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Chapter 14: Energy

BULGARIAN POSITION regarding observations and recommendations of the Report on Nuclear Safety in the Context of Enlargement Doc. 9181/01 ATO 36 ELARG 118

1. Introduction

The nuclear safety in the EU and elsewhere is a topic governed by country-specific national rules and regulations. For the needs of the enlargement process an evaluation of the legislation in the nuclear sector, the organisation and management of regulatory authorities and the level of safety of nuclear installations in each of the Candidate States has been presented within the Report on Nuclear Safety in the Context of Enlargement.
The Report on Nuclear Safety in the Context of Enlargement (NSCE Report) determines the level of safety in Candidate States as compared with "high level of nuclear safety" within the EU.

Bulgaria accepts the recommendations of the NSCE Report. It is important to note, that the findings of the Report have been recognised by the Kozloduy NPP and the corresponding corrective measures have been undertaken. The measures which have been, are being or will be implemented in relation with each recommendation are discussed in different sections of the text below and in the Attachment, which highlights the safety improvement programmes under implementation at Kozloduy NPP. Annexes to the Attachment list and schedule the safety improvement measures for Kozloduy 3 – 4, 5 - 6 and the Radwaste Treatment Facility associated with the recommendations of NSCE report. Annex 5 demonstrates the schedule for fulfillment of the recommendations related to the Regulatory Body on nuclear safety- the Committee on the Use of Atomic Energy for Peaceful Purposes.

Bulgaria is ready to provide further information including within the framework of the peer review foreseen under this exercise.

The scope of the present document includes the provision of necessary information on the status of Kozloduy NPP, measures implemented, under implementation or planned to be implemented, as well as additional clarification related to the NSCE Report recommendations. References are made to specific analysis reports, evaluation documents, programmes and/or plans that provide more technical details for the status update. Those documents are to be considered as an integral part of the Bulgarian position on NSCE Report recommendations.

The objective of the present document is

- To present the Bulgarian position regarding the findings and recommendations contained in applicable sections of the NSCE Report. The aim is further to explain the measures that have been, are being, or will be undertaken to address both general and specific NSCE Report recommendations, and to establish the schedule for their completion.

- To establish Bulgarian commitments in response to the Type I and Type II recommendations.

2. *Review and comments on the observations on Bulgaria*

In addition to offering specific recommendations for Bulgaria, the NSCE Report presented observations on Bulgaria. The observations mainly consider the Bulgaria commitments related to units' closure and the development and implementation of the closure programmes in line with the Understanding of 29 November 1999.

On the occasion of the updating of the energy strategy which will be completed in 2002, Bulgaria will decide, in agreement with Commission and taking account of the NSA Agreement and other relevant factors, on the definitive closure dates for Units 3 and 4.
The units 1 and 2 at Kozloduy are of WWER 440/V-230 design and their closure dates are fixed. Regarding Kozloduy units 3 and 4, which are an advanced model of WWER 440 reactors with three–train safety systems, the closure schedule would be decided next year. The units 5-6 at Kozloduy are of a WWER 1000/V 320 design and they are subject of large programme for modernization.

Since the early nineties, all units at Kozloduy NPP have been under continuous upgrading. For Units 1-4, initially the so-called short term upgrading programme has been implemented in the period 1992-1997. Extensive upgrading programmes were developed both for units 1-4 and for units 5-6 during the second half of nineties and now are under implementation.
The extensive improvement programme for Kozloduy units of 440 MW, referred to as PRG'97, has been developed using modern western and IAEA standards and taking into account international findings and recommendations as well as Bulgarian own experience and analysis.

The PRG'97 scope significantly exceeds the one suggested by the IAEA "issues books" for this type of reactors. It has to be noted that of the 60 issues identified by IAEA TECDOC 640, and upon which a consensus was reached by international experts (including measures to rectify the reactor design deficiencies, as compared to international standards), all but 4 issues had been fully implemented in Kozloduy 3-4. This fact was documented by the IAEA Mission to Bulgaria held in October'2000. The remaining 4 issues were found to be well addressed by PRG'97. In addition, following the international expert recommendations, PRG'97 was complemented by 15 measures and a revised version was issued known as PRG'97/A.

Thus, Kozloduy 3-4 upgrade programme is much broader than the upgrade programmes in some other countries. Therefore, although some delays occurred in the implementation of the whole programme, all the internationally required essential issues have been addressed.

It should be taken into consideration that there are very significant differences between units 1 - 2 and units 3 - 4 at Kozloduy plant. While units 1-2 indeed are of standard design V-230 and have several major design differences (i.e. uncladded vessel), units 3-4 were originally designed and constructed with many upgrades, which in terms of main (safety related t) design features bring them close to the standard WWER 440/213 design.

It has to be noted that Kozloduy units 1-2 in fact are subject to continuous and comprehensive modernisation efforts. Only due to the closure commitment, the upgrade programme for units 1-2 is not implemented to the same level as for the units 3 and 4. The units 1-2 closure being planned for the next year, some of the measures indeed would not be implemented. The activities ongoing at units 1-2 are also related to the preparation for the decommissioning, which provides that operational safety is receiving due attention and diligence for the remaining lifetime of those units.
As indicated for units 3-4, vast majority of the measures for addressing IAEA recommendations had been implemented by the end of the year 2000. The ongoing upgrading programme on the units, coupled with initially implemented short term safety improvement programme and Kozloduy NPP continuous improvement programme required an investment of *more than 200 million* EURO in safety enhancement over the last decade. With scheduled completion of the major modernisation programme PRG'97/A (see Attachment) in the period 2001-2003, IAEA experts estimated that the safety level of Kozloduy 3-4 will be comparable with safety level of units of the same vintage which are in operation in other countries.

In addition to that, the level of operational safety also was significantly enhanced towards the best international practice promoted by IAEA. These positive changes were developed and implemented in a process of extensive international cooperation and support by such organisations as IAEA and WANO and utilities as EDF(France).

