplished during the later stages of operation.

18.3. Design Basis of the Kozloduy NPP Units 3 and 4

The design of the Kozloduy NPP units 3 and 4 was developed at the beginning of the 70s in compliance with the specialised legislative and technical framework concerning nuclear installations that was being under approval at that time in the former USSR.

The legislative framework refers to the issues on ensuring of nuclear safety and radiation protection at all hierarchical levels. It also defines special requirements on the construction, production, installation and operation of the NPP equipment. The term “safety systems” at an NPP was approbated at that time in relation to the systems for ensuring the plant safety.

The main design characteristics, distinguishing units 3 and 4 from units 1 and 2 comprise of functional establishment of the safety systems into multichannel structure. Each channel is able to fulfil all design functions of the corresponding system. Although the maximal design basis accident is the same, there are two emergency core cooling systems, under low and high primary circuit pressure. Both systems have a three-channel structure. The rest of the safety systems have also a three-channel structure. Design solutions on partial territorial and physical separation of the safety systems channels exists.

18.4. Design Basis of the Kozloduy NPP Units 5 and 6

The designs of the Kozloduy NPP units 5 and 6 were developed at the beginning of the 80s on the basis of the unified with the USSR design of WWER-1000/V-320 reactor.

The project's technical specifications of units with a WWER-1000/V- 320 reactor are based on design basis accident, caused by rupture of a primary circuit pipeline with maximal diameter. The reactor and the equipment together with the radioactive coolant are placed in an airtight containment with armoured steel cladding.

The safety systems are classified into four groups according to their functions, i.e. safety, localising, supply providing and control systems. They are designed in the multi-channel structure following the principle on physical and functional independence between the channels. The passive elements are also included in the safety systems. The safety principles implemented in the design of these units comply as a whole with the provisions of INSAG-3 "Basic Safety Principles for Nuclear Power Plants".

18.5. Design Basis of the Belene NPP

The design of the Belene NPP was developed between 1980-1987 and was an analogue of the design of the Kozloduy NPP units 5 and 6. New solutions were implemented aiming at the increase of safety and reliability, such as:

- main vessels foundation on sealed ballast cushion up to 12 m thick and based on the bed rock;
- design, construction and equipment withstanding seismic effects with intensity of 8^{th} grade on the MSK-64 scale;
- improved construction and technology for building the armoured steel containment;
- improved structure of the safety channels;
- improvement of the nuclear fuel neutron-physical and thermo-hydraulic characteristics;
- implementation of improved equipment and apparatus.

Analyses and research performed later on and based on the operational experience gained, showed that other improvements without significant changes of the initially accepted general technical solutions are also possible.

Taking into account the modifications of the Kozloduy NPP units design that were accomplished, planned and presented in the chapter related to Article 6 of the Convention, from the above mentioned facts follows the conclusion that the Republic of Bulgaria meets the requirements of Article 18 of this Convention.

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."

19.1. Initial Authorization to Operate a Nuclear Installation

Article 22, paragraph 1 of the Act on the Use of Atomic Energy for Peaceful Purposes states that *"Activities relating to the use of atomic energy shall be implemented after issuance of licences by the Inspectorate on the Safe Use of Atomic Energy".*

According to Article 21, paragraph 2 of the Act on Public Health, the State bodies on sanitary control issue permission for use of radioactive substances with view of avoiding

harmful influences on the public. Article 28 of the Rule for Implementation of the Act on Public Health regulates that commissioning of facilities is performed under the written permission of the State bodies on sanitary control which are a part of the State Start up Licensing Commision, according to Article 280 of the Labour Code.

The legislative and regulatory framework of the licensing system for nuclear facilities is discussed under the text of Article 7 of the Convention.

Article 13 of Regulation No. 5 of the Committee on the Use of Atomic Energy for Peaceful Purposes reads that licences for commissioning of nuclear facilities are issued on the following stages:

- initial fuel storage at the site;
- initial loading of the reactor core;
- initial criticality;
- commercial and ramping start up;
- final commissioning.

According to Article 15, paragraph 1 of the same Regulation, issuance of a licence for commissioning is preceeded by submittal and approval by the Committee on the Use of Atomic Energy for Peaceful Purposes of the following documentation:

- programmes for physical and commercial start up;
- methodologies and programmes for pre-operational tests during physical and commercial start up;
- list of systems and equipment to be available at the different commissioning stages;
- technical specifications;
- instruction on operation of the reactor installation;
- instruction on ensuring the nuclear safety during the physical start up;
- instruction on ensuring the nuclear safety during refueling, transportation and storage of fresh and spent fuel;
- instruction on radiation protection during operation;
- instruction on accident procedures of the reactor installation;
- programmes for training and certification of the operational personnel;
- instruction regulating the personnel actions during accidents;
- methodologies and scenarios for carrying out of the staff emergency training;
- planned measures for staff protection during hypothetical severe accidents;
- list of systems and equipment significant to the safety;
- guidelines for the engineering management and the Start up Management Team during commissioning.

According to Article 19, paragraph 1 of the same Regulation, the following additional documentation should be submitted for licensing the final commissioning of nuclear facilities:

- report on the results of the physical and commercial start up and analysis of the results obtained;
- testing schedules of the safety systems;
- procedures for safety system testing, taking into account the requirements of the technical specifications;
- changes in the design, structures and operation logic of the nuclear facility equipment, resulting from the commissioning;
- revised limits and conditions for safe operation in consideration of the pre-operational adjustment results, the physical and commercial start up;
- operational documentation modified as a result of the physical and commercial start up;
- revised Safety Substantiation Report in based on the results from the construction, pre-operational adjustment and integral testing.

The following stages of equipment and system test are envisaged during the commissioning of NPP:

- functional tests of the different systems;
- an integral test of the nuclear installation from cold conditions up to nominal parameters (without nuclear fuel);
- equipment revision after the integral test;
- physical start up of the nuclear installation;
- commercial start up and ramping power up to the nominal rate.

A special Start up Management Team is created for engineering support and control of the above mentioned activities. This Team is responsible for the following:

- equipment, system and compartment readiness required for each stage;
- scope and duration of the tests performed;
- substantiation of the design basis characteristics;
- correct definition of the assessment criteria;
- definition of the safety limits, measures and conditions;
- supervision of the activities of event and accident investigation commissions.

This approach is applied during the commissioning of each of the Kozloduy NPP units.

All the activities are implemented under the regulatory supervision of the Committee on the Use of Atomic Energy for Peaceful Purposes over the preparations and the results obtained.

The final commissioning of the unit is performed after an inspection by a State Start up Licensing Commission.

19.2. Operational Limits and Conditions

According to Article 15, paragraph 1 of Regulation No. 5, the order for initial authorization to operate a nuclear installation stipulates that Technical Specifications comprising operational limits and conditions have to be submitted for approval by the Committee on the Use of Atomic Energy for Peaceful Purposes. The limits and conditions for safe operation revised on the basis of the results of pre-operational adjustment, physical and commercial start up have to be submitted additionally for the final commissioning of the nuclear installation.

Annex 1 of Regulation No. 5 "Safety Substantiation Report" stipulates that the limits and conditions for safe operation and actuation setpoints of protections and interlocks is required to be described and justified. The following information is required to be presented in relation with the safe operational conditions:

- power levels and allowed modes of operation;
- conditions related to the number and status of the available systems and equipment for operation in the allowed modes;
- conditions related to the acceptable limits of radioactive releases outside the confinement;
- conditions related to the permissible number of loading cycles of the equipment and modes of operation of the reactor installation;
- external conditions, including natural phenomena and anthropogenic factors around the site which impose emergency shutdown of the power plant;
- conditions connected with implementation of maintenance, test and repairs of equipment and systems significant to the safety, including the scope, terms, methodology and technical means;
- conditions caused by the movement and location of fissile and radioactive materials, including fresh and spent fuel, dismantled radioactive equipment and other sources of ionizing radiation, as well as the conditions resulting from the control over them;
- permissible time periods of reactor power operation and power levels in case of safety system failures.

According to Regulation No. 3 of the Committee on the Use of Atomic Energy for Peaceful Purposes, the organization for technical specifications' development is performed by

the operator. The technical specifications are approved by the Scientific Supervisor, Chief Constructor of the reactor installation and the Chief Designer. The operational instructions are developed on the basis of the technical specifications.

Article 22, paragraph 2 of Regulation No. 5 of the Committee on the Use of Atomic Energy for Peaceful Purposes stipulates that for implementation of design and technology modifications, the applicant submits a written request for licence issuance, enclosed with the modified design, construction, technological and operational documentation, approved according the established order. When the limits and conditions for safe operation are changed as a result of the above mentioned modifications, a safety justification is required to be presented.

19.3. Operational Documents

In general, the Kozloduy NPP documentation is classified in three functional groups.

The first group includes all documents regulating the requirements for mode of operation, maintenance and other activities performed by the NPP staff (basic documents). The following documents are referred here:

- normative acts;
- technical documents (design, documents from suppliers, design modification documents, etc.);
- general technical documents (technical information provided by equipment manufacturers, operational experience from other power plants, general studies and analyses);
- external documents (licences issued by the Committee on the Use of Atomic Energy for Peaceful Purposes and other control authorities, documents of the National Electric Company, etc.).

The basic documents are not applied directly to the work of the NPP staff. They serve as a basis for the development of the operational documents. As an exception, some of these documents have a direct application. They are involved in the documentation control system by an order issued by the Kozloduy NPP Manager.

The second group of documents are the operational ones that are used during the NPP operation. They are divided into two main subgroups - technological and administrative documents.

The operational technological documents define the technical requirements, technology and procedures for implementation of all activities related to the plant operation and maintening the equipment designed state.

The administrative documents stipulate the responsibilities of the officials at the different positions and the order for implementation of all activities related to the plant operation.

The third group of documents are used for quality assurance of the activities performed (reporting documents) including:

- documentation of implemented projects, modifications, repairs, etc.;
- reports and data records of the equipment status;
- operational documents, records from recording devices, diskettes with operational data about the equipment status.

The Technical Specifications of the units and the operational instructions of the technological systems were developed originally by the designer and delivered together with the engineering project, which is a specific feature of the Kozloduy NPP.

The following requirements are stipulated at Kozloduy NPP:

- all activities should be implemented in accordance with the written documents (procedures, programmes);
- the activities related to the safety and quality assurance should be performed by monitoring of the operational steps implementation.

The application of these requirements results into two different approaches of using the operational documents. The first one relates to the use of instructions and programmes describing the operational and maintenance procedures or the administrative management. The application of these documents is obligatory during the preparation works, but not during implementation of a certain activity. The second approach relates to the use of programmes, comprehensive operational instructions or parts of operational documents (operational sheets, standard check lists). Their application is obligatory during the implementation of each activity. The directions for use of the operational documents are described in the quality assurance programmes or administrative procedures..

The format and content of the Kozloduy NPP documentation are defined in the quality assurance documents. Due to functional differences between the operational and reporting type of documents, additional requirements exist towards their format and content.

The quality assurance documents regulate also the order for reviewing, enforcement, registration and distribution of the operational documentation. After the document registration in the main record office, the enforcement conditions are identified and if necessary a specific staff training is performed.

There is an administrative Rule for Operation of Electrical Networks and Power Plants that regulates the requirements for periodic review of the documentation in force. Subject to

the periodic review are the documents permanently in force. The other documents (requalification programmes, programmes for functional test implementation, etc.) are considered as newly developed for use only in certain cases. In addition the review period for every type of document is defined. It is admissible to make amendments in the current documentation at the Kozloduy NPP. The order for development, review, distribution and training on the amendments is the same as for the new documents.

19.4. Emergency Procedures

The active emergency procedures at Kozloduy NPP are developed considering the requirements of the normative acts and the practices existing for units with WWER type reactors in the 80s. On the basis of the technical specifications and the safety analyses performed, procedures are developed to regulate the personnel actions during normal plant operation and during deviations out of the normal operation. On the base of the same documents emergency procedures are developed to define the personnel actions for ensuring the safety during occurrences that may result from all reviewed in the design initiating events leading to accidents. These procedures are periodically updated due to the operational experience gained, additional analyses performed and the modifications implemented in the systems.

At present the symptom oriented emergency operating procedures are in a process of development and the respective personnel training is provided. This is one of the safety upgrading measures of the unit operation. The Kozloduy NPP joined the International programme on Nuclear Safety (Lisabon Initiative) in 1994 and participates in the Expert Working Group-2 on the development of symptom oriented emergency procedures. The activities of the Expert Working Group-2 are carried out with the assistance of the US Department of Energy. Three of the basic documents for WWER-1000 units have already been created and another two are in a process of development. First editions of 24 emergency procedures are developed and the remaining 16 are being prepared. Verification of 12 emergency procedures has started for the WWER-1000 units.

An Emergency Plan for Kozloduy NPP is developed (see the chapter under Article 16 of the Convention). Written procedures and instructions for emergency response team during radiological accident are enforced.

19.5. Engineering Support

The units' commissioning and their further operation have been performed with the engineering support of design, construction and research organizations, and with the support of equipment manufacturers.

Department "Engineering support" is established in each of the power production enterprises at the Kozloduy NPP. These departments have their own structure and staff to support the following activities:

- control and storage of fresh and spent fuel;
- calculation of the reactor core neutron physics and basic thermal hydraulic characteristics;
- development of reactor refueling schemes;
- control of the limits and conditions for safe operation;
- control of the performance indicators;
- control of the operational and technological documentation;
- control of the functional tests;
- control of the design modifications.

The core calculations are performed entirely by special teams for units 1-4 andunits 5-6, provided with relevant staff and computer codes. All the engineering support activities at the site are implemented according to procedures regulating the order, rules, requirements and responsibilities for the corresponding activities, including the interaction with other departments.

The supporting activities that are not subject of the "Engineering support" department are performed with the assistance of external engineering and research organizations. The relations with these organizations are stipulated in Regulation No. 5 of the Committee on the Use of Atomic Energy for Peaceful Purposes, in documents of the National Electric Company and the Kozloduy NPP. One of the main companies involved in the NPP engineering and research supporting system is Energoproekt-PLC. If necessary other engineering companies are engaged as well as experts from Universities and specialized scientific and research institutions in the Republic of Bulgaria.

The engineering and technical support activities are implemented in accordance with the current normative requirements, quality assurance programmes (see the chapter under Article 13 of the Convention) and specific requirements of the Committee on the Use of Atomic Energy for Peaceful Purposes.

Foreign companies are engaged sometimes for carrying out of engineering services (when a Bulgarian company is not able to perform such activity or when an international tender is declared, etc.).