The last OSART and Follow-up OSART missions held on Kozloduy 1-4 in 1999 and 2001 confirmed that the plant not only met the requirements of IAEA on operational safety but also reached level that is comparable with the operational safety level of western plants of the same vintage. In the Follow-up Mission's Report the following statement is made:

FOLLOW-UP MAIN CONCLUSIONS

The IAEA follow up team was pleased to find the great majority of the recommendations and suggestions offered by the team in 1999 were resolved by the plant, a few had satisfactory progress to date, and only one suggestion was classified as insufficient progress to date.

In 1999 the OSART team stated that the managers and staff at Kozloduy NPP were committed to improving operational safety at the plant, and that can be restated during this follow up visit. The results of this review indicate that corporate and plant management continue to give priority for the continuous improvement of operational safety of Kozloduy, and this has supported an evolving safety culture at the site.

Several of the actions taken by the plant went beyond the intention of the recommendations and suggestions offered by the team. Examples of these are the improvements in the main control rooms and the actions taken to test the efficiency of the plant iodine filters.
For Units 5 and 6, the implementation of the *about 400 million EURO* Modernisation Programme has been initiated in 1995 (Annex 4 to the Attachment). The Programme development and implementation are under strict supervision of the Bulgarian Regulatory Body. With the Programme completion in accordance with the schedule, units 5 and 6 should fulfill all the criteria for achieving "high level of nuclear safety".

5. Bulgarian position on NSCE REPORT general recommendations

Three general recommendations applicable to all Candidate States are established in the NSCE Report. The applicability of these recommendations to Kozloduy NPP and the relevant plant commitments are discussed below.

Regarding the First general recommendation – type I

The recommendation requires completion of the plant-specific programmes for safety improvement within the terms given in the implementation schedules by all Member States.

At present, there are two major modernisation programmes ongoing at Kozloduy NPP, respectively for units 1-4 and units 5-6.

Due to proximity to units 1-2 closure, since 2001 the activities on these units are no more considered as a part of the modernisation programme. The activities under implementation are mainly focused on assuring sufficient level of operational safety for the remaining operating time as well as on units preparation for decommissioning.

At units 3-4 the complex modernisation programme PRG 97/A is ongoing. The programme scope was established following international recommendations as well as Kozloduy NPP own development and observations. This programme was originally developed in 1997 and peer reviewed by international experts. In 2000, the programme was enhanced in order to address issues that were not addressed previously and to clearly distinguish units 3 and 4 from the standard V-230 design model of WWER-440. The additional programme, called PR-209M complement the original PRG 97/A. The complex programme as it stands now, has been seen as the most comprehensive safety improvement programme for reactors of Kozloduy 3-4 type. The programme completion is scheduled for *2003*. The programme scope and firm schedule for implementation of specific items are detailed in Attachment

Kozloduy NPP has assured sufficient financial and human resources for the timely completion of this programme. Moreover, contracts have been signed with a variety of qualified suppliers. The programme management is performed by a specially established Kozloduy NPP Directorate, and its implementation is monitored by the plant Executive Director and the Board of Directors on a monthly basis.

Modernisation programme at units 5 and 6 started in 1996 with the preparation of international tendering process and, upon completion of the Basic Engineering Phase, in 2000 entered in active Implementation Phase. The contracts for the various segments of the programme were signed with Framatome ANP, Westinghouse and Atomenergoexport. The Programme financing is provided by Kozloduy NPP own funds and by the state-guaranteed credit agreements with EURATOM, Citibank and Rosseximbank. The programme management is performed by the specially established Kozloduy NPP Directorate, supported by international team formed by the recognised consultancy company Parsons (USA) and experienced nuclear operator EDF (France). The Programme implementation is monitored by the plant Executive Director and the Board of Directors on a monthly basis.

Summary of the Units 5 and 6 Modernisation Programme is given in Annex 4 to the Attachment.
Kozloduy NPP confirms its commitment that all the elements of the modernisation programmes for units 3-4 and for units 5-6 will be completed in accordance with the schedule:

- The plant - specific safety improvement programme for Kozloduy 3-4 will be completed by the end of *2003* - The plant - specific safety improvement programme for Kozloduy 5-6 will be completed by the end of *2006*

Regarding the Second general recommendation – type I

The second general recommendation encompasses 5 items that are applicable to Kozloduy NPP to a varying degree. The applicability of each of those and Bulgarian position/commitment to each of those is discussed below

Regarding full Safety Analysis Report and related safety improvement measures

The recommendation requires completion, including review and approval by the Regulatory Body, of plant - specific Safety Analysis Report (SAR) in accordance with western standards, that covers:

- all related operation modes; - all relevant internal and external hazards (for example, seismic) using actual data for the plant and site; - plant - specific severe accident vulnerability analysis, including all levels of defence in -depth; - taking into account the results of all analysis made in the development and implementation of plant - specific safety improvement measures.

The original licensing process for Kozloduy NPP units indeed did not require the preparation of a complete Safety Analysis Report to a western standard. However, it has to be stated that the safety documentation, included in the original units design documents, contains many elements that are parts of the Safety Analysis Report.
The scope of the design basis accident to be analysed also deviated from current western practices. The beyond design basis accidents were not considered in the original design.
While recognizing that the lack of a high quality Safety Analysis Report is essential for determination of the safety level of the units, Kozloduy NPP initiated performance of analysis and development of necessary documentation to establish a western standard Safety Analysis Report document for units 3-4 and 5-6. The development of a full-scope Safety Analysis Report (and supporting safety analysis) to comply with all the requirements of USNRC RG 1.70 has been initiated.

In 2000 Reports for Safety Substantiation (RSS) of all units 1 to 4 were developed. The format and content of the RSS is in accordance with the document developed within the PHARE - supported project for Bulgarian Nuclear Safety Authority (PHARE/BG/TSO/05) aiming at western standard basis establishing for Safety Analysis Report. Already completed reports for safety substantiation (RSS) are a good basis for Safety Analysis Report as far as they represent the current status of the units, including the completion of the corresponding safety measures.

It should be noted that, in the frames of safety improvement programme implementation, there have been performed numerous accident, reliability and probabilistic analyses for justification of the measures following western standards for relevant analyses, which also are suitable for incorporation in the Safety Analysis Report. The results from the analyses have been taken into account at implementation of Kozloduy 3-4 improvements, such as new pressurizer and steam generator safety-relief valves seismically qualified for 0.2 g, RCS restraint improvements, leak before break approach measures, hydro-insulation of floors at 14.7 elevation, etc.

The development of the full-scope Safety Analysis Report for units 3-4 started at the end of 2000 and the whole process is supposed to be completed in 2002.
In the frames of Safety Analysis Report development , a full set of design basis accidents as required by the USNRC RG 1.70 is being analysed using western thermal-hydraulic codes and the input data deck specifically developed and validated for Kozloduy 3-4. Within these analyses the beyond design basis accidents have also been addressed using western codes, validated for Kozloduy 3-4.

All operating modes as required per RG 1.70 are also being addressed. Internal hazards of fire, flooding and pipe whip are considered in deterministic approach and fire is taken into account in PSA analysis, while seismic hazards are taken into account both in deterministic and probabilistic approaches.

For Kozloduy 5-6, the Safety Analysis Report was developed at the stage of units commissioning. In the frames of the Units 5-6 Modernisation Programme additional accidents are being analysed using modern codes. All the internal and external hazards applicable to Kozloduy NPP site have been already analysed. For those eventually missing analyses or for events where changes/improvements to be implemented to the plant are causing changes in plant responses or vulnerabilities, additional analyses will be completed during the implementation of the Modernisation Programme.

The beyond design basis accidents and plant's response to those are being addressed within the Modernisation Programme for Units 5-6. As the Modernisation Programme is coming to continue after those analyses have been completed, any and all specific vulnerabilities found during the analyses would be additionally addressed during the Programme implementation. Mechanisms to allow for the revision and/or expansion of the safety improvement programme on units 5-6 are envisaged within the project management.

The Safety Analysis Report to fully comply with Western standards is being developed. The Bulgarian Nuclear Safety Authority is receiving sections of the Safety Analysis Report and other documentation for reviews as those are being prepared. The whole process of updating/completing the documentation to fully comply with Western Standards will be completed concurrent with the completion of the safety improvement programme for units 5-6.

Regarding safety reassessment practices

It is recommended that the national practices are implemented for safety reassessment on a recurrent basis, co-cordinated with national schedules for license renewal and with the continuing plant-specific programmes for safety improvement.

The Bulgarian legislation on nuclear power plants requires that a license be issued for a period of maximum 5 years. However, the practice is that the regulatory body has been issuing operating license for a single cycle (i.e. 1 year). The reasons were often in specific safety improvements or other activities that were needed to be completed before units would be allowed to operate.

With the completion of full and complete reassessment of units 3-4 and units 5-6, full safety analysis will be completed using modern western tools and approaches in the frames of preparation for the major safety improvement programmes at those units, and with the condition of additional safety analysis which will be completed concurrent with the safety improvements, longer (i.e. 5 years) operating license will be issued. At the end of the 5-year period, the issuance of the next license will be conditional on a safety re-evaluation (i.e. periodic safety review) which would address all the changes which have been instructed at the plant and also reflect the changes in safety standards and criteria as appropriate.

On the basis of analyses performed and their subsequent review by Bulgarian Nuclear Safety Authority, Kozloduy NPP expects to receive the operating license for a longer period. The latest expectations to receive this kind of license are 2002 for Units 5-6 and 2003 for Units 3-4.

Within the framework of development of a new Regulation on assurance nuclear power plant safety during design, construction and operation, requirements will be put in force for periodic reassessment of its safety. Expected term is November 30, 2002.

Regarding the Emergency operating procedures

The recommendation suggests implementation of emergency operating procedures, including proper directions for management of beyond design basis accidents.

The development of modern symptom oriented emergency operating procedures following widely accepted Westinghouse methodology was initiated in 1994. Today, the entire scope of procedures has been developed, verified and now they are in the process of preparation for implementation in the control rooms for Kozloduy NPP units. The operating personnel is being extensively trained on the use of the procedures. The implementation of procedures will be completed in 2002.

Symptom oriented procedures are in their nature also appropriate for the management of certain beyond design basis accidents. The operational staff is also trained to use those procedures for eventual severe accidents. During the implementation of the safety improvement programmes for unit 3-4 and 5-6 the Kozloduy NPP expects to base on the development and implementation of the Severe accident management guidelines which would be a logical continuation of the Symptom oriented emergency operating procedures.

Regarding the Operational experience feedback

The recommendation requires that the implementation of systematic analysis of operational experience and new research information be continued, both in the nuclear power plants and in the regulatory body, in order to provide continued learning and improvement as an element of the national safety culture.

A process of systematic feedback of operational experience using the root cause analyses methodology and performing analysis of own events and selected events which occurred at other units at Kozloduy NPP has been initiated in early nineties following the recommendations received from various IAEA OSART and ASSET missions.

As proposed, a systematic process where all operational events are recorded and analysed in accordance with their safety significance is fully in place. The ASSET methodology is used for Root cause analyses. The total number of personnel devoted to the analyses of operational events is more than 30 people.

In 1997 the threshold for reporting the events was lowered significantly in order to increase number of events to be analysed to take benefit from the analyses. In 1999 a procedure for reporting and analyzing of minor events and "near misses" have been introduced. All this led to the increasing the number of analysed events and stable trend of decreasing the INES assessment.