19.6. Reporting of Incidents

Article 19, paragraph 1 of the Act on the Use of Atomic Energy for Peaceful Purposes stipulates that *"The legal entities and physical persons must immediately notify the Committee on the Use of Atomic Energy for Peaceful Purposes of the operational changes and events that took place as well as of any accident conditions relevant to nuclear and radiation safety, accounting for, storage and transportation of nuclear material."*, and according to Article 19, paragraph 2 *"The Committee on the Use of Atomic Energy for Peaceful Purposes shall notify competent bodies of the events and accident conditions that have occurred..."*.

According to the requirements of Regulation No. 2 of the Committee on the Use of Atomic Energy for Peaceful Purposes, a notifying system is implemented at the Kozloduy NPP that regulates the following:

- criteria for event reporting;
- order for notification;
- terms for notifying depending on the importance of the event;
- format and content of the notifying reports.

In the period between 1989 to 1997 the Kozloduy NPP has reported 199 events relevant to safety to the Committee on the Use of Atomic Energy for Peaceful Purposes. Twenty events have been reported during the first six months of 1998. The information is made public through the Incident Reporting System of the IAEA.

19.7. Collection and Analysis of Operational Experience

On the basis of the ASSET missions performed in 1990 and 1992 at the Kozloduy NPP, during 1993 a procedure for operational event analysis was developed and introduced. In this procedure the ASSET-methodology for reporting and analysis of events relevant to the nuclear safety was used. The event classification is performed according to the IAEA INES scale. The ASSET missions held in 1993 and 1994 established that the recommendations made were considered and the Kozloduy NPP pursue a policy of transparency and accident prevention.

All deficiencies and deviations are collected in a data base to provide information about the equipment reliability, quality of documentation and personnel actions. The deficiencies registered are assessed by the Council on Nuclear Safety and Radiation Protection.

As a result of the analyses and evaluations performed by the Council on Nuclear Safety and Radiation protection, compensatory measures are defined and implemented which aim at the following:

- direct consequence elimination;
- recovery of the required quality of the failed component;
- prevention of the possibility for repeated failures.

Data about other NPPs is obtained regularly through the information networks, electronic mail or printed text. The messages received are classified as follows:

- for information, when the data relates to NPPs with technical and organizational differences;
- data on human errors, which is sumbitted to the personnel for comments and discussions;
- information from similar NPPs, where equivalent corrective measures are possible to be applied. The data is analysed by relevant experts and suggestions are made.

The current practice shows that the collection system is an efficient one.

19.8. Radioactive Waste Management

The Act on the Use of Atomic Energy for Peaceful Purposes (Article 6, paragraphs 1 and 2) and Regulation No. 3 of the Committee on the Use of Atomic Energy for Peaceful Purposes (section X of the second chapter) contain requirements related to radioactive waste. The basic requirements are stipulated in Regulation No. 7 of the Committee on the Use of Atomic Energy for Peaceful Purposes.

For many reasons (described in the chapter under Article 6 of the Convention) the activities connected with the radioactive waste generation, collection, treatment, and storage for a long period of time in the Republic of Bulgaria, have not enough been efficient. At the end of the 80s more efficient activities were carried out for solving the existing problems. These activities are performed according to an approved programme. Some of the objectives of these programme are formulated in the following way:

- implementation of modern technologies;
- minimizing of the generated radioactive waste;
- minimum exposure of the personnel;

- site and environment protection from radioactive contamination;

- radioactive waste treatment which allows consequent long term storage and/or disposal;

- minimizing the end volume of radioactive waste to be stored.

As a result of the pursued radioactive waste management policy, the amount of generated waste for the period 1993 - 1997 has decreased about 4 times. Treatment of the entire quantity of generated solid radioactive waste started in 1994 and since 1997 has begun the drawing and treatment of the solid radwaste already collected in the storage facilities. The total activity of the solid radioactive waste generated during the whole period of operation is less than 740 GBq, and for the liquid radwaste, it is less than 370 TBq.

The IAEA expert missions and projects implemented under the PHARE Programme contributed to the improvement of the radioactive waste management.

From the above mentioned facts follows the conclusion that the Republic of Bulgaria meets the requirements of Article 19 of the Convention on Nuclear Safety.

Annex 1

List of the Nuclear Installations

I. Kozloduy Site

Location: North-western Bulgaria,
3.5 km south-eastern from the town of Kozloduy;

1.1. Units 1 & 2, WWER-440/V230 type (in operation);

1.2. Units 3 & 4, WWER-440/V230 type (in operation);

1.3. Units 5 & 6, WWER-1000/V320 type (in operation);

1.4. Spent fuel storage facility;

1.5. Installations for storage and treatment of low and medium radioactive waste (under construction).

II. Belene Site

Location: Northern Bulgaria, the 571 km of Danube River,
4 km eastern from the town of Belene

2.1. Units 1 & 2, WWER-1000/V320 type (under construction, ceased).

Annex 2

Data on the Nuclear Installations

I. Units at the Kozloduy NPP site

1. Basic Data and Main Characteristics of the Nuclear Facilities at the Kozloduy NPP site

The six units at the Kozloduy NPP site are designed and delivered from Russia. They were commissioned as follows:

Unit 1	October 1974	WWER-440	V-230
Unit 2	November 1975	WWER-440	V-230
Unit 3	December 1980	WWER-440	V-230
Unit 4	June 1982	WWER-440	V-230
Unit 5	November 1987	WWER-1000	V-320
Unit 6	August 1991	WWER-1000	V-320

Table II-1

WWER-440 and WWER-1000 General Design Features and Parameters

Parameter	Dimension	1 - 4	5 - 6
Reactor		WWER-440 type V-230	WWER-1000 type V-320
Reactor power			
- Thermal	MW	1375	3000
- Electrical	MW	440	1000
Primary circuit pressure	MPa	12.3	15.7
Reactor inlet coolant temperature	C	268.7	289
Reactor outlet coolant temperature	C	301.3	320
Average coolant temperature difference of the reactor core	C	28	30.3
Fuel assemblies	number	349	163
Reactor control rod assemblies	number	37	61
Fuel rods in a fuel assembly	number	126	312
Average density of the thermal flow	W/cm^2	44	57.9
Average linear thermal flow	W/cm	125	165.7
Loops in primary circuit	number	6	4
Coolant flow rate	m^3/h	45000	84800
Maximum fuel enrichment in U-235	**%**	3.6	4.4
Steam Generators			
Type		PGV-4E	PGV-1000
Quantity per unit	number	6	4
Steam capacity	t/h	425	1480
Thermal power	10^6 kJ/h	827	2690
Steam pressure	MPa	4.6	6.3
Feed water temperature	C	225	220

Turbines			
Type		K-220-44	K-1000-60
Quantity per unit	number	2	1
Power	MW	220	1000
Main steam parameters			
- Pressure	MPa	4.3	5.9
- Temperature	C	256	274
Main Coolant Pumps			
Type		GCN-310	GCN-195M
Quantity per unit	number	6	4
Generators			
Type		TVV-220-2	TVV-1000-4
Rated Power	MW	220	1000
Generator voltage	kV	15.75	24
Grid voltage	kV	400/220	400

2. Site Description

2.1. Location and Hydrogeological Characteristics

The Kozloduy NPP site is located 3.5 km south-east from the town of Kozloduy and 12 km north-west from Miziya town, region Montana. At about 3 km away from the NPP is the border with the Republic of Romania - the Danube river.

The site is surrounded by the Danube river lowland (20 m absolute altitude) from north and by the water shed plateau slope (90 m absolute altitude) from south. The NPP Kozloduy site can not be submerged, it has +35 m absolute altitude. The relief of the region represents a hilly plain with 100-200 m absolute altitude, segmented by the Tzibritza, Ogosta and Skat rivers. Wide, elongated and flat new soil elevations, the biggest of which is the Zlatia plateau, have been formed between them. The Danube river bank is higher (up to 100-110 m) in the Oryahovo region and westward from Kozloduy, while the lowest point (25-30 m) is in the Kozloduy lowland.

Concerning the geology, the site consists of Pliocene and Quaternary sediments. The overlayer has 14-15 m thickness and consists of loess and loess type clay. The surface layer has about 7 m thickness of sediment loess and Pliocene deposits (densed marl clays and sands) are observed at 18-20 m depth. There is a sand layer at about 35 m in depth, about 10 m thick. The overall thickness of the Pliocene deposits is about 100 m.

The underground water is connected with the water bearing alluvial gravel-sandy deposits and the Pliocene sands. The hyposometric level of the existing underground water is 29.0 m with a flow direction from south-west to north-east. The underground water is not "aggressive" towards concrete.

2.2. Seismic Characteristics

The NPP site is located in a seismic region, but there are no active tectonic structures. The maximum design basis earthquake is evaluated to be 8 on the MSK-64 scale and the design basis earthquake according to the same scale is evaluated to be 7. In case of an earthquake, no residual deformations and other resulting phenomena are expected.

The plant site is located on the so called Miziya platform which is classified as 7th degree on the MSK-64 seismic scale.

2.3. Meteorological Data

The climate is "moderate continental" with cold winter and hot summer, which is representative of the north climatic region of the Danube lowland. The NPP Kozloduy surrounding landscape is such, that cold and strong winds especially from the west and north-west are possible during winters.

The absolute maximum temperature measured for Kozloduy is +43.2°C (August). The absolute minimum temperature measured is -26.6°C (January). The average annual air temperature is +11.5°C.

Data about the air temperature and relative humidity for the period 1977-1986, provided by the Kozloduy meteorological station is presented in table II-2. The analyses have been performed for the hottest months June -September.

Table II-2.

Air temperature, °C	Average relative humidity, %
>30	71.0
29-30	71.0
28-29	54.4
27-28	59.8
26-27	60.2
25-26	63.5
24-25	63.0

The strongest winds with speed up to 25 m/s are observed during spring. Data for the period 1977-1986, provided by the Kozloduy meteorological station is presented in table II-3.

Table II-3.

Average Wind Speed with Corresponding Frequency and Direction, m/s

Direction	N	NE	E	SE	S	SW	W	NW
Frequency,%	12.4	14.7	12.8	2.3	2.2	4.1	26.3	25.2
Average speed	2.0	2.0	1.9	2.1	2.3	2.1	2.4	2.5

Measurements of the Danube river water temperature have been performed at the Oryahovo post for the period 1937-1967. The specific temperatures are presented in table II-4.

Table II-4.

Specific Danube Water Temperatures, °C

Month	Maximum	Average	Minimum
January	5.8	1.4	0
February	8.1	1.7	0
March	11.2	5.0	0
April	17.9	11.2	4.1
May	23.9	16.7	10.9
June	25.8	20.7	15.2
July	27.3	22.9	17.6
August	27.5	22.9	17.0
September	25.3	21.3	14.2
October	21.3	13.9	7.5
November	14.0	8.3	1.7
December	8.2	3.5	0
Average year	27.5	12.2	2.0

2.4. Demographic Data

The population density in the region is non-uniform. The towns with highest density are Oryahovo (100-120 persons per km^2), Kozloduy (80-100 persons per km^2) and Miziya (20-30 persons per km^2). The average population density for the area is 60-80 persons per km^2.

3. Reactor Installations

3.1. Pressure Vessel of Reactors Type WWER-440/V-230

The reactor is a vertical cylindrical vessel with the reactor internals installed in it and a movable closure head.

The vessel's internal diameter is 3580 mm and the wall thickness is 140 mm. The fuel assemblies are placed in a portable stainless steel basket in a cylindrical shaft inside the vessel. The steel thickness of the basket and the shaft, as well as the coolant circulating between them and the reactor vessel, protect the vessel steel from the neutron flux radiation impact. Thirty-six shield ("dummy") assemblies are placed at the core periphery of units 1, 2 and 3 in order to extend the operational lifetime of the vessel.

The twelve reactor nozzles of 500 mm inner diameter are located in a two-level thickened zone. The lowest point of the lower nozzle row is 1450 mm above the upper part of the core.

The reactor pressure vessel closure head consists of a spherical lid with guiding tubes for the control assemblies and metal construction for transportation. The closure head is installed on the main flange of the reactor pressure vessel.

3.2. Pressure Vessel of Reactors Type WWER-1000/V320

The WWER-1000 reactor pressure vessel has an analogous structure to the WWER-440 one.

The WWER-1000 vessel has eight nozzles of 800 mm inner diameter, located in two levels. The reactor vessel specifications are as follows:

- Reactor vessel diameter 4535 mm;
- Reactor vessel length 10880 mm;
- Reactor length with the closure head 24770 mm;
- Reactor vessel weight 304 t;

3.3. Reactor Core of WWER-440/V-230 Type Reactors

The core of WWER-440 reactor comprises of 349 assemblies. 312 of them are fixed fuel assemblies and 37 are movable ones of the reactor control and protection system. The fixed fuel assemblies in units 1, 2 and 3 are 276 since 36 shield assemblies have been installed at the core periphery.

The fuel assembly represents a hexagonal tube of Zirconium alloy, where 126 fuel rods are arranged in a triangular grid with an uniform pitch.

The average uranium content in one fuel assembly is 118.5 kg distributed in 126 fuel rods. The length of the active part of the assembly is 242 cm (in cold conditions).

The reactor core has an approximately cylindrical shape of 288 cm in diameter and 242 cm in height. The uranium mass in the reactor core is about 37000 kg for units 1, 2 and 3 and about 41200 kg for unit 4. The average U-235 enrichment is 2.4% and the average uranium burn-up during steady state is 29.0 MW.d/kg U.

The movable control assembly consists of two parts: lower, which is a fuel assembly and a follower - neutron absorber (boron steel). During operation the upper parts of the control assemblies are completely withdrawn and only one control assembly group is partially inserted in the core. This control assembly group is used for reactor power control and compensation of quick reactivity changes of the reactor (temperature and power effects)

Boric acid is diluted in the primary circuit coolant to compensate the slow reactivity changes (fuel burn-up, unsteady poisoning with Xenon and Samarium) and to bring the reactor to subcriticality during refuelling and cooling down.

3.4. Reactor Core of WWER-1000/V-320 Type Reactors

Equivalent core diameter	3160 mm
Core height	3530 mm
Number of assemblies	163
Number of fuel rods in an assembly	312
Fuel weight (UO_2)	79.5 t
Average fuel burnup for a 2-year fuel cycle	27 MW.d/kg U

The average time of unit operation between two refuellings is 6900 full power hours. Refuelling is performed when the reactor is shut down, deeply subcritical and in cold condition.