The whole piece of operational experience feedback is also regularly monitored by the Committee on the Use of Atomic Energy for Peaceful Purposes (CUAEPP). All the event analyses of significant events are being submitted to the CUAEPP for review and corrective action (depending on their safety significance).

Within the framework of the annual programmeme for CUAEPP inspectors training conducting of workshops will be envisaged for summarising operational experience and introducing new information related to safety culture. The envisaged term for the first workshop is end of May 2002.

Recent OSART Mission looked into the operational experience feedback and found it to correspond to the best international practices. Nevertheless some recommendations were given for further improvements and during the Follow-up Mission were evaluated with satisfactory progress.

Regarding Resources of the regulator

This issue is addressed in detail in the relevant section on the recommendations for Bulgaria.

Regarding Third general recommendation - type II

Regarding Probabilistic Safety Analysis

Measures to complete a comprehensive, plant-specific probabilistic safety analyses (PSA) are recommended. They have to be performed using western standards and should be tools for identification ranking of the problems arising from Safety Analysis Reports and periodic safety reassessments.

All units of Kozloduy plant have a plant-specific PSA developed over the last 5 years. Those studies have been developed using proven western methodology and computer codes. Studies have been developed by a local engineering organisation (Risk Engineering Ltd.). For PSA for units 3 -4, Empresarios Agrupados of Spain was acting as an external consultant and provided support in terms of methodology. The IAEA have provided many PSA related missions , which addressed specified issues, needed for PSA development.

For all units PSA level 1, including Seismic PSA has been developed. For units 3-4 in addition a detailed probabilistic fire analysis is under way. The shutdown PSA is also underway for units 3 and 4 to be completed during 2001. All the studies have been reviewed by IAEA, either as a full-scope IPERS or topical reviews of specific parts. For units 3 and 4 an IPERS received the PSA in 1999. After inclusion of the comments, the IPERS follow up undertaken in 2000 have declared the study to be of acceptable quality.

Level 2 PSA study for units 3-4 is scheduled after the completion of major reconstructions of accident localisation system.

PSA studies for units 3-4 and 5-6 have been used to support the safety improvement programmes of those units, in order to identify the issues which need improvements and to prioritise the improvement schedule to reflect the risk significance. At Units 3-4 at least 5 individual improvement items are identified as a direct consequence of the PSA.

Kozloduy NPP plans to keep both PSA models in living state, by introducing all the changes in the plants that are occurring over time. With the completion of modernisation programmes on units 3-4 and 5-6, both PSAs will be fully overhauled to reflect new plants status, and to support any further decision-making for prioritisation of safety relevant funds and improvements needed. The review of the PSA level 1 for Units 3-4 has been already started.

Regarding Regulatory quality management

Appointment of CUAEPP quality management officer is foreseen by the end of November 2001. Approval of a plan for updating the documents in force and development of new documents on quality management in CUAEPP is the next measure to be implemented by the end of 2001, followed by fulfilment of the approved plan till the end of 2002.

6. Bulgarian position and commitment regarding specific recommendations

The NSCE report on Bulgaria issued a total of 11 specific recommendation.. The NSCE REPORT recommendations are arranged by priority into two types Type I and Type II. The recommendation and position and commitments of Kozloduy NPP to each of those are discussed below.

Regarding NSCE REPORT recommendation type I - Regarding the nuclear legislation

Adoption of the Law on the Use of Nuclear Energy for Peaceful Purposes is envisaged to take place by the end of March 2002 at latest.

From point of view of regulatory independence the Bulgarian party considers important the following requirements, which are reflected in the draft law.

REGULATORY INDEPENDENCE

Separation of the functions

According to the Draft Law, the State Agency on Atomic Energy (SAAE) - successor of the Committee on the Use of Atomic energy for Peaceful Purposes will have no functions concerning promotion or utilisation of nuclear energy.

For example, a provision in the Draft Law assigns state management of the activities with radioactive waste to the Council of Ministers and to the Chairman of the State Agency of Energy and Energy Resources (SAEER).

It means that SAEER is empowered with management functions but the SAAE is the regulatory body under the Draft Law.

According to the Draft Law the SAAE participates in the development of the national spent fuel and radioactive waste management strategy which guarantees that nuclear safety and radiation protection aspects are considered properly. The basic obligation for the development of this strategy is of the SAEER from the management point of view. The Council of Ministers approves the strategy and the Parliament adopts it. Concerning erection of nuclear facilities of particular importance, it is a matter of management in the field of nuclear energy and ionising radiation. The decision making process on nuclear facilities, mentioned above, is established by a cross-reference to Energy and Energy Effectiveness Law of 1999, amended in 2000. The State Agency of Energy and Energy Resources is established under this Law.

Adequate staffing and financial resources

Adequate staffing and financial resources is an other element of the regulatory independence.

There are no provisions in the current law concerning the regulatory independence of the CUEAPP on how its budget should be set up. There is a provision in the Draft Law that the Chairman of the SAAE proposes the Agency budget to the Council of Ministers.

The "Nuclear Research, Nuclear Safety and Radiation Protection" Fund is envisaged in the Draft Law. This fund will be managed by the SAAE Chairman. The main activities of the SAAE will be financed by this fund, including additional payment to the staff.

The SAAE staff is determined by secondary legislation. The Organisational Statute has to be approved by the Council of Ministers. It means that the requirements concerning the staff of the regulatory body could be easily changed.

Direct reporting line

According to the Draft Law, the SAAE Chairman is appointed by and is directly reporting to the Council of Ministers.

Information to the public
A possibility for the public to participate in the licensing process is not limited in the Draft Law. The main provisions for the procedure on participation of the public in the activity of the state authorities are subject to the Act on access to public information.

Regarding NSCE REPORT recommendation Type I - Regarding resources of the Regulator

The CUAEPP staff consist of 80 persons as of October 15, 2001.

The Council of Ministers by Decree No.142 dated 6 of June 2001 adopted the Organisational Statute of the CUAEPP and its administration in order to bring positions of the staff in accordance with the Law on Administration. Thus, the salaries of the staff were doubled approximately.

Elaboration of analysis of CUAEPP needs in human and financial resources is envisaged to be prepared by the end of March 2002 in order to continue quality fulfilment of future obligations.

Elaboration of a schedule for implementation measures for provision of needed human and financial resources and its submission together with the above-mentioned analysis is envisaged by the end of April 2002.

Approval of the schedule by the Council of Ministers is envisaged to take place by the end of May 2002, followed by implementation of the schedule.

In parallel to it, it is envisaged to propose in the draft law on the use of nuclear energy for peaceful purposes to include provisions for establishing a respective fund which to be governed by the regulatory body for financing its activities.

Regarding NSCE REPORT recommendation - type I - Safety Documentation

This recommendation reiterates the general recommendation #2/I but specifically addresses the status of safety documentation at Units 3-4 and 5-6 of Kozloduy NPP.

As discussed in the Kozloduy NPP position on general recommendation #2, Kozloduy NPP is actively pursuing development of the safety documentation for units 3-4 and 5-6 both the completion of Safety Analysis Report and the completion of necessary safety analyses, using western methods and recognised approaches and codes.

The Safety Analysis Report in compliance with western standards (US NRC RG 1.70) for units 3-4 is being developed in two phases – report for safety substantiation (RSS) and full-scope Safety Analysis Report. The first report has been completed in 2000 following specially established requirements for this kind of document within a PHARE/BG/TSO/05 project. The report reflects most of western standard requirements for Safety Analysis Report and practically is the basis for development of full-scope Safety Analysis Report.

The full-scope Safety Analysis Report development for units 3-4 started in 2000 by contracting of the consortium of Bulgarian engineering companies technically supported by EdF - France. The completed chapters of Safety Analysis Report are submitted accordingly for review by the Bulgarian Nuclear Safety Authority. The completion of Safety Analysis Report is scheduled for 2002 and all necessary updates and changes will be introduced reflecting the safety improvement programme completion.

For Units 5-6 the Safety Analysis Report to follow the RG 1.70 is being developed in parallel with the implementation of the safety improvement programme. Within the programme, numerous additional analyses will be developed addressing specific design features and accidents. Also those will be fully reproduced in the Safety Analysis Report. The Safety Analysis Report including a review by Bulgarian Nuclear Safety Authority is expected to be completed by the time the safety improvement programme is completed, i.e. by 2005

Regarding operational safety of Kozloduy NPP units 1 and 2 until their final shut down

In observation of the agreement reached between the Bulgarian Government and the EC regarding the closure of Kozloduy units 1-2, the plant management is developing the programme and schedule of activities supposed to support the implementation of that agreement. While significant focus is on the development of decommissioning plans, part of the activities is also focused on maintaining safety for the remainder of the operating lifetime of Kozloduy 1-2.

A conceptual technical design for decommissioning was completed in 2000 and detailed technical design is in the process of preparation to be completed by December'2001. In development of the detailed design, the relevant experience of western plants will be also used. The detailed technical design will be submitted to the Bulgarian Nuclear Safety Authority as a first step of the licensing process of the decommissioning.

All the necessary modifications (without items which would be needed for a prolonged operation of the units) have been implemented at units 1-2. Moreover, regular and extended maintenance activities are being performed without any reduction in scope or the emphasis. The Kozloduy NPP management's position clearly stated that both units should be fully operable without any reduction in performance of any equipment, system and structures until the moment those are shut down.

The Kozloduy NPP management is considering different options for keeping motivation of the staff working at units 1-2. New qualification of the staff for operation of units 3-4 and for performance of specific decommissioning activities is foreseen in the developed plans for minimising of social effects. The effective measure is considered giving employment guarantee to the staff for fixed period which would keep all the staff gainfully employed.

It is expected that this and other measures planned to be implemented will ensure that there is no degradation of the staff motivation for the remaining operating time of Kozloduy 1-2.

An organisational structure for decommissioning is established to manage and coordinate the decommissioning activities .

The Kozloduy NPP Management takes specific role and will monitor closely the fulfillment of requirements stated in the Action plan. Any deterioration of safety will be acted upon immediately.

Regarding improvements in Kozloduy NPP units 3 and 4

The recommendation includes three important safety problems. The first one is related to the correspondence between the capability of reactor protection system, second is related to the implementation of leak before break concept and the third one - to planned improvement measures regarding the leak tightness of the confinement.

All those items are fully addressed and envisaged for an implementation in the PGR 97/2A.

The reactor protection system is indeed of an older design and during the period 1993-1998 it was a subject of an in-depth evaluation and modernisation. The acceptability criteria correspond to the current requirements. During this modernisation the basic structure of the system was not changed so in view of the longer remaining operation of these units a decision was made to replace it with a new system.

Initially, a detailed analysis to define exactly the extent of the replacement taking into account the experience from the plants which have already undertaken such replacement is to be completed by the end of 2001. This analysis will define in detail the actions needed to comply with the requirements applied within the EU.

This will be followed by a major modernisation of the reactor protection system to be completed in 2003. In addition to the replacement of the Edge automatics, safety systems instrumentation and emergency power loading sequence are being replaced by digital ones. The diesel generator excitation and control systems are being replaced as well. All these activities are to be completed till 2002 depending on the units' outages schedule.

The leak-before-break analysis has been conducted for Kozloduy NPP units 3-4. The analysis found that the piping arrangement and materials used are such as to assure full applicability of the leak before break to the large diameter primary piping, in accordance with the methodology and criteria described in the USNRC SRP 23.6.3, and other applicable documents. The methodology applied and the analysis conducted fully comply with the requirements for the leak-before-break documents in the EC countries.