3.5. Instrumentation and Control of the Reactors

The WWER-440 and WWER-100 type reactor control functions are performed by similar systems as follows:

- system for group and individual control;
- system for control of the control rods position;
- system for automatic power control;
- system for alarm and emergency protection.

The instrumentation for control of the reactor neutron flux performs:

- measurement and control of the neutron flux density in the range from 10^{-8} to 115 % of the nominal reactor thermal power;
- measurement and control of the relative gradient of the neutron flux density (the reactor period) in the range from 10^{-6} to 115 % of the nominal reactor thermal power;
- transmission of alarm and emergency signals to the reactor protection system;
- transmission of analogue signals to the system for automatic power control;
- transmission of signals of all measurement ranges to the displaying and recording devices in the main control room.

The instrumentation for thermal control of the reactor coolant takes measurements of the following parameters:

- coolant temperature at the outlet of a certain number of fuel assemblies;
- coolant temperature at the outlet of the mixing chamber located above the core;
- pressure drop in the core;
- coolant pressure in the core;
- coolant temperature difference of the "hot" and "cold" loop legs;
- pressure and water level of the pressuriser;
- water level of the reactor coolant (during refuelling);
- coolant temperature at the inlet and outlet of the steamgenerators;
- discharge pressure of the head of each main coolant pump;
- temperature of steamgenerator feed water;
- water pressure in the primary make-up system;
- temperature of the reactor components.

Systems for early detection of leaks from the primary coolant system (ALUS type) are installed at units 1-4.

The reactor control and protection system ensures the reactor safety during the following modes of operation:

- reactor start-up and power increase up to 3÷5 % of the nominal power and manual power control;
- automatic power control in the range of 3÷5% to 100 % of the nominal power;
- compensation of reactivity changes;
- reactor scram leading to subcritical conditions for a time period of 8.5÷12 s for WWER-440 (1.7 4 s for WWER-1000).

3.6. Cooling Circuits (Primary and Secondary)

The units with WWER type reactors are designed with two technological circuits. The primary circuit performs heat removal from the reactor core through steamgenerators to the secondary circuit. The primary circuit consists of a main coolant loop and auxiliary systems.

Radioactivity is generated in the reactor coolant during power operation, which depends on:

- the coolant radioactivity resulting from the interaction between the flux of fast neutrons and the oxygen isotopes;
- the radioactivity of U-235 fission products get into the reactor coolant through the fuel micro-underclad crackings;
- the corrosion radioactivity of the coolant as a result of core component material activation.

The secondary circuit is designed to generate non-radioactive steam and to transfer it to the turbine generators to produce electricity. Secondary circuit comprises of steamgenerators, turbine generators and auxiliary equipment in the turbine hall.

The cooling and service water source for the Kozloduy NPP is the Danube river. There are two riverside pump stations with total capacity of about 160 m^3/s. The water is transferred through a 7.5 km long "cold" channel. In parallel is the "hot" channel which returns the spent water back to the Danube river.

4. Protection of the Environment

4.1. Radioactive Effluents into the Environment

Data about the average daily amounts of the Kozloduy NPP releases of Noble radioactive gases (NRG), long-lived aerosols (LLA) and Iodine-131 into the atmosphere are given in Table II-5.

Table II-5

Activity of gas-aerosol effluents during 1996 and 1997 in comparison with the acceptable values

	NRG [TBq]	**LLA [GBq]**	**Iodine-131 [GBq]**
Permissible average daily amounts	70	2	1,4
Average daily amounts of the Kozloduy NPP releases during 1996	1.086	0.02459	0.0055
Average daily amounts of the Kozloduy NPP releases during 1997	0.556	0.0051	0.0073

4.2. Reactor Confinement

The equipment of the V-230 reactor installation is situated in a confinement which is a system of sealed compartments, resistant to a pressure of 0.2 MPa (abs.).

The equipment of the V-320 reactor installation is situated in a pre-stressed reinforced concrete structure with steel cylindrical-shaped coating, covered with a spherical dome resistant to a pressure of 0.5 MPa. The containment is pre-stressed by a special rope system (tendons) which allows resistance to extreme internal and external impacts. The steel coating and the concrete screens at the internal side of the confinement are acting as a protection against jets and missiles and rupture of power-intensive pipelines.

4.3. Safety Systems

The safety systems of units 1 and 2 are of independent two-train type with a capacity of 2x100 %. The emergency power supply of each unit is provided by 3 diesel generators.

The following classification of the safety systems exists according to their functions:

- Protection systems, including:

- reactor emergency protection system;
- emergency high pressure injection system;
- primary overpressure protection system;
- secondary overpressure protection system;
- emergency feed water system;
- fast acting isolation valves of the main steam lines.

- Localisation systems, including:

- spray system;
- system of airtight compartments

- Support systems, including:

- reliable power supply system;
- system for ventilation of the safety system compartments;
- emergency lighting system;
- service water system;

- Control systems, including:

- system for formation of emergency protection signals under neutron-physical and technological parameters;
- automatics of diesel generators staggered loading;
- automatic power controller;
- main coolant pump automatics;
- system for formation of safety system control signals.

The single failure principle is applied in the design basis of units 3 and 4. The safety systems are comprised of 3 independent trains. Each of them is designed to perform independently the system's functions and to ensure the unit safety in all operational modes for each design basis initiating event (capacity 3x100 %). There is a three-train low pressure emergency core cooling system at units 3 and 4 in addition to the high pressure injection system.

The single failure principle is applied also in the design basis of units 5 and 6. Each safety system comprises of three independent trains with functional and physical separation.

Each of the trains is designed to perform independently the system functions and to ensure the unit safety in all operational modes and during maximum design basis accident.

A passive system for emergency core cooling is installed at units 5 and 6. It consists of four hydro-accumulators with a volume of 50 m^3, filled up with boric acid solution for flooding the reactor core in case of primary pressure drop under the set value.

5. Information on the Safety Analyses

The maximum design basis accident for the Kozloduy units 1-4 is defined as the loss of coolant accident with an equivalent diameter of 32 mm pipe rupture.

The safety system analyses and requalifications performed in the period 1991-1996 show that the safety systems have enough capacity to ensure the reliable core cooling in case of a loss of coolant accident with an equivalent diameter of 64 mm pipe rupture. Questions concerning the confinement tightness maintaining during beyond design basis accidents, have still remained open. Analysis of loss of coolant accident with an equivalent diameter of 100 mm pipe rupture has been considered too.

Large number of detailed thermal hydraulic analyses were performed in the framework of the Probabilistic Safety Assessments - level 1 for the Kozloduy NPP, which provide information on the final core state during different transients, depending on the equipment availability in every single case. In the framework of the 6-month WANO Programme and during implementation of the 3-stage Programme for Safety Upgrading of units 1-4, safety studies and analyses were performed, such as: deterministic, primary circuit metal examination, reactor pressure vessel examination, thermalhydraulics, thermalmechanics, probabilistic, seismic, etc. The results of these analyses have been accepted by the Consortium of Western European Expert Organisations and Regulatory Bodies. The results of the Probabilistic Safety Assessment - level 1 for units 5 and 6 are submitted and reviewed by the IAEA experts.

II. Spent Fuel Storage Facility at the Kozloduy NPP

The spent fuel assemblies are stored for a period of 3-5 years in spent fuel storage pools, situated at the reactors. After that, the spent fuel assemblies are transported to the spent fuel storage facility by means of internal plant transport cask and special truck platform.

The spent fuel storage facility is a pool type. The design of this facility provides storage for the assemblies of both WWER-440 and WWER-1000 type reactors. The spent fuel assemblies are stored in baskets under a protective layer of demineralized water. The spent fuel distribution in the storage facility guarantees compliance with the nuclear safety requirements having sufficient subcriticality margin. The design basis capacity of the spent fuel storage facility is 168 baskets with 30 assemblies of WWER-440 reactor type in each basket. The fuel is stored in four operational sections. It is permissible 3/4 of their capacity to be filled up with spent fuel. There are 3146 spent fuel assemblies of WWER-440 type reactors, distributed in 107 baskets by 31.06.1998.

III. Radioactive Waste Treatment and Storage Facilities at Kozloduy NPP site

At the present moment the radioactive waste (RAW) is treated and stored by means of facilities which were constructed together with the relevant units.

The basic methodology for treatment of solid RAW is to press them in 200 l steel drums. The pressing process is carried out in two stages: preliminary pressing of the solid RAW in drums and pressing the drums themselves by a press. The pressed drums are stored in a monolithic reinforced concrete storage facilities.

The liquid RAW are collected by specific systems and after precipitation and mechanic filtration, they are treated in two-stage evaporation facilities, resulting in distillate and radioactive residues with salt content over 300 g/l.

The distillate is passed through ion-exchange filters, then the chemical and radiochemical parameters are checked and the distillate is returned back into the technological cycle. The radioactive residues are stored in residue tanks, placed in Auxiliary buildings at the Kozloduy NPP site.

A complex of facilities is under construction, which is designed for treatment and storage of RAW collected from the existing storage facilities, transportation to the place of treatment, treatment and solidifying to a hard matrix and further long term storage of the treated RAW.

The technology and the main facilities are delivered under contract with Westinghouse company. The technology provides liquid RAW cementation and solid RAW pressing and filling into reinforced concrete storage containers.

The filled up and sealed containers are placed in a storage facility located on the ground level, which isolates the RAW from the direct atmosphere influence and localising the radioactive products during accidents.

IV. Belene NPP

The NPP site is situated in the lowland of Svishtov and Belene on the bank of the Danube river, 571th km. The site is located 7,5 km from the border with the Republic of Romania, across from the largest island in Danube river - the Belene (Persin) island.

In 1987 an engineering design was developed for construction of four units with WWER-1000/V-320 type reactors by experts from Atomenergoproekt - Kiev and Energoproekt - Sofia. The construction activities started up in 1987. The all-out NPP construction was performed in the period 1988 - 1990. In 1991 the construction activities were stopped.

In the period of 1- 20 July, 1990 a PREOSART mission on review of the construction was held by IAEA experts, including observers from Romania and Cuba. The conclusion of the mission was that the project organisation is an integral and centralised formation, valid for the member states of the former Council of Mutual Economical Assistance. It functions on the basis of the accepted unified design of WWER-1000 aimed to achieve a high level of reliability and safety with minimum cost and optimal construction schedule. The mission gave a positive evaluation of the management, construction and preparation for operation. The main recommendation was for a Quality Assurance Programme to be developed.

In 1990 another IAEA mission took place to assess the safety aspects of the design. The duration of the mission was two months. A review of the reactor core design, safety systems design and safety analyses was performed. The conclusion of the mission was that in consideration of the topics reviewed, the design of Belene NPP is similar to the modern Pressurised Water Reactors. No significant safety deficiencies were recognised. The recommendations made by the experts related to possible future safety upgrading.

On the basis of studies performed during 1996 and 1997, the operational experience gained by Kozloduy NPP and other plants with WWER type reactors, engineering improvements were suggested for continuation of the Belene NPP construction. These improvements lead to upgrading of nuclear safety, operational reliability and maintenance.

In consideration of the current legislation of the Republic of Bulgaria, all performed activities and procedures are revised. As a result the following studies were developed:

- research activities and measures for site safety enhancement of Belene NPP, developed under an IAEA programme;

- an engineering review and possibilities for implementation, January 1996;

- application documentation for licensing of site selection and construction, August 1997.

After stopping the construction activities of the Belene NPP, a programme was implemented with conservation measures for the main building constructions and reconservation of the main equipment stored at the site. A current control of the building construction conditions is performed and the deficiencies identified are removed. Recommendations by the manufacturers delivered the main equipment are used in the conservation process.

So far no final decision has been taken relating to the continuation of the Belene site construction.

Annex 3

Measures for Safety Upgrading of the Kozloduy NPP Units

I. Measures Performed for Safety Upgrading of Units 1÷4 in the Framework of the Short-Term 3-Stage Programme

1. Development of the 3-Stage Programme for Upgrading

ASSET and SRM missions were carried out by IAEA experts at the Kozloduy NPP in 1990 and 1991 for assessment of the units 1-4 safety and recommendations were given for the plant safety performance upgrading. On the basis of these missions' results the Council of Ministers of the Republic of Bulgaria adopted a resolution to shut down Kozloduy units 1 and 2 until the fulfilment of a special programme for units' safety upgrading. In pursuance of that resolution a significant number of research activities and analyses were carried out to specify the specific technical decisions, organisational and structural changes. All these efforts and tasks were incorporated in a programme of measures for upgrading the units' safety. The adopted stage-by-stage approach in the Programme for safety upgrading defines the priority of measures carried out in each stage depending on the designing and technical feasibility, the possibilities of their implementation and taking into account the particular features of the power units.

Stage 1 of the Programme

The developed "Programme for Ensuring the Equipment and Systems Functional Capability and Upgrading the Reliability and Operational Safety of the Kozloduy NPP units 1 and 2 - Measures of Stage 1" (Version 2 of June, 1992) consists of two volumes:

- Volume 1 - technical aspects;
- Volume 2 - operational aspects.

The Programme was developed based on the following documents:

- Resolution No. 219/22.07.1991 of the Council of Ministers for shut down of units 1 and 2 and realisation of an urgent programme for safety upgrading;
- Requirements of the CUAEPP for safety improvement of the Kozloduy power units;
- Conclusions and recommendations of the IAEA missions carried out in the Kozloduy NPP and summary results of missions carried out at plants of the same reactor type (Bohunice, Novovoronezh and Kola NPP);

- WANO recommendations;
- Suggestions made by the Kozloduy NPP.

An approach for open licensing of the activities on safety upgrading has been accepted in order to achieve an independent evaluation. Experts from WANO, CUAEPP, the Consortium of expert organisations and regulatory bodies of European Union country members participated in this process. The consortium included the following institutions:

- AIB - Vincotte Nuclear (AVN), Belgium;
- Gesellschaft Anlage und Reaktorsicherheit (GRS), Germany;
- Institute de Protection et de Surete Nucleaire (IPSN), France;
- UK Atomic Energy Authority (AEA Technology), R&D.

Independent short-term programmes were developed (within the planned preventive outages) for the first stage safety improvements of units 3 and 4 jointly with the implementation of the unit 1-2 Programme. These short-term programmes included the following technical aspects:

- upgrading the safety systems reliability;
- assessment of the primary and secondary equipment metal condition;
- safety systems tests.