In order to fully qualify for the leak-before-break approach on the primary piping, three independent leak detection systems will be available at Kozloduy 3-4 by the end of 2003. Those include qualified acoustic leak detection system, a system using measurement of confinement air cooler condensate, under qualification now, and a qualified system for moisture detection located on the piping and selected equipment of the primary circuit. First two systems are already installed. In addition the modernisation/qualification of the radiation monitoring system "System 8004" is under way to enable its use for early leak detection

The Confinement function at Kozloduy NPP 3-4 is extensively addressed within the scope of the safety improvement programme. The structural analyses to verify the containment function for the whole spectrum of design basis and some beyond design basis accidents has been performed. The results have shown that even in the case of a break of the largest diameter primary piping, the confinement will remain functional with no structural damage. Additional justification is ongoing in the framework of major confinement reconstruction to be completed in 2002. The hermetic zone leak rate reduction programme has been established using technical support of VUEZ (Slovakia), with an aim to reduce the leak rate at least to below 100% per day. One of the key elements of confinement upgrading for accident conditions is the installation of the vortex condenser system which will prevent uncontrolled releases of radioactivity both in the early stage of the accident and during long term cooling of the core after a large break Loss of Coolant Accident without overpressurization of the confinement. The operability of that system has been verified in experiments conducted in Russia. The installation of that system will be completed in 2002 at both units.
All measures related to the confinement improvement are to be completed by the end of 2003.

Regarding improvements in Kozloduy NPP units 5 and 6

The NSCE REPORT recommended that the safety case demonstrating that an adequate protection exists for the high-energy pipe breaks shall comply with requirements and practices widely accepted within the EU.

The solution of the issues (which is also one of the safety issues identified by the IAEA, and thus fully respected in Kozloduy NPP 5-6 safety improvement programme) has been developed by SIEMENS, and successfully applied elsewhere (e.g. in Mochovce). Within the Kozloduy NPP 5-6 safety improvement programme all the analysis (structural, thermo-hydraulic effects, radiological, etc) will be developed and used as the basis for a solution to the problems. The actual measures which need to be implemented will be decided upon at the completion of the analysis. The completion of all analyses is scheduled for 2002 and the implementation of actual measures will be completed by 2005

Regarding the increasing number of operational events at Kozloduy NPP units

The NSCE REPORT recommends that the measures be implemented to investigate root cause analysis of operational events and to significantly reduce their numbers.

As discussed in the answer to general recommendation #2, the system for operational experience feedback exists at Kozloduy NPP. In fact, several international missions gave a very positive assessment of the system including the root cause analysis, which is systematically performed for all events of specified safety significance which occur at Kozloduy NPP. As in the future Kozloduy NPP will continue its quest for enhancing operational safety which includes operational experience feedback, it is felt that this recommendation is already addressed at Kozloduy NPP.

The increased number of investigated operational events at Kozloduy NPP over the last few years, which is believed to be the basis for the recommendation, deserves additional explanation. In 1997, within its quest for increasing operational safety, Kozloduy NPP reduced the threshold for reportable events. This was combined with management actions to encourage reporting of all kinds of occurrences at Kozloduy NPP. Therefore, while the number of reported operational events has indeed increased, it is due to a change of reporting criteria and not a sign of a significant deterioration of safety. This is illustrated below by the total number all investigated events, deviations and safety significant events for units 1 - 4 during the last four years:

Year	Total number of events and deviations	Safety significant events
1997	20	6
1998	52	6
1999	99	5
2000	103	5

In addition, it should be noted that at Kozloduy NPP Units 5 and 6 since 1994, respectively 1996, no automatic reactor SCRAM have occurred.

Kozloduy NPP strategic goals is to work on further reduction of safety significant operational events by enhancing the event analysis and strengthening the process of feedback of operational events. At the same time increasing the number of the reported and analysed deviations and "near misses" is targeted as the plant strategic policy to strengthen the effectiveness of the process.

Regarding the surveillance programme for reactor pressure vessels of Kozloduy NPP units 3 - 4

The NSCE REPORT recommends that the reactor pressure vessel surveillance programme and supporting analysis shall assure safety margins of reactor pressure vessel for all design basis events and over the designed lifetime.

Reactor pressure vessels for all Kozloduy NPP have been under high scrutiny by Kozloduy NPP, Bulgarian Nuclear Safety Authority and international entities over the years. Additional samples have been taken from reactor pressure vessels of Kozloduy 1- 2. The vessel state for each of the units is been regularly submitted to the Bulgarian Nuclear Safety Authority for the review as part of operating licensing procedure.

Extensive analysis has been undertaken for the vessels of units 3-4. The results of the analysis, also using the results of the detailed metallurgical analysis of Kozloduy 1-2 samples, have confirmed that the actual lifetime of the vessel is very long, in fact much longer that the design lifetime of the plant. The preliminary results from ongoing project for the rest of lifetime evaluation, carried out by consortium of FRAMATOME-ANP and ATOMSTROYEXOPT – Russia indicate that unit 3 reactor pressure vessel is assured without any corrective actions at least to the 26 fuel cycles (the current one is the 17th) and for unit 4 the problem with irradiation embrittlement does not exist due to high quality of metal during manufacturing. Nevertheless, the safety improvement programme for Kozloduy 3-4 encompasses several specific actions aimed at continuous monitoring and the certification of the reactor pressure vessels for both units.

Regarding the surveillance programme for reactor pressure vessels of Kozloduy NPP units 5 and 6

The NSCE REPORT recommends that the reactor pressure vessel surveillance programme and supporting analyses shall assure safety margins of reactor pressure vessel for all design basis events and over the designed lifetime.

In some of the IAEA Missions to Kozloduy NPP 5-6, the issue of the surveillance programme for reactor pressure vessels for those units was highlighted as needing attention. Within the safety improvement programme for units 5-6 the upgrade of currently existing reactor pressure vessel monitoring is envisaged. This will include evaluation of the results from the analysis of the reactor vessel material samples which are installed inside the reactor pressure vessel as well as analysis of additional samples which are subject to an accelerated irradiation. On the basis of this evaluation, any eventually needed improvements will be addressed as appropriate. The programme for the monitoring of the reactor pressure vessel is to be implemented between 2001 and 2007. Investigation of the samples which are inserted for accelerated irradiation is to be undertaken in 2005. A number of additional studies and technical solutions are performed beyond the Modernisation programme frame in order to significantly increase the quality of results.

Regarding Kozloduy NPP unit 5 and 6 large modification management

The NSCE REPORT raises the issue of the co-cordination of numerous tasks and multitude of companies involved in the implementation of the safety improvement programme for units 5-6. Also an issue of modifications involving variety of technologies, like instrumentation and control system replacement , is raised.

For the management of Kozloduy 5-6 Modernisation programme, a separate Directorate was established for management of reconstruction and modernisation activities. This Directorate possesses full authority and bears responsibility for management of all the activities included in the Kozloduy 5-6 Modernisation Programme.

One of the Contractors selected for Programme implementation is the European Consortium – Kozloduy, formed by FRAMATOME ANP (France and Germany) and ATOMSTROYPROGRESS (Russia). The Consortium has full responsibility for co-cordination and control as well as for supervision of activities of its members and subcontractors involved in the Programme. The work of the Consortium is put in co-cordination with another Contractor – Westinghouse (USA).

The co-cordination is managed by the Reconstruction & Modernisation Directorate of Kozloduy NPP, supported by the recognised project management consultant PARSONS POWER (USA). The role of the Consultant Parsons is to provide advice and to independently monitor both technical and financial aspects of the Modernisation programme implementation, as well as to provide advice on any specific issues, including the technology compatibility. The Consultant Parsons is also addressing the development of configuration management system for the large plant modification resulting from the Modernisation programme implementation.

Recently, the international consultancy team was completed by the experienced nuclear operator EDF (France). In addition, European companies with extensive experience in management of safety improvement programmes, Empresarios Agrupados (Spain) and British Energy (UK), are also involved in providing consultancy services and training to Kolzoduy NPP project management team. .

In this way, the issues of activity co-cordination, plant modification management and compatibility of different technologies are properly addressed in the Kozloduy 5-6 Modernisation Programme management.

Regarding national emergency exercises- type II

It is planned to update the National emergency plan by the end of 2001.

Approval of a plan for periodic full-scope national emergency exercises is envisaged by the end of March 2002 including analysis of the achievements, deficiencies and adequacy of the emergency planning.

Updating of the National emergency plan according to the results of the full-scope national emergency exercises is envisaged to be performed following each exercise.

7. Recommendations concerning the Safety of Other Types of Nuclear Installations and the related regulatory framework in the context of enlargement

Regarding NSCE REPORT recommendation Type I to Bulgaria, related to the regulatory framework

Elaboration is envisaged of a plan for development of legislative documents pursuant to the adopted Law on the use of nuclear energy for peaceful purposes, which takes into account all nuclear facilities in Bulgaria. The term is 30 days after adoption of this law.

Development is envisaged of legislative documents according to the plan within one year following the adoption of this law.

These legislative documents are the ones in force at present, related to the safety of nuclear facilities, licensing process, personnel training, etc. that have to be repealed by new ones pursuant to the provisions of the adopted Law on the Use of Nuclear Energy for Peaceful Purposes. A set of new documents will be developed, that arrange the social relations in the field of the decision-making process on erection of nuclear facilities, regulation concerning zones with special statute, regulation concerning safeguards pursuant to the Acquis, etc.

The safety of other types of installations and the related regulatory framework

Bulgaria has its long term national strategy for safe management of spent fuel and radioactive waste, including appropriate schemes for storage of radioactive wastes. The existing facilities for interim storage of spent fuel were upgraded and licensed and there are planing for additional storage of dry type establishment.

Two special national funds were created for Safe storage of radioactive wastes and for Decommissioning. The funds are available for adequate financing of relevant activities both for NPP Kozloduy and for other type of installations.

The Safe storage of radioactive wastes fund has 32,5 mil.lv financial resources as of October 2001 and the Decommissioning fund has 122,5 mil.lv respectively.

The operation on power of the IRT-2000 research reactor has been ceased, awaiting a final decision of the possibility for further use of the site, existing fresh nuclear fuel, facilities and equipment. A decision should address the possibility of reconstruction and modernisation of the facility as a 200 kW critical assembly for use for educational purposes and some applied research. An additional requirement is that the spent fuel currently in store be shipped for reprocessing.

Novi Han is the only repository for low and intermediate level waste from the ionising sources application in the industry, medicine, science, research and agriculture. Institute for Nuclear Research and Nuclear Energy to BAS is the operator of Novi Han near surface facility.

The recommendation regarding the regulatory framework is addressed for other nuclear installation than nuclear power reactors as presented here above.

"Disused sealed sources left from activities that have now ceased are of considerable concern in several Candidate States. In this regard, the AQG makes the following general remarks. Firstly, the future management of disused sealed sources will basically be covered by the *acquis* on radiation protection. Secondly, under Article 28 of the Joint Convention, Contracting Parties are obliged to ensure that safety issues related to disused sealed sources are properly addressed. As already pointed out, this should be considered as good practices.
ARTICLE 28. DISUSED SEALED SOURCES
1. Each Contracting Party shall, in the framework of its national law, take the appropriate steps to ensure that the possession, re-manufacturing or disposal of disused sealed sources takes place in a safe manner.
2. A Contracting Party shall allow for re-entry into its territory of disused sealed sources if, in the framework of its national law, it has accepted that they be returned to a manufacturer qualified to receive and possess the disused sealed sources."

Both provisions of the Joint convention have been taken into account during drafting the Law on the Use of Nuclear energy for Peaceful Purposes.