The above mentioned measures for improvements were developed, based on a "Programme for Ensuring the Equipment and Systems Functional Capability and Upgrading the Reliability and Operational Safety of Kozloduy NPP units 1 and 2 - Measures of Stage 1"

Stages 2 and 3 of the Programme

An additional short term programme for improvement of the safety was developed in compliance with the adopted approach for implementation of technical measures in the framework of units' outages and continuous upgrading of the safety culture at the Kozloduy NPP. The chosen approach includes the following features:

- the programme covers all Units 1 to 4;
- the technical measures are presented in a separate volume and linked with their implementation during a certain outage;
- the measures related to operational aspects improvement are part of a continuous and obligatory process and not connected with a certain restart of the units;
- all measures reflected in the Programme are categorised in two stages to be carried out depending on the priority of the measures, technical and design preparedness for its accomplishment.

The main goal of the measures included in Volume 1 (Technical Aspects) of the Programme is stage-by-stage upgrading of the reliability and operational safety of units 1-4 by means of:

- ensuring the functional performance of the unit's systems and equipment especially of those which provide the nuclear and radiation safety;

- upgrading the reliability and stability of the safety systems in compliance with the single and common cause failure criteria (including human errors);

- upgrading the reliability of the three basic barriers against release of radioactive materials (fuel cladding, primary coolant system, confinement).

The measures included in the Programme were developed based on the first stage programmes and recent researches carried out in Bulgaria as well as in the framework of the 6-month WANO Programme.

The execution of these measures is scheduled to be carried out stage-by stage within the next outages of each Unit as a logical continuation of the first stage measures.

Volume 2 of the Programme for upgrading the reliability and operational safety of Kozloduy NPP Units 1-4 includes measures for improvement in the following areas:

- management;
- operating procedures;
- plant operation;
- plant maintenance;
- training;
- emergency planing.

The planned measures in Volume 2 of the Programme were developed taking into account the following:

- IAEA recommendations for upgrading the reliability and operational safety;

- experience, knowledge and results of the performed first stage Programmes for upgrading the reliability and operational safety of the Kozloduy NPP units 1-4;

- experience and knowledge gained during the co-operation with the Bugey NPP in the framework of the Twinning Programme;

- experience and knowledge gained during the joint work with experts of the WANO Technical Assistance Team.

The execution of the foreseen measures was carried out as a continuous process. As a result of this approach the terms for accomplishment, scheduled in the Programme were fixed for a certain year and not for a certain unit outage.

As a result of the execution of these measures, a significant improvement of the quality of the operating documentation was achieved, including development and approval of a new technical specifications book, new operating and emergency response procedures, quality assurance documents for all plant activities, new organisational structure etc.

2. Stages of Execution

2.1. First Stage.

The first stage measures programmes were carried out during the outages of the Kozloduy NPP units 1-4 in 1992 and 1993. The units were restarted as follows:

- restart of unit 1 on December 28, 1993;
- restart of unit 2 on December 28, 1992;
- restart of unit 3 on February 26, 1993;.
- restart of unit 4 on October 19, 1992.

Follow-up SRM and ASSET missions were carried out by the IAEA in 1993 at the Kozloduy NPP. The IAEA experts assessed favourably the execution of the measures for technical improvements and safety culture enhancement. They evaluated the planned activities for the subsequent stages as appropriate for the policy on management of the Kozloduy NPP aimed at constant upgrading of the plant safety.

Fundamental Activities Performed within the Programmes of Stage 1

A. Overall Recovery of the Operational Control for Backfitting the Design Safety Level.

A systematic approach for the recovery of the operational control was implemented with the help of the WANO experts and approved by the regulatory body.

The activities were divided into 11 groups, responsible persons were designated for the execution of the activities and a system was developed for supervision and final acceptance of the performed activities.

As a result of this the following basic improvements were achieved:

- elimination of leakage;
- restoration of the spent fuel pools internal wall leak tightness;

- repairing and recovering of the electrical connections of the main valves, electrical motors, cable and I&C junction boxes etc., using technical means provided by CEGELEC company from France;

- restoration of equipment heat insulation;

- improvement of confinement room leak tightness;

- restoration of the electric lighting system;

- implementation of measures for improvement of industrial safety;

- implementation of additional measures for improvement of fire protection safety;

- implementation of measures for improvement of the radiation safety;

- review and repair of the primary and secondary coolant system equipment and rest life time analysis and replacement of safety related equipment;

- large scale programme for metal examination including ultrasonic inspection of reactor pressure vessels and eddy current test of the steam generators;

- "in-in-out" nuclear fuel refuelling pattern was implemented .

B. Upgrading of the Operational Safety Level Including:

- development and declaration of the management policy related to the safety culture;

- introducing changes in the plant organisational structure aimed at ensuring priority to the nuclear safety and safety culture education based on effective and flexible management;

- introducing administrative instructions for regulation of the responsibilities and the control of the plant operation;

- introducing directives for quality assurance for all activities performed at the plant in the framework of the overall QA programme;

- improvement of the operating and technical support documentation based on the recommendations resulted from the researches (topic F and K of the WANO 6-month programme) and experience exchange with other plants;

- development of a set of documentation for functional tests aimed at requalification of the safety systems after repairs and modifications and clearly defining the acceptance criteria for the tests;

- enhancement of personnel training through development and implementation of training programmes, courses, simulator training, seminars, etc.;

- upgrading of the radiation protection and dosimetry by introducing preventive measures, strict control during execution of all kinds of activities in the restricted area, usage of manipulators and other devices for dose consuming operations, personnel training on the irradiation risks and radiation protection rules;

- updating of the plant emergency plan based on analyses of possible beyond design accidents, providing the necessary technical means required by the plant emergency plan (including an accident management centre) and of the procedures for the implementation plan.

C. Performing Accident Analyses Aimed at Evaluating the Margins and Systems Behaviour Response to Different Initiating Events and Suggestions for Modifications Based on the Analyses Results.

In the framework of this activity the following analyses were carried out:

- full plant blackout with mechanical inertia rundown of 6 out 6 main primary coolant pumps;
- feed water pipeline rupture;
- inadvertent opening of a pressurizer safety valve;
- assessment of the reactor core margins in case of design based loss of coolant accidents (LOCA);
- analysis of LOCA (rupture of a 45 mm diameter pipeline);
- boron acid dilution;
- control fuel assembly ejection;
- tube rupture in a steam generator;
- reactor protection system failure during an accident;
- loss of a normal feed water flow;
- rupture of steam pipelines.

D. Improvements in the Engineering Systems

Modifications have been implemented as a result of the performed analyses of accidents and qualitative analyses of the engineering safety systems reliability aimed at introducing improvements in the following areas:

- actuation of the reactor protection system prior to safety systems actuation;
- implementation of measures against common cause failures;
- back-up of system elements for increasing the reliability in case of single failures;
- implementation of measures for upgrading the functional alertness;
- interconnections between systems of adjacent power units;
- implementation of two independent power reliable supply systems for Unit 1 and 2 safety systems;
- minimising the emergency diesel generator protections in order to ensure absolute priority of the nuclear safety over the actuation of diesel generator protections;

- implementation of new systems, such as operator computer support system, supplementary emergency feed water system (using fire protection vehicles) and etc.;

- improvement of the fire protection by measures for fire confining and early detection of fire.

- antiseismic anchorage of the main plant equipment;

- installation of acoustic system for early detection of leaks from primary coolant system.

E. During the Outages some Particular Activities were Carried out Such as:

- reactor pressure vessel annealing of units 1 and 3 (in 1989) and unit 2 (in 1995)

- use of shielding dummy assemblies for neutron irradiation protection of reactor pressure vessel at units 1,2 and 3;

- decontamination of primary coolant system of units 1 and 3;

- ultrasonic inspection of reactor pressure vessels;

- eddy current tests of steam generator tubes;

- chemical cleaning of secondary circuit;

- extended in-service metal inspection;

- full scope tests of the confinement rooms;

- full scope tests of the safety systems in order to prove their design characteristics.

As a result of the execution of the above mentioned measures, the main goals of the Programme for Stage 1 were achieved. The design safety level related to the operational condition of the equipment, constructions and premises was achieved also.

These conclusions justified the restart of the units ensuring reliable and safe operation.

2.2. Stage 2

The second stage measures were carried out during the 1994 outages for units 2-4 and the 1995 outage for unit 1 taking into consideration the experience gained from the backfitting activities and implementation of technical measures within Stage 1 of all four units.

Some of the more significant technical measures carried out within Stage 2 are:

- cross connection between the emergency feed water pumps of two adjacent Units;

- large number of activities for enhancement of the steam generators' confinement leak tightness and full scope tests for tightness inspection at high pressure;

- large number of antiseismic measures;

- large number of fire protection measures;

- optimization of reactor protection;

- optimization of the diesel generators step-by-step loading;

- improvement in case of accident of the main control room air-conditioning and working conditions as well as in other premises;

- reconstruction of the fire extinguishing system with transition from foam to water;

- installation of a system for precise measurement of primary coolant system temperature;

- conducting of uninterrupted control on boron acid concentration in the primary coolant system;

- installation of technical tools for control of the electric circuit lines and isolation in the safety systems;

- introduction of computrized system for control of the reversible electric motor-generators;

In parallel with the execution of the technical measures the work on the analyses, studies and enhancement of the operational documentation was further continued. In the framework of Stage 2 the basic predesign studies for modernisation within the next stage were carried out and a number of new studies were performed, namely:

- loss of feed water and verification of " feed and bleed" procedure;

- radiological aspects in case of tube rupture in a steam generator;

- inadvertent opening of steam generator safety relief valve;

- inadvertent opening of quick-acting steam-dump valve to atmosphere;

- study on the possibilities and necessity of automatic isolation of systems in case of an earthquake;

- risk analysis of fire in the main control room;

- risk analysis of fire in the turbine hall;

- assessment of the internal initiating events based on the operational experience;

- verification of computation codes for assessment of the reactor pressure vessel enbrittlement after annealing, taking into account the results of a repeated irradiation of boat samples from the reactor pressure vessel of unit 2.

2.3. Stage 3

The main modernizations carried out in the principal technological systems within Stage 3 of the Programme are:

- replacement of steam generators safety relief valves;

- installing quick-acting isolation valves on main steam pipelines from the steam generators;

- introduction of a redundant emergency feed water system for the steam generators of units 3 and 4;

- introduction of a second fire-extinguishing pumping station;

- improvements in the fire-extinguishing and fire-alarm systems;

- introduction of a computerised system for control of the main parameters related to the plant safety (SPDS- Safety Parameter Display System);

- installing redundant safety relief valves on primary coolant system pressurizer;

- installing main generator breakers;

- introduction of system for leak detection from the primary coolant system to the secondary circuit.

Research in the following fields were carried out parallel to the above mentioned activities:

- assessment of the reactor pressure vessel condition and research on the reactor pressure vessel enbrittlement by repeated irradiation of boat samples;

- justification of the LBB(Leak Before Break) concept applicability to the main primary coolant pipelines;

- qualification of the equipment necessary to set the nuclear power supply system in safe condition in case of an accident (including earthquake impact)

- assessments and design of antiseismic anchorage for the main technological systems and structures;

- assessment of the equipment rest life time;

- assessment of the unit 1 reactor pressure vessel enbrittlement according to the results of the performed investigations of boat samples from the reactor pressure vessel in 1996 as well as the results of the thermohydraulic and thermomechanic analyses;

- PSA (Probabilistic Safety Analysis) level 1 for units 1 and 2;

- PSA (Probabilistic Safety Analysis) level 1 for units 3 and 4.

The overall implementation of Stage 3 measures of the short term Programme was completed in 1997.

I. Planned Measures for Safety Upgrading in the Framework of the Complex Programme for Modernisation of Units 1-4, PRG'97

Code	Measure	Unit	Term
M.1.1.	Replacement of neutron flux control system in the "Source Range"	1-2	1999
M.1.2.	System for on-line monitoring of the axial reactor core power distribution	1-2-4	1999
M.1.3.	Optimisation of nuclear power supply system parameter limit table for different modes of operation	1-2-3-4	1999
M.2.1.	Fuel elements leak tightness control by reference isotopes	1-2-3-4	1999
M.2.2.	Analysis of reactor core cooling in case of LOCA in diameter of 100-500 mm	1-2-3-4	1998
M.2.3.	Substantiation of the strength of the reactor pressure vessel internalsaccording to modern standards	1-2-3-4	2001
M.2.4.	Providing feed water to the units 1 and 2 steam generators from a redundant emergency feed water system	1-2	1999
M.2.5.	Providing uninterrupted power supply for pumps 1 and 2 of the back-up demineralized water tank	1-2	1998
M.2.6.	Repair of back-up demineralized water tanks 1 and 2	1-2	1999
M.3.1.	Assessment of the probability for reactor pressure vessel rupture	1-2-3-4	2000
M.3.2.	Assessment of the reactor pressure vessel rest life time	1-2-3-4	1999
M.4.1.	Additional design justification of steam generator strength	1-2-3-4	2000
M.4.2.	Static-dynamics strength analysis of primary coolant system	1-2-3-4	1999
M.4.3.	Upgrading the reliability for operation of primary coolant system pipelines of 200 and 500 mm.	1-2-3-4	1999
M.4.4.	Replacement of steam generator blow-down system iron pipelines with stainless steel ones	1-2-3-4	2000
M.4.5.	Rehabilitation of steam generator blow-down system	1-2-3-4	1999
M.5.1.	Justification of the permisible air-leak of the steam generator confinement room	1-2-3-4	1998
M.5.2.	Assessment of the parameters in the steam generator confinement room in case of primary coolant system pipeline rupture	1-2-3-4	1998

M.5.3.	Enhancement of the localising systems	1-2-3-4	2001
M.5.4.	Equiping the air-lock chamber to the main coolant pumps room	1-2-3-4	1998
M.5.5.	Upgrading the reliability of the sprinkler system	1-2	1999
M.6.1.	PSA -level 1	1-2-3-4	1998
M.6.2.	PSA -level 2	1-2-3-4	1999
M.6.3.	Assessment of the impact on the environment	1-2-3-4	1999
M.6.4.	Development of a document replacing SAR (Safety Analysis Report)	1-2-3-4	1999
M.6.5.	Enhancement of the safety systems according to the results of PSA - level 1	1-2-3-4	1998
M.6.6.	Programme for rest life time control and management	1-2-3-4	1999
M.7.1.	Analysis of failures in the reliable power supply system	1-2-3-4	1999
M.7.2.	Minimising the diesel-generator protections	3-4	1999
M.7.3.	Total physical separation of the reversible electric motor-generators	1-2	1998
M.7.4.	Installing breakers at the main generators	1-2	1999
M.7.5.	Replacement of the breakers and cathode dischargers in the main switch yard	1-2-3-4	1999
M.7.6.	Replacement of 6 kV, 0.4 kV and DC busbars	1-2-3-4	2001
M.7.7.	Replacement of the generator sealing bearings	1-2-3-4	1998
M.7.8.	Registration system of transients at in-house electrical systems of units 1 and 2	1-2	1999
M.7.9.	Replacement of generator excitation system	1-2-3-4	2000
M.7.10.	Dismantling the emergency service water tanks	3-4	1998
M.7.11.	Diesel-generators back-up cooling system	1-2-3-4	1999
M.7.12.	Introduction of hydrogen supply line from units 5 and 6	1-2-3-4	1998
M.7.13.	Installing a common power unit battery	1-2-3-4	1999
M.7.14.	Replacement of diesel-generators batteries	1-2-3-4	1999
M.7.15.	Replacement of the diesel generator automatic regulating excitation	1-2-3-4	1999
M.7.16.	Automatic temperature control of the main generator cooling water and gas	1-2-3-4	2000
M.7.17.	Installing a redundant start-up stand-by transformer	3-4	2000

M.7.18.	Replacement of safety relief valves at deaerator and secondary circuit equipment	1-2-3-4	1999
M.8.1.	Justification of operation with reduced number of emergency protection trains	1-2-3-4	1998
M.8.2.	Modernisation of the emergency control panel	1-2	1998
M.8.3.	Introduction of safety parameter display system	1-2	2000
M.8.4.	Modernisation of the operator support system	1-2-3-4	1998
M.8.5.	Steam generator water level control system	1-2-3-4	1999
M.8.6.	Modernisation of generator temperature regime control	1-2-3-4	1999
M.8.7.	Modernisation of generator gas control I&C	1-2-3-4	1999
M.8.8.	Information system for monitoring the water level in the plant "cold" channel	1-2-3-4	1999
M.8.9.	Replacement of the operating staff intercommunication system	1-2-3-4	1999
M.8.10.	Turbine-generator vibration control system	1-2-3-4	1999
M.8.11.	Separating the control circuit of quick-acting valves to turbine condenser at units 1 and 2	1-2	1999
M.9.1.	Modernisation of radiation control system in the restricted area	1-2-3-4	2000
M.9.2.	Reconstruction of pass-control room to the restricted area	1-2-3-4	1998
M.9.3.	Assessment of the equivalent dose of neutron irradiation	1-2-3-4	2000
M.9.4.	Installing additional tanks for storage of liquid radioactive waste	1-2-3-4	2001
M.9.5.	Rehabilitation of the system for treatment of draining radioactive water	1-2-3-4	1999
M.10.1.	Ensuring safe evacuation of the personnel in case of fire	1-2-3-4	1998
M.10.2.	Enhancement of the main control room ventilation system in case of fire	1-2-3-4	1998
M.10.3.	Automatic operation of the draining pumps in the turbine hall	1-2-3-4	1998
M.10.4.	Modernisation of the fire alarm systems at units 1 and 2	3-4	1999
M.11.1.	Anti seismic anchorage of the equipment and building structures	1-2-3-4	2000
M.11.2.	Assessment of the spent fuel pool racks in case of earthquake impact	1-2-3-4	1999

M.12.1.	Fresh fuel storage equipment enhancement	1-2-3-4	1998
M.12.2.	Safety upgrading during fuel storage, fuel transportation and reactor refuelling	1-2-3-4	2001
M.12.3.	Modernisation of the reactor refuelling machine control system	1-2-3-4	1999
M.12.4.	Establishment of internal area for units 1-4	1-2-3-4	1998
M.13.1.	Qualification of the equipment for operation in emergency conditions	1-2-3-4	1999
M.13.2.	Qualification of pipelines and categorisation of welded junctions	1-2-3-4	1998
M.13.3.	Enhancement of the operational documentation	1-2-3-4	1999
M.13.4.	Emergency instructions for management of over design based accidents	1-2-3-4	2001
M.13.5.	Prevention of unauthorised access to emergency core cooling system room	1-2-3-4	1998
M.13.6.	Change of water samples taking during refuelling	1-2-3-4	1998
M.13.7.	Project for a programme for decommissioning	1-2-3-4	2000
M.13.8.	System for automatic control of the secondary circuit water chemistry regime	1-2	1999
M.13.9.	Increasing the capacity of the demineralized water production facilities	1-2-3-4	1999
M.13.10.	Replacement of the nitrogen-oxygen facility	1-2-3-4	1999
M.13.11.	Facilities for cleaning the turbine condensers	1-2-3-4	1999
M.13.12.	Introduction of a simulator for personnel training	1-2-3-4	2000
M.13.13.	Modernisation of the air-conditioning systems	1-2-3-4	1999
M.13.14.	Replacement of the turbine condenser tubes	1-2-3-4	2002
M.13.15.	Turbine reconstruction	1-2-3-4	2001

III. List of Improvements Carried out at the Kozloduy NPP Units 5 and 6 in the Period from Start-up to 1998

No.	Subject	Unit
1	Performing tests on reactor containment air-leak tightness and strength	5 и 6
2	Modification of the logic of the steam generator feed water level main controllers	5
3	Upgrading the unit dynamic stability	5
4	Modification of turbine-generator unloading logic when 1 out of 2 turbine-driven pumps shuts down	5
5	Providing on-line information of the trains status for accelerated unit unloading to the computerised information system in case of generator switching off the grid	5 и 6
6	Modification of the logic of the device for acelerated unloading of the unit	5 и 6
7	Physical protection and access restriction to the unit 6 main control room	6
8	Upgrading the operational reliability of the mechanical devices for control and protection	5 и 6
9	Upgrading the effectiveness of alarm and emergency protection system	5 и 6
10	Ensuring accident free performance of high pressure emergency core cooling pumps	5 и 6
11	Replacement of primary coolant pump sealing	5
12	Reconstruction of the electronic component in the turbine regulating system	5 и 6
13	Improvement of steam generator feed water level controllers performance	5 и 6
14	Upgrading the reliability of power supply panels for the reactor protection system	5 и 6
15	Modification of preset limit for turbine-driven pump emergency shut-down due to increased feed water flow	5 и 6
16	Ensuring reliable functioning of the communication devices, uninterrupted power supply AC and DC consumers within the computerised information system and turbine hall	5 и 6
17	Optimisation of control rods function in the WWER-1000 reactor core	5 и 6

18	Modernisation of steam generator water level protections aimed to improve the operation stability in case of rapid flow increase	5 и 6
19	Permissible unloading rate of the nuclear power supply system by the controller for power unloading and limitation in case of shut-down of 1 out of 4 main coolant pumps	5 и 6
20	Replacement of spent fuel pool racks with compacted ones	5 и 6
21	Reconstruction of steam generators blow-down system	5 и 6
22	Replacement of reactor control rods position sensors	6
23	Replacement of safety systems batteries	5 и 6
24	Replacement of reactor control rods position sensors	5
25	Keeping up nominal water level in the steam generators and modification of technological alarm presets after modernisation of feed water and blowdown systems	6
26	Upgrading the dynamic stability in transients in case of inadvertent closing of quick-acting isolation valves	5 и 6
27	Replacement of the steam generator water level control electric valves with pneumatic ones	5 и 6
28	Updating the 1992 technical specifications book for safe operation of WWER-1000/V-320 units	5 и 6
29	Replacement of reactor half-length absorber control rods with full-length ones	5 и 6
30	Upper reactor unit, sensor sealing assemblies - replacement of nickel gaskets with extended graphite ones	5 и 6
31	Replacement of compressors	6
32	Refinement of intermediate bars for the reactor mechanical control rods	5 и 6
33	Corrections in the reactor protective tubes unit	6
34	Improvement of the diesel generator lubrication system during blackout	5 и 6
35	Reconstruction of the cool down system	5 и 6
36	Replacement of the battery for the reactor control and protection system	5
37	Enhancement of the independent radiation monitoring	5 и 6
38	Providing planned cooling down of primary coolant system at low pressurizer water level	5 и 6
39	Replacement of secondary circuit safety relief valves	5 и 6
40	Modification of the technical specifications book for safe operation of WWER-1000/V-320 unit	5

41	Transferring to three year reactor fuel cycle	5
42	Modification of the WWER-1000 reactor operational safety limits with regard to the specific primary coolant activity	5 и 6
43	Reactor unloading upon closing of turbine generator stop valves and a prohibition for opening of the quick-acting pressure reducing valve to the turbine condenser	6
44	Replacement of dispatcher monitoring panel	5
45	Replacement of neutron flux control system with new one	5

IV. Information on the Programme for Modernisation of the Kozloduy NPP Units 5 and 6

The Programme for Modernisation of the Kozloduy NPP units 5 and 6 was developed with the help of recommendations, assessments and analyses of safety based on:

- conclusions of OSART and ASSET missions carried out by the IAEA in 1991, 1994 and 1997;
- conclusions of similar missions carried out by the IAEA at power plants with WWER-1000/V-320 type reactors;
- recommendations given by the chief designer;
- Kozloduy NPP operation experience;
- scientific research carried out in the Republic of Bulgaria;
- assessments carried out by French and Cerman nuclear institutes on WWER-1000/V-320 type reactors.

The Programme goals are to define the technical measures for improvement of the technological, control and monitoring systems of the power units in such way as to meet the safety requirements reflected in the IAEA recomendation documents and evaluate the necessary financial expenses for their implementation.

The Programme was developed by the Kozloduy NPP, Energoproject PLC (Bulgaria) and Risk Engineering (Bulgaria) in cooperation with EDF (France). It was approved by the National Electric Company PLC (in May 1995) and the CUAEPP (in June 1995) and examined by the IAEA (in July 1995) and Riskaudit (in April 1997).

The Programme for modernazation of the Kozloduy units 5 and 6 structurally combines the concept of defence in depth, taking into account the fundamental functions of the safety. The areas for modernization are:

- qualification of components and equipment;
- in-service metal inspection;
- control and monitoring systems;
- electric power suply systems;
- water cooling systems and ventilation;
- risk of internal impacts;
- risk of external impacts;
- systems relibility analysis.

The measures for upgrading the nuclear safety and radiation protection of the Kozloduy units 5 and 6 foreseen in the Programme are structurally divided in 5 areas (design oriented measures for units' safety upgrading, studies and additional investigations, measures related to the units' availability upgrading, measures for house keeping upgrading, measures related to the units' decommissioning). According to the execution schedule these measures are incorporated in three groups (group A, group B, and group C) and altogether they are more than 168.

The list of the basic measures on the modernization of units 5 and 6 is shown below:

No.	Measure	Term of Execution	Main Executor
1.	2.	3.	4.
1.	Replacement and enhancement of the existing computer information system: a/ unit 5; b/ unit 6	 1999 - 2001 2001 - 2002	 Westinghouse /USA/
2.	Implementation of safety parameter display system (SPDS) a/ unit 5; b/ unit 6	 1999 - 2001 2001 - 2002	 Westinghouse /USA
3.	Replacement of the computerized systems for in-core reactor parameter monitoring with more effective ones: a/ unit 5; b/ unit 6	 2002 2003	European consortium Kozloduy/ECK/ Atomenergo-export/Russia/

4.	Replacement and enhancement of the unifying complex of technical means at unit 5	2001-2005	Westinghouse /USA/
5.	Implementation of diagnostic computerized information systems for radiation monitoring	2002	Westinghouse /USA/
6.	Upgrading the reliability of steam generators' relief valves of units 5, 6	2002	ECK, Siemens
7.	Replacement of 6 kV breakers aimed to upgrade the reliability	2002	ECK, Siemens
8.	Installing of systems for detection and recombination of hydrogen	2002	ECK, Siemens
9.	Implementation of system for quick detection and localizing of a leak from the upper unit of the reactor	2002	ECK, Siemens
10.	Improvement of the effectiveness of the gas fire exstingushing system	2002	ECK, Siemens
11.	Upgrading the quality of the fire alarm system in accordance with the requirements for seismic stability	2002	ECK, Siemens
12.	Heating up the water in the tanks for emergency core cooling systems (high and medium pressure) above 55 ^{o}C	2002	EKK, AEE
13.	Upgrading the reliability of the relay protection and automatics of the main electric distribution system	2002	ECK, Siemens
14.	Mitigation the effects of secodary circuit pipelines rupture in the reactor containment	2002	ECK, Siemens
15.	Development of a personnel training system based on ALARA principle	2000	ECK, Siemens
16.	Replacement of the main generator power breakers	2002	ECK, Siemens

17.	Installing a redundant diesel-generator at each unit	2002	ECK, Siemens
18.	Designing and procurement of automatic information system for water chemistry monitoring	2001	ECK, Siemens
19.	Renovation of the water treatment system and reagent facilities	2002	ECK, Siemens

Annex 4

DESCRIPTION OF THE NATIONAL LEGISLATION

I. System of the Normative Acts of the Republic of Bulgaria

The Constitution is the supreme law of the Republic of Bulgaria. This is an act of the highest legislative force. No other law shall contravene it.

The law is an act, with lower level legislative force in the system of normative acts. This is a normative act which regulates fundamental social relations and is passed under a special procedure determined by the Constitution of the Republic of Bulgaria and the Rule for the National Assembly Organisation and Activities - legislative process.

Under the Constitution (Article 114) and the Law on Normative Acts, the Council of Ministers issues ordinances to approve rules, regulations and directives (instructions). Rules shall be issued for implementation of the law in its entirety or for the organisation of state bodies or for by-laws governing their activities. The regulation shall be issued for the implementation of separate part, chapter or provision of the superior normative act.

The ministers and head of other authorities issue rules, regulations, directives (instructions) and orders (Article.115 from the Constitution)

The Council of Ministers shall rescind any illegitimate or improper act issued by ministers or head of state authorities.

International Acts in the Hierarchy of Acts

Under the Constitution of the Republic of Bulgaria, Article 5, Paragraph 4 international instruments which have been ratified by the constitutionally established procedure, promulgated and having come into force with respect to the Republic of Bulgaria, shall be considered part of the domestic legislation of the country. They shall supersede any domestic legislation stipulating otherwise. Under this provision, the Convention on Nuclear Safety is a part of the legislation of the Republic of Bulgaria.

The National Assembly ratifies and denounces international acts (agreements) which require ratification by a law. The Council of Ministers has the rights to conclude, confirm or denounce international treaties when authorised to do so by law. The President of the Republic of Bulgaria has the right to conclude international treaties in the circumstances established by the law (Constitution of the Republic of Bulgaria, Article 98). Promulgation and entering into force of international acts are done under the same procedure as for entering into force and promulgation of national acts.

Development of Regulations Within the CUAEPP System

The development of normative acts is set in the Instruction for development of safe utilisation of atomic energy regulations. Under Article 1, Paragraph 1.3, safety standards and rules are determined by regulations. Instructions give obligatory directions on enforcement of regulation's resolutions. Manuals give recommendable methodological instructions. Regulations and instructions are obligatory for all legal entities and physical persons, which exercise atomic energy utilisation activities on the territory of the Republic of Bulgaria. This instruction specifies that the regulations issued:

- should comply with laws, international agreements in which the Republic of Bulgaria is a part and the recommendations IAEA, ICRP, Health International Organisation and other international organisations requirements;
- should not contain requirements that reduce the already reached safety level;
- should make note of the level attained by the ACQUIS COMMUNAUTAIRE, according to the Europe Agreement Establishing an Association between the European Communities and their Member States, of the one part, and Bulgaria, of the other part.

The objective of these specific provisions is to provide adequacy of legal basis for the national laws, international acts and safety standards on the safe use of sources of ionising radiation.

Under an annual plan, adopted by the CUAEPP, acts under Article 1, Paragraph 1.3, are being developed.

The regulations and instructions are obligatory for the addressees and are published in the Official Journal and in the CUAEPP official edition. Manuals (they are advisory) are published only in the official editions.

II. Laws and Secondary Legislation in the Field of Nuclear Safety and Radiation Protection

1. Treaty on the Non-proliferation of Nuclear Weapons (ratified by the Presidium of the National Assembly's Decree No. 668, 10 August 1969, entry into force for the Republic of Bulgaria on 5 of March 1970, Promulgated D.V. No. 39, 1971);
2. Agreement between the People’s Republic of Bulgaria and the International Atomic Energy Agency for the Application of Safeguards in connection with the Treaty on the Non-proliferation of Nuclear Weapons (entry into force for the Republic of Bulgaria on 29 February 1972);

3. Convention (Vienna Convention) on Civil Liability for Nuclear Damage (CCLND, ratified by National Assembly's Act, passed 26 August 1994, entry into force for the Republic of Bulgaria on 24 November 1994, Promulgated D.V. No. 76, 1994, amended D.V. No. 91, 1994);
4. Convention on the Physical Protection of Nuclear Material (CPPNM-1979, ratified by the State Council of the Republic of Bulgaria's Order No. 3514, 30 December 1987, Promulgated D.V. No. 2/ 1988);
5. Convention on Early Notification of a Nuclear Accident (CENNA-1986, ratified by State Council of the Republic of Bulgaria's Order No. 3514, 30 December 1987, Promulgated D.V. No. 2/ 1988);
6. Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency (CANARE-1986, ratified by State Council of the Republic of Bulgaria's Order No. 3514, 30 December 1987, Promulgated D.V. No. 2/ 1988);
7. Convention on Nuclear Safety (CNS-1994, ratified by a National Assembly's Law, passed 14 September 1995, Promulgated D.V. No. 86/ 1995);
10. Agreement on the Privileges and Immunities of the International Atomic Energy Agency (ratified by a National Assembly's Law, passed 12 January 1994, Promulgated D.V. No. 8/ 1994);
11. Agreement between the Government of the Republic of Bulgaria and the Government of the Republic of Greece on Early Notification of a Nuclear Accident and Exchange of Information on Nuclear Facilities (Adopted by a Council of Ministers' Decree No. 165, October 23, 1989);
12. Agreement between the Government of the Republic of Bulgaria and the Government of the Republic of Romania on Early Notification of a Nuclear Accident and Exchange of Information on Nuclear Facilities (7. Convention on Nuclear Safety, ratified by a National Assembly's Law, passed 25 September 1997 - D.V. No. 87/1997, Promulgated D.V. No. 17/1998, entry into force 01.01.1998);
13. Agreement between the Government of the Republic of Bulgaria and the Government of the Republic of Turkey for Notification of a Nuclear Accident and on Exchange of Information on Nuclear Facilities (ratified by a National Assembly's Act, passed 28 January 1998 - D.V. No. 15/1998, Promulgated D.V. No. 60/1998, entry into force 21.05.1998);
14. Agreement for Co-operation between the CUAEPP to the Council of Ministers of the Republic of Bulgaria and the Federal Supervision on Nuclear and Radiation Safety of the Russian Federation (Approved by a Council of Ministers' Resolution No. 17, March 11, 1996);

16. Agreement between the Government of the Republic of Bulgaria and the Government of the Russian Federation for Co-operation in the Field of Peaceful Use of Atomic Energy (Approved by a Council of Ministers' Resolution No. 380, 06 September 1995);
17. Agreement for Co-operation between the CUAEPP to the Council of Ministers of the Republic of Bulgaria and the Federal Ministry of Natural Environment, Nature Protection and Reactor Safety of the Federal Republic of Germany (Approved by a Council of Ministers' Resolution, 25 May 1992);
18. Act on the Withdrawal of Reservations and Declarations under International Conventions concerning the Compulsory Jurisdiction of the International Court of Justice and the International Court of Arbitration (Promulgated, D.V. No. 8 of 27 January 1994)
19. Act on the Use of Atomic Energy for Peaceful Purposes (Promulgated D.V. No. 79/1985, corrected D.V. No. 80/1985, amended and supplemented D.V. No. 69/ 1995);
20. Act on the Protection of Environment (Promulgated D.V. No. 86/1991, corrected D.V. No. 90/ 1991, amended and supplemented D.V. No.100/ 1992, D.V. No. 31/ 1995 and D.V. No. 63/ 1995);
21. Act on Public Health (Promulgated D.V. No. 88/ 1973, corrected D.V. No. 92/ 1973, amended D.V. No. 73/ 1976, D.V. No. 28/ 1983, D.V. No. 66/ 1985, D.V. No. 27/ 1986, D.V. No. 89/ 1988, D.V. No. 87/ 1989, D.V. No. 99/ 1989, D.V. No.15/ 1991, corrected D.V. No. 24/ 1991, amended D.V. No. 64/ 1993, D.V. No.31/ 1994, D.V. No. 36/ 1995 and D.V. No. 12/ 1997);
22. Act on Concessions (Promulgated D.V. No. 92/ 1995; Ruling of the Constitutional Court of Republic of Bulgaria of 6 February 1996 - D.V. No.16/1996; amended D.V. 44/1996, in force as from 1 June 1996, amended and supplemented D.V. No. 61/1997, supplemented D.V. No. 123/1997);
23. Act on Territorial and Regional Organisation (Promulgated D.V. No. 29/ 1973, corrected D.V. No. 32/ 1973, amended D.V. No. 87/ 1974, D.V. No. 3/ 1977, D.V. No. 102/ 1977, D.V. No. 36/ 1979, D.V. No. 3/ 1980, D.V. No. 5/ 1984, D.V. No. 19/ 1985, D.V. No. 36/ 1986, D.V. No. 14/ 1988, D.V. No. 31/ 1990, corrected D.V. No. 32/ 1990, amended D.V. No. 15/ 1991, D.V. No. 63/ 1995 and D.V. No. 104/ 1996);
24. Act on Support in Case of Social Disasters (Promulgated: D.V. No. 304/1948, corrected D.V. No. 308/1948, amended D.V. No. 17/1955, D.V. No. 63/1976);
25. Act on Healthy and Safe Conditions at Work (Promulgated: D.V. No. 124/1997);
26. Act on Ministry of Internal Affairs (Promulgated D.V. No. 122/1997; Judgement 6 of the Constitutional Court of Republic of Bulgaria of 7 March 1998 - D.V. No. 29/1998; amended D.V.No. 70/1998. amended and supplemented D.V. No. 73/1998);

27. Rule for implementation of the Act on the Use of Atomic Energy for Peaceful Purposes (Approved by a Decree of the Council of Ministers No. 37 of 1 July 1986, promulgated D.V. No. 66/1986);
28. State Council Decree 265 for Civil Defence (Promulgated D.V. No. 14/1978);
29. Regulation No. 2 on Cases of and Procedures for Notifying the Committee on the Use of Atomic Energy for Peaceful Purposes, on Nuclear Safety and Radiation Protection Related Operational Variations, Occurrences and Emergency Situations (Promulgated D.V. No. 26 of 1988, amended D.V. No. 28 of 1988);
30. Regulation No. 3 on Nuclear Power Plants Safety Assurance During Design, Construction and Operation (Promulgated D.V. No. 27 of 1988);
31. Regulation No. 4 on Nuclear Material Accounting, Storage and Transport (Promulgated D.V. No. 66 of 1988; amended D.V. No. 83 of 1993);
32. Regulation No. 5 on Licensing the Use of Atomic Energy (Promulgated D.V. No. 13 of 1989; amended and supplemented D.V. No. 37/1993);
33. Regulation No. 6 on Criteria and Requirements for Training, Qualification and Licensing of the Personnel Employed in the Field of Atomic Energy (Promulgated D.V. No. 47 of 1989; amended D.V. No. 43/1991);
34. Regulation No. 7 on Radioactive Wastes Collection, Storage, Treatment, Transportation and Disposal on the Territory of the Republic of Bulgaria (Promulgated D.V. No. 8 of 1992);
35. Regulation No. 8 on Physical Protection of Nuclear Facilities and Nuclear Material (Promulgated D.V. No. 83/1993);
36. Regulation on Relieve of Small Quantities of Nuclear Material from the Convention (Vienna Convention) on Civil Liability for Nuclear Damage Responsibilities (Approved by Council of Ministers Ordinance No. 93, April 27, 1995, promulgated D.V. No. 43/1995);
37. Basic Standards for Radiation Protection, Approved by Council of Ministers Ordinance No. 252, 11 December 1992;
38. Regulation No. 0-35 on Manipulation with Radioactive Substances and Sources of Ionising Radiation (Promulgated D.V. No.96 of 12.08.1986, in force as from 02.08.1974)
39. Regulation No.46 on Transportation of Radioactive Substances (Promulgated D.V. No.53/02.07.1976);
40. Regulation No.4/07.07.1998 on Environmental Impact Assessment (Promulgated: D.V. No. 84/22.07.1998)
41. Regulation No. 7 on the Levels for Determination the Quality of Surface Water for Different Type of Polluters (Promulgated D.V. No.96/1986);

42. Regulation on the Procedure for Establishing and Imposing Sanctions in Case of Environmental Damages or Pollution above the Maximum Permissible Levels (Approved by Council of Ministers Ordinance No. 24/1993, promulgated: D.V. No. 15/1993, amended D.V. No. 101/1995, D.V. No.34/1997)
43. Regulation on establishment, exploitation and development of National Automated System for constant control of the gamma-background measurement on the territory of Republic of Bulgaria (Approved by Council of Ministers Ordinance No. 434, 19.11.1997, promulgated: D.V. No. 112/1997, in force as from 28.11.1997)
44. Council of Ministers Ordinance No.493/30.12.1997 on the Export and Import Regime (promulgated: D.V. No. 126/30.12.1997, in force as from 01.01.1998, amended D.V. No. 2/07.01.1998, in force as from 07.01.1998, amended D.V. No. 92/07.08.1998, in force as from 23.08.1998);
45. Council of Ministers Ordinance No. 216, 11 October 1994, on Exemption of Custom Duties of the Imported in the Republic of Bulgaria, Within the Framework of Gratuitous Help to the Kozloduy NPP Equipment (Promulgated: D.V. No. 86/1994);
46. Council of Ministers Ordinance No. 45, 30 December 1988 on adoption of Regulations on Rescue and Other Urgent Activities' Structure and Management in Natural Disasters and Severe Industrial Accidents;
47. Council of Ministers Ordinance No. 31, 23 June 1989 on Enhancement of Country Preparedness for actions in Natural Disasters and Severe Industrial Accidents;
48. Council of Ministers Ordinance No. 212, 10 November 1993 on organisation of 24 hour duty for notification in case of military activities or disasters and industrial accidents (Promulgated: D.V. No. 98/1993, amended D.V. No. 43/1994, D.V. No. 29/1996, D.V. No.18/1998)
49. Council of Ministers Ordinance No. 27, 04 June 1984 on Management of Consequences from Disasters and Industrial Accidents (Promulgated: D.V. No. 48/1984, amended D.V. No. 15/1989, D.V. No. 43/1990, D.V. No. 65/1991)
50. Rule on Organisation and Activities for Mitigation of Disasters, Accidents and Collisions Consequences (Adopted by Council of Ministers Ordinance No. 18, 23 January 1998, promulgated: D.V. No. 13/1998, in force as from 03.02.1998)
51. Council of Ministers Resolution No. 53, 5 April 1988 on Enhancement of the Country Radiation and Chemical Protection and the Kozloduy NPP and Other Nuclear Reactors' Nuclear and Radiation Safety;

52. Council of Ministers' Resolution No. 182, 20 April 1995, on Defining of a Nuclear Facility and its Operator Under the Convention (Vienna Convention) on Civil Liability for Nuclear Damage;
53. Council of Ministers' Resolution No. 106, 23 January 1997, on Defining of a Nuclear Facility, its Operator, Type, Terms and Time-limits of Financial Guarantee of the Operator, compensating liability for nuclear damage under Act on the Use of Atomic Energy for Peaceful Purposes, Article 36b, for RRT-2000;
54. Council of Ministers Bureau's Order No. 18, 27 December 1989, on Improvement of State Control in NPPs;
55. Temporary Instruction on Co-operation of Specialised Authorities and Sections of the Permanent Commission for Public Protection in Cases of Calamities and Emergencies in a case of Radiological Emergency in the Territory or Outside the Territory of the Republic of Bulgaria (Approved by the Chairman of the Permanent Commission for Public Protection in Cases of Calamities and Emergencies to the Council of Ministers and the Chairman of the Committee on the Use of Atomic Energy for Peaceful Purposes to the Council of Ministers, 1992);
56. Instruction for Enactment of the System for Public Protection in cases of Radiological Emergencies (Approved by the Chairman of the Permanent Commission for Public Protection in Cases of Calamities and Emergencies to the Council of Ministers and the Chairman of the Committee on the Use of Atomic Energy for Peaceful Purposes to the Council of Ministers, 1992);
57. National plan "Environment and Health". Approved by Council of Ministers Resolution No. 314 of the 29.06.1998.

III. National Programme for Adoption of the *ACQUIS COMMUNAUTAIRE*

Field of Energy - Nuclear Safety

General Objectives

- Approximation of the existing and future nuclear legislation of the Republic of Bulgaria with the EC legislation.
- Improvement of the functional safety and assessment of the opportunities for reconstruction of the existing energy production capacities with reactors WWER-440 and WWER-1000
- Improvement of the qualifications of the executive and other personnel of the regulatory body and organisations operating nuclear installations

- Reduction of the harmful effect of ionising radiation from nuclear equipment and other sources of ionisation radiation upon the personnel, the population and the environment

Improvement of the management of nuclear materials in the Republic of Bulgaria

Short-term Activities (1998)

- Expected Law on the Ratification of the Integrated Convention for Safety in the Management of Spent Nuclear Fuel and Safety in the Management of Radioactive Waste.
- Expected Law on the Ratification of the Protocol on the Review of the Vienna Convention on Civil Liability for Nuclear Damage and the Convention on Additional Financing
- Act on the Safe Use of Nuclear Energy. Planned activities for the preparation of a new act.
- Act on the Radiation Protection of the Population. Planned activities for the preparation of a new act.
- Rule for the application of the Act on the Use of Atomic Energy for Peaceful Purposes. Continued activity for the preparation of a new act.
- Regulation on the emergency planning and preparedness for accidents in nuclear installations with radioactive fallout in the environment. Continued activity for the preparation of new legislation.
- Radiation protection standards. Continued activity for updating of the existing standards.
- Regulation on the terms and conditions for the issuance of licences for the use of atomic energy. Planned activity for updating of the existing regulation
- Regulation on the basic rules for work with sources and ionising radiation. Planned activity for the preparation of a new act.

Regulations on the terms and conditions for the raising, spending and control of resources in the following funds: Energy Development, Energy Efficiency, Safe Storage of Radioactive Waste, and Decommissioning of Nuclear Installations

Medium-term Activities (1999-2000)

- Standards for permissible contents of radionuclides in metal and non-metal raw materials and products

- Standards for permissible radioactive pollution of foods and fodder in the event of nuclear accident or emergency radiation situation. Planned activity for updating of the existing document. Planned activity for the preparation of a new act.
- Special arrangements for import and export of foods and fodder in the event of nuclear accident or emergency radiation situation.. Planned activity for the preparation of a new act.
- Regulation on the Safety of Nuclear Energy Installations. Planned activity for the preparation of a new act.
- Regulation on the border radiation control. Planned activity for the preparation of a new act.
- Regulation on the Safety of Installations for Final Storage of Radioactive Wastes. Planned activity for the preparation of a new act.
- Regulation on the criteria and requirements towards the training, qualifications and licensing of the personnel working in the use of atomic energy. Planned activity for updating of an existing document.
- Regulation amending and supplementing Regulation No. 2 of the CUAEPP. Planned activity.
- Regulation amending and supplementing Regulation No. 7 of the CUAEPP. Planned activity.
- Regulation on the transportation of radioactive substances. Planned activity for updating of the existing legislation.
- Regulation on the technical control of equipment, installations and pipelines of the nuclear power plant. Planned acitivity for the preparation of a new act.
- Regulation amending and supplementing Regulation No. 4 of the CUAEPP. Planned activity.
- Provisions regulating the safe decommissioning of nuclear power plants. Planned activity for the preparation of new legislation.

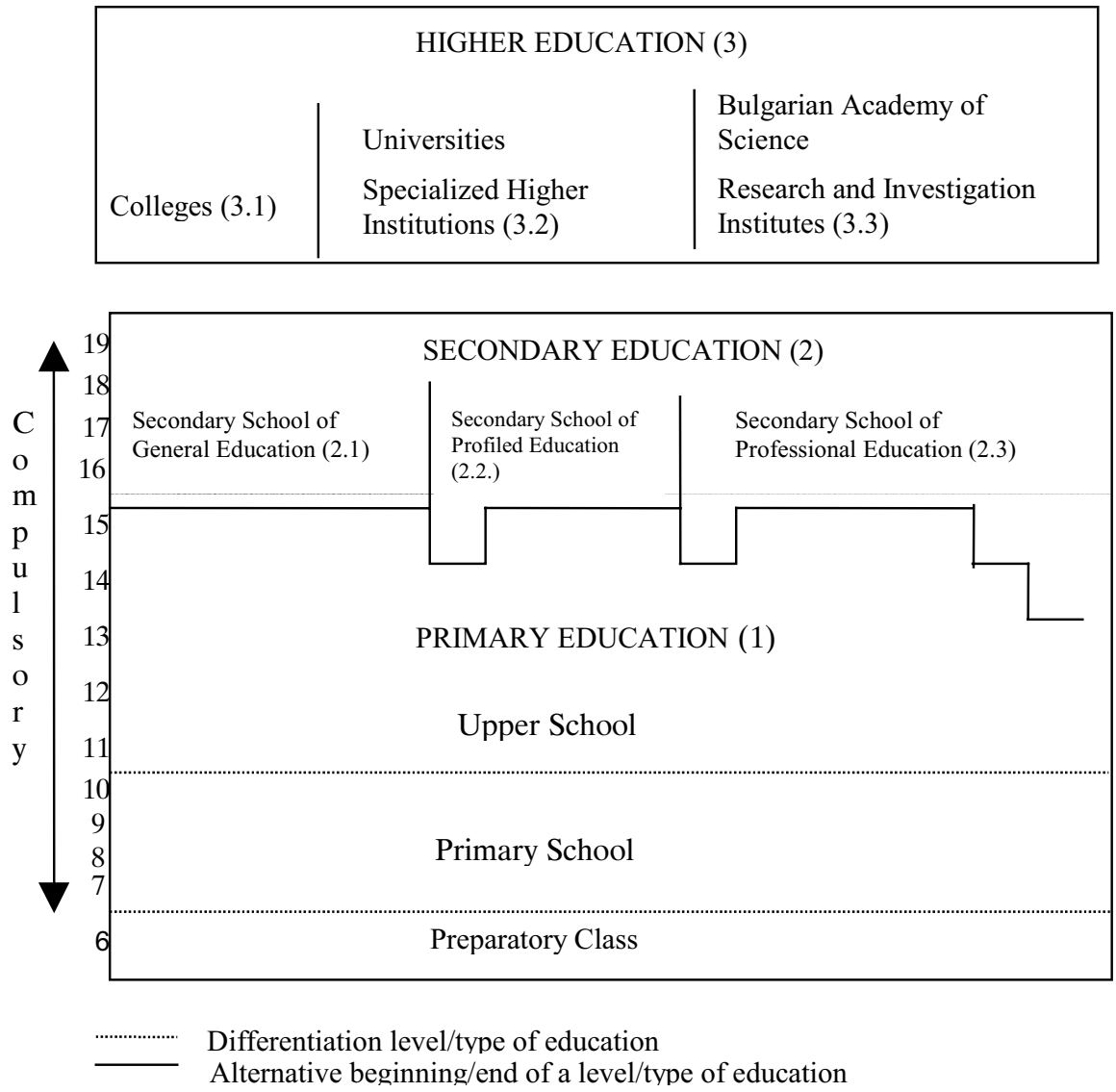
Long-term Activities (2001-2007)

- Agreement with EURATOM on the accounting and control of nuclear material. Planned activity.
- Co-ordination of all agreements for fresh nuclear fuel with EURATOM. Planned activity.

Annex 5

System for Training and Qualification of the Kozloduy NPP Personnel

5.1. Educational System in Bulgaria



Description of the Educational System

(1) Primary education has been compulsory in Bulgaria since 1921. It covers children from 6, 7 till 16 years of age and continues from 1st to 8th class, including:

- a preparatory class for children, who had not attended kindergarden or have poor knowledge of Bulgarian language;

- Primary Education from 1st to 4th class;

- Upper School from 5th to 8th class.

- Professional Technical Education after either 6th, 7th or 8th class.

(2) One can get three types of secondary education in Bulgaria: general, profiled or/and professional.

(2.1) Secondary general education is acquired in the secondary schools of general education, where students are admitted after graduating 7th or 8th class for 5 or 4 years of education respectively.

(2.2) Secondary schools of profiled education, where students are admitted after graduating 7th or 8th class for 5 or 4 years of education respectively, provide general secondary education along with a special educational profile (foreign languages, natural sciences, mathematics, humanities).

(2.3) Secondary professional education can be acquired in the technical (professional) schools, where students are admitted after graduating 7th or 8th class for 5 or 4 years of education respectively. The first type of schools provide intensive study of foreign language.

(3) Higher education, according to the Law for Higher Education (1995), can be acquired in the following institutions of higher education: universities, specialized institutions of higher education (academies, institutes etc.,) and colleges (semi-higher institutes) - independent or comprising faculties or branches of universities. Higher education graduates can acquire the following educational qualification degrees:

- specialist - following 3-years of education;

- bachelor - following 4-years of education;

- master - following 5-years of education or one year of post Bachelor╥s Degree educational programme;

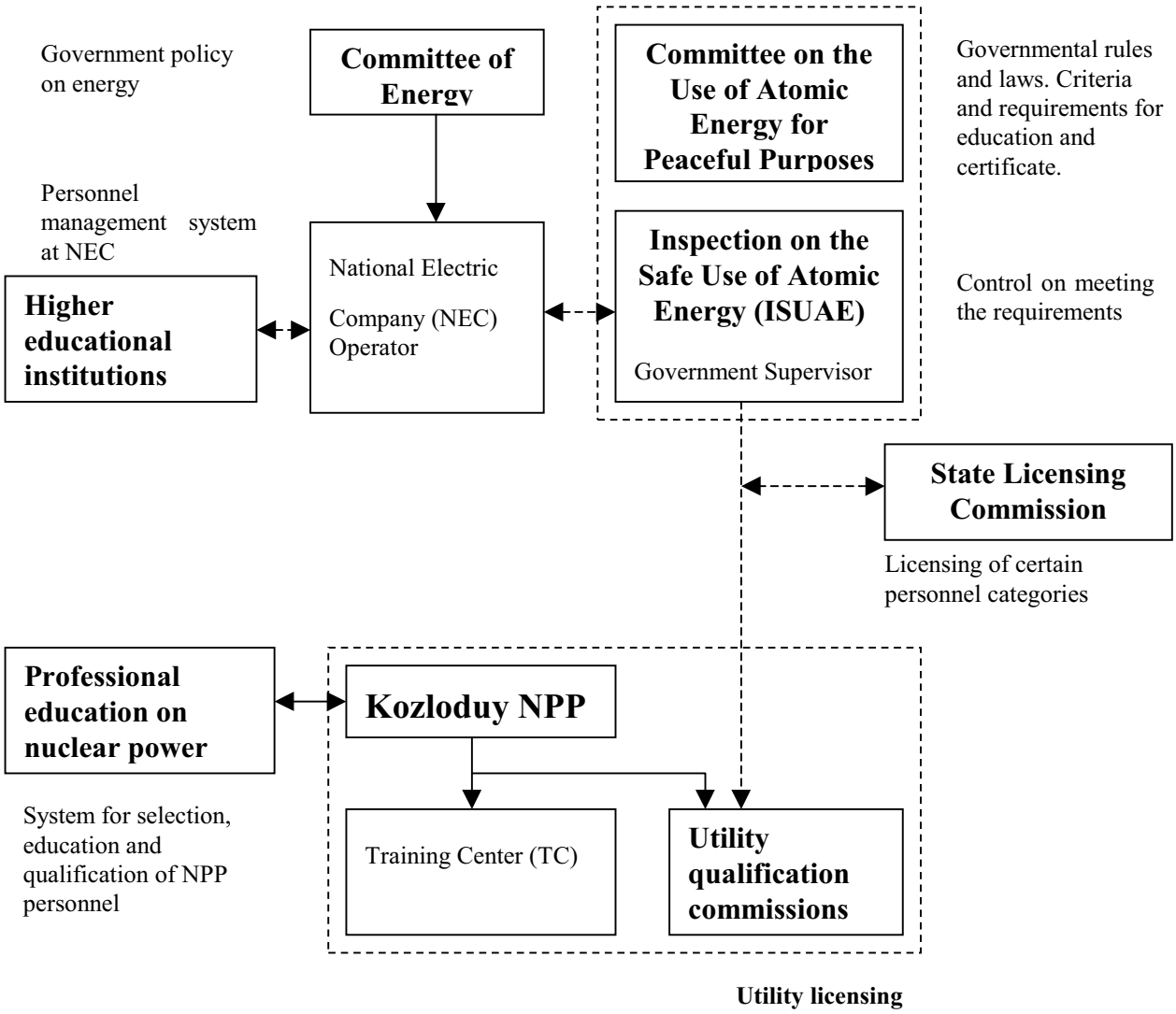
- doctor - following a 3-year post Masters Degree educational programme.

(3.1) Colleges (semi-higher institutes), being independent educational institutions provide certain professional qualification and offer educational programmes of at least three years of education for attaining the degree - Specialist.

(3.2) Universities and specialized higher institutions (academies, institutes) cover a wide spectrum of specialties in the field of humanities, natural sciences and industrial technologies. They provide the possibility of acquiring the degrees - Bachelor, Master and Doctor. Education on qualification improving is provided as well. Research and development activities are carried out too.

(3.3) The specialized higher institution, such as the Bulgarian Academy of Science (BAS) and the specialized research and development institutes, offer educational programmes designed for obtaining a Doctor's degree of specialties for which they are authorized.

5.2. Scheme of the Interactions between the Kozloduy NPP, NEC and the State Authorities, Concerning the Plant Personnel Education, Training and Qualification



5.3. Brief Description of the Simulators at the Kozloduy NPP's Training Centre

Type	Reference unit	Designed for training of personnel at unit:	Status
Full-scope simulator	6	5,6	In a process of installing and commisioning; educational papers under preparation
Analytical simulator	6	5,6	Installed in 1995; educational papers under preparation
Compact simulator	6	5,6	Installed in 1995; educational papers under preparation
Multifunctional simulator	3	1-4	Under process of development
Engineering analyzer	3,6	1-6	Installed in 1998.

Multifunctional simulator of WWER-440 (Kozloduy NPP's unit 3 as a referent unit) was developed within the framework of a regional PHARE-TACIS project and its delivery is expected by September 1998.

The full-scope simulator (FSS) of WWER-1000 (Kozloduy NPP's unit 6 as a referent unit) is under construction. Part of the equipment has been already supplied and the simulator panels are installed. Within the framework of the full-scope simulator project, an analytical WWER-1000 simulator was provided and installed, at the time being used for personnel training and operational procedures verification.

A compact simulator of WWER-1000 (Kozloduy NPP's unit 6 as a referent unit), has been installed at the Training Centre, supplied by Corys (France) and designed for training the operational staff from Reactor, I&C and Reactor Control & Protection Divisions, thus supporting the General Technology courses, as well as control room operators, by using it as an introduction to FSS training.

Engineering analyzer (EA) is designed for investigations by actual analyses of units' performance during all normal and emergency modes of operation; adequate training of the operators; development and verification of symptom oriented emergency procedures. EA main components are the operating stations, a computer code RELAPS5/MOD3 for thermo-hydraulic analysis and the code CVS (graphic interface).

5.4. List of Documents, Regulating the Education and Qualification of the Kozloduy NPP Personnel

1. Act on the Use of Atomic Energy for Peaceful Purposes (AUAEPP)
2. Rules for application of the AUAEPP
3. Labour Code
4. Act on Public Health
5. Basic standards of radiation protection
6. Regulation No 6 of the CUAEPP
7. Concept for selection, professional evaluation and training of NEC-PLC personnel
8. Main postulates of NEC-PLC. personnel management
9. Rule for distribution of resposibilities on the professional qualification at NEC-PLC.
10. Statute of Personnel Management Council of NEC-PLC.
11. Statute of the Branch Center for Professional Qualification within NEC-PLC administrative structure.
12. Statute of the Branch Council for Education and Training within NEC-PLC administrative structure.
13. Rule for interrelations between NEC-PLC. and the institutions for professional-technical and higher education, preparing personnel for the power generation facilities.
14. Regulation for professional staff recruitment within NEC-PLC. administrative structure.
15. Regulation for the order and the way of organizing the professional qualification of different categories and groups of personnel at NEC-PLC.
16. Regulation for evaluation of professional knowledge and skills of NEC-PLC personnel.
17. Job description patterns, methodological guidelines and procedures for their drafting.
18. Patterns and methodological guidelines for preparation of profession descriptions.
19. Regulation for technical operation of electrical plants and grids.
20. Industrial safety rules.
21. System for recruitment, selection, training and qualification improvement of the Kozloduy NPP personnel.
22. System for training and qualification of the personnel at the Kozloduy units 1-4
23. Statute of the Kozloduy NPP Higher Training Centre (HTC)
24. Rule for in-house order at the HTC

25. Personnel training and qualification policy declaration of the Kozloduy NPP management

26. Rule for qualification control and licensing of the Kozloduy NPP personnel

27. Directive for recruitment, selection, distribution and appointment of the Kozloduy NPP personnel

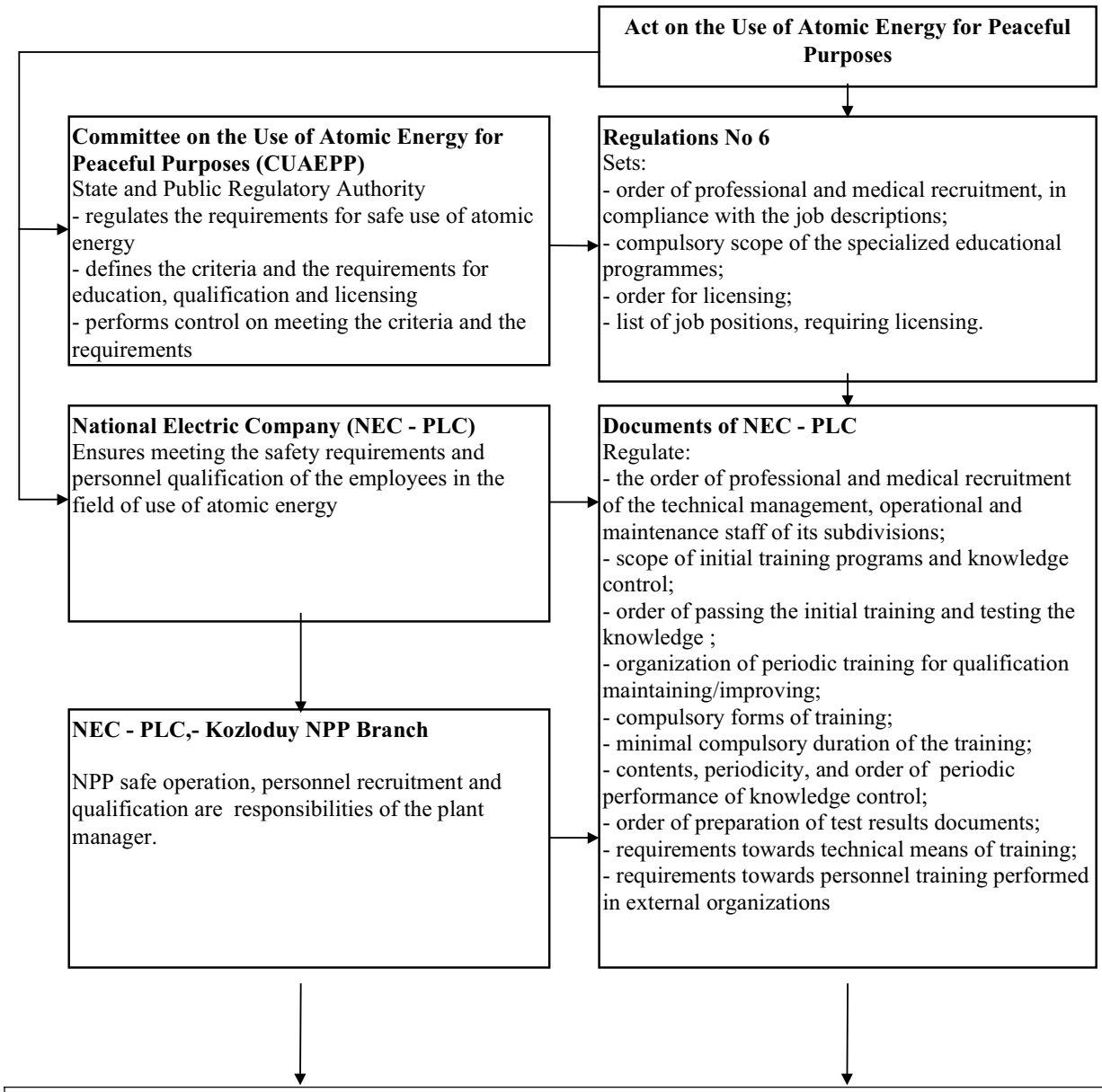
28. List of job positons liable to knowledge control and qualification level proof in front of Utility and State Qualification Commissions

29. Orders for Exam Commissions staffing

30. Procedures for evaluating the industrial and radiation safety knowledge by tests

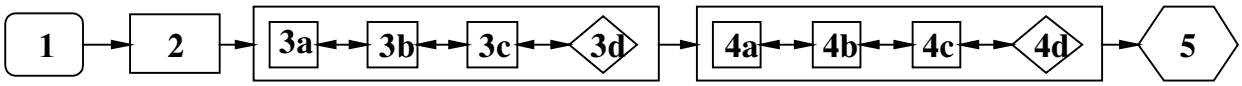
31. Training programmes.

5.5. Requirements According to the Documents at Different Levels, Concerning Personnel Education and Qualification



5.6. Model of the System for Personnel Training, Applied at the NPP and Some Edditional Explanations on its Implementation

I Model of the System for Personnel Training, Applied at the NPP



1. Admittance of the candidate, "Introduction" course, preliminary testing of the knowledge;

2. Safety courses, initial exam on safety, issuing a document for working place access

3. training for a job position (initial training):

3a - Training through lectures and testing of the knowledge

3b - training in working conditions;

3c - training by technical means, including mock-ups, simulators etc., and testing of the acquired skills;

3d - exam in front of a qualification commission and issuing a license

4. Periodic training:

4a - safety courses, periodical exams on the rules;

4b - courses on operational issues and testing of the knowledge;

4c - practical courses and training by technical means, including mock-ups, simulators etc., and tests on the acquired skills;

4d - exam in front of a qualification commission and confirming the qualification.

5. Decision on training for promotion to a new job position.

II Implementation of the Model for Personnel Training

(A) Training stages:

1**. Initial training:** It is applied to newly coming candidates and trains them to occupy a certain job position (working place). The scope, forms and duration of the initial training are regulated within the training programmes for each job position.

2. **Periodic training**: Maintains and improves the employees' qualification at the corresponding job positions (working places) at NPP. It includes training and periodic exams on the rules in force at NPP, theoretical and practical education carried out within working hours. The duration of the training is at least 20 hours per annual for theoretical education and emergency response drills.

3. **Extraordinary training**: Back-fits or updates employee╥s qualification for a certain job position (working place) in the following cases: long term absence, serious violation of instructions, procedures and control authorities prescriptions as well as in case of a personally expressed will of an employee (coordinated with his direct supervisor and TC management) and also under extreme circumstances.

4. **Retraining**: Prepares an employee to occupy a certain new job position for which a certain amont of time spent at the previous job position is required. Scope, forms and duration of the retraining are regulated by the training programs for each job position.

5. **Knowledge testing**: Checks the knowledge and skills acquired during the training as well as the qualification received after each training stage. The forms of knowledge testing are written, oral and practical examinations.

(B) Forms of Training

The educational training process is carried out at the Training Centre or at the working places either during working hours or other work:

1. **Theoretical training** - lectures, seminars and self-education. It includes studying the rules and regulations in force at the NPP, passing the general technical courses related to NPP technology and equipment as well as specialized theoretical training on learning the Kozloduy NPP technological scheme, the technological process, the operated systems and equipment, necessary for carrying out one's duties.

2. **Practical training** - education and training on different kinds of simulators, training in laboratories and workshops and training at mock-ups, training in working conditions and as stand-in man for the purpose of receiving practical skills on operating systems and equipment, necessary for carrying out one's duties.

3. **Instructions** - including initial instructions at the working place, periodic and extraordinary instructions.

Annex 6

Extended Programme on Additional Studies and Activities for Increasing the Safety of the Kozloduy NPP and Belene Sites

The objective of the programme is the assessment of the seismic stability and updating of the existing emergency plan. It includes the following tasks:

- neotectonic studies of the faults located up to 25akm from the site: a definition of the location and the potential seismicity of the faults by geological, geo-morphological and airphoto analysis, seismic profile, drills and river terraces analysis, etc.; development of seismic models;

- reevaluation of the historical earthquakes up to 320akm from the site; reevaluation of the parameters (coordinates, magnitudes, etc.) of historical earthquakes and those in the 20th century; analysis according to the IAEA TECDOC-434;

- geophysical fields in the regional and local area of the NPP site; performance of local geophysical measurements aiming at determination of the parameters of the corresponding geophysical fields;

- relation between the seismicity of the regional and local areas of the site and the geophysical fields and the earth core structure, as well as definition of their parameters and investigation of their interdependence;

- establishment of a local network of seven seismic stations; selection of seismic sites up to 20-30akm from the site, design, construction; construction of a local telemetric seismic network; programme ensurance;

- establishment of an accelerographs system and updating of the industrial antiseismic protection systems, built up at the six units:a design and construction of two new seismic stations for industrial antiseismic protection systems; development of a procedure on inspection after an earthquake of the design basis earthquake level;

- revision of the records of strong earthquakes at the NPP; interpretation and analysis of the records of strong earthquakes at the NPP and its region; assessment of the regional attenuation of the seismic energy;

- experimental studies of the dynamic ground layers characteristics; site microvibrations; interaction between the units and the ground base; laboratory determination of the non-linear dependences of the ground layers; field registration of the microseismic noise aiming at

determination of the site prevailing periods; induced vibration studies of the units aiming at determination of the interaction between the buildings, the soil and the equipment;

- analysis of the seismic risk as a result of local and regional sources:a development of seismo-tectonic models of the strong regional earthquake centres; reevaluation of the seismic hazard based on the reevaluated parameters of the local and regional sources; justification of the earthquake levels design basis earthquake and maximum design basis earthquake;

- definition of the design seismic characteristics of the site:a determination of the design seismic characteristics by using probabilistic and deterministic analyses based on registered and summarised accelerogrammes concerning the regional and local seismic and geological conditions;

- justification of the seismic stability fields of buildings, components and equipment:a justification of the stability fields and coefficients during operation and seismic effects; measures on ensurance of the necessary security;

- improvement of the local geodesic network and its connection to the national one; design, construction of reference points and systems on the site; connection with the national network;

foundation seismic stability

- assessment of the seismic stability of the channels of the service water supply system and the bank pump stations: new seismic studies of the bank pump stations and the channels on sand movement, sliding, sufosion, erosion by using the new site seismic characteristics;

- analysis of the underground part of units 1 to 4 during earthquakes: investigation of the tentions and deformations between the foundaments and the ground during seismic effects;

- assessment of the tentions at the contacting point foundations layer-hydro-isolation: studies on the tentions and deformations of the asphalt layer under the foundation during seismic effects;

meteorology

- establishment of an automated system on meteorological surveys;

- development and adjustment of models of statistical and numerical prognosis on radionuclide distribution in the atmosphere, revision of the meteorological data collected; development of models for distribution;

- investigation of the possibilities of extreme meteorological events (tornado, etc.) occurrence;

hydrology and water supply

- reassessment of the maximum design flooding level; reassessment of the flooding level of he Danube river according to the IAEA safety recommendations 50-5-10A taking into account the risk combinations of several calamities;

- development of a hydrological and meteorological model on determination of the maximum water level; development of a model based on the statistical data, and definition of a maximum water level according to the accepted risk;

- analysis of the hydrological equipment and emergency risk assessment; analysis of the hydrological equipment safety by combination of the most severe factors on assessment of potential emergencies and the relevant risk;

- development of a hydrological monitoring system and programme: development of an optimal survey system on water level control in the site's region; investigation of the relation between the surface and underground water;

radiological impact

- updating the existing monitoring programme on the basis of the performed surveys and the developed models in compliance with the IAEA recommendations;

- development of an automated external monitoring system;

- models on assessment of the public exposure in the vicinity of the NPP during normal operation and an emergency situation; analysis of all possible pathways of radiological impact: atmosphere, water, food, soil;

demography

- study on the territorial distribution of the population in sectors in the NPP 30akm. area; performance of field studies aiming at collection of information about the inhabited areas (permanent and temporary residence; age and sex structure; identification of special institutions, employment, migration, etc.); assessment of the demographic potential according to the IAEA recommendations;

- assessment of the site selection in compliance with the population distribution; development of population maps and histograms; assessment of the NPP radiological impact on the population;

exceptional events as a result of human activities

- investigation of the possible sources that may have unfavourable influence over the NPP safety; classification of the sources is performed and their potential impact on the NPP is evaluated;

- summary of the information about the sources of extreme situations; development of maps that include the total effect of sources of extreme situations;

quality assurance programme

- basis for control and review of all activities that have influence over the quality of the results obtained from the studies and assessments accomplished in the Exclusive Programme;

data-base

- a station with computer calculation equipment collecting the information received telemetrically from all surveys constantly performed in accordance to the Exclusive Programme is under construction.