All the Acquis in the field of radiation protection will be implemented into the Bulgarian legislation.

ATTACHMENT

Highlights of safety improvement programmes at Kozloduy NPP and related activities

The safety improvement activities at units 1-2 and 3-4 are addressed in the relevant programmes PRG-97A and PR-209M, and Kozloduy NPP Investment programme. The financing of these measures is ensured by mostly using plant own funds and to some extent funds from the EC's PHARE programme.
For units 1 and 2, all the measures of PRG-97A are completed. Four basic areas of activities related to decommissioning of units 1 and 2 of Kozloduy NPP are defined in the Strategic plan for the implementation of the Agreement on 29.11.1999 regarding the Kozloduy NPP's future that was accepted by Bulgarian Counsel of Ministers on 13.07.2000.

These areas of activities address issues related to licensing, and technical and social aspects.

Of particular interests is a set of measures related to mitigating of social consequences to be caused by the closure of units 1-2 for the territory of Kozloduy municipality and for near-by region.

The technical measures related to decommissioning of units 1-2 are being developed by BELGATOM - Belgium, EWN - Germany and ENPRO Consult - Bulgaria. The Safety Analysis Report and the Environmental Impact assessment are being prepared. The funding for these measures will be provided by the National fund for decommissioning of nuclear facilities, EBRD international fund Kozloduy, PHARE programme and Kozloduy NPP Investment programme.

About 60% of all activities which comprise the Safety improvement programme for units 3 and 4 (PRG-97/A and PR-209M) are completed. The implementation of the remaining activities is on-going and will be mostly completed by the end of 2002. Kozloduy NPP own funds are made available for this programme within the framework of the Investment programme (in the long term) and in the yearly approved financial Plan 2001 and Plan 2002.

An IAEA mission held in October 2000 evaluated the broadness of the complex programme for upgrading of units 3 and 4 and concluded that known design issues are well addressed and implementation of the programme will bring the units to the current safety standards accepted worldwide.

One of the major aims of the Safety improvement programme is solving the problems related with the emergency core cooling system, primary circuit integrity and hermetic compartment leaktightness. One of the key elements is the installation of the vortex condenser system that will prevent uncontrolled releases of radioactivity both in the early stage of the accident and during long term cooling of the core after a large break loss of coolant accident without overpressurization of the confinement. The operability of that system has been verified in experiments conducted in Russia. The installation of that system will be completed in 2002 at both units.
The application of leak-before-break criteria to the primary piping of Kozloduy NPP 3-4 has been analytically proven. Remaining measures for the leak-before-break include the installation of two additional leak-monitoring systems. Those will be installed during 2002.

The tightness of the hermetic compartments will be significantly improved during the outages in 2001 and 2002.

A new IAEA mission is planned for the middle of 2002 to evaluate the implementation status of complex programme and the completed improvements.

The safety improvement programme for units 1 to 4 (measure 6.4/1 of PRG'97) includes an update of the Safety Analysis Report for units 3 and 4 to address the post modernisation status of those units. The new document entitled "Report for safety substantiation" (RSS) was developed in accordance with the requirements of Bulgarian regulatory documents and international practice .

This document was developed following the content and format required by the document developed for the Bulgarian Nuclear Safety Authority under PHARE programme "Requirements to the structure and contents of RSS of Kozloduy NPP units 3 and 4" (PHARE/BG/TSO/05 project) which defines the requirements for the Safety Analysis Report of Kozloduy NPP Units 3-4. This requirement place additional demands on the performance of deterministic safety analysis.

A contract was signed at the end of 2000 with a consortium of leading Bulgarian engineering organisations for the development of a new Safety Analysis Report for units 3 and 4 in accordance with the current western standards. Another contract was signed with EDF for the technical support in the development of the Safety Analysis Report.

The current level of implementation of the Safety improvement programme for units 5 and 6 is about 50%. The implementation of about 40% of the measures is on going following the contracts signed with the suppliers. Some of the modernisation measures are addressed within the Kozloduy NPP Investment programme and Plan 2002.

An IAEA expert mission to evaluate the technical adequacy of the measures within the second phase of the Modernisation programme was conducted in July 2000. The mission also reviewed the status of the implementation of the IAEA experts' recommendations provided by a mission in 1995. The conclusion of the expert mission was that all the safety issues for WWER 1000 Model V 320 (IAEA-EBR-WWER-05) applicable to Kozloduy NPP units 5-6 are being addressed and are either already completed or implementation is underway.

Symptom oriented emergency operating procedures for units WWER 440 and WWER 1000 are developed on the basis of Westinghouse approach. US consultants supported the development and validation of the EOPs. A total of 32 EOPs for units 1-4 were developed . More than 60 thermohydraulic analyses were performed in the process of development and analytical validation of the EOPs. A pilot project for the development of training materials for operators' training on EOPs is completed. The implementation of procedures in main control rooms is scheduled for completion in 2002 after operators training on their use.

Some preparatory activities for the development of Severe Accidents Management Guidelines were performed along with the development of EOPs. During 2001 an application for financing by PHARE programme of a special SAMGs project for Kozloduy NPP is expected to be organized and the TOR for development of SAMGs will be prepared.

For units 5-6 a total of Thirty eight Symptom oriented EOPs were developed and verified. The EOPs were developed by adapting EOPs of Beaver Valley NPP, to Kozloduy NPP 5-6. The EOPs validation of the EOPs is being performed on the full-scale simulator of Kozloduy NPP units 5-6. A pilot project for the development of training materials for operators' training on EOPs is completed. All EOPs for units 5&6 will be implemented in control rooms after all the operators have been trained on their use.

A significant increase of operational events reported at Kozloduy NPP units after 1997 is due to a change of the "Instruction for the analysis of operational events" which was modified around middle of 1997. This instruction improved the reporting criteria. As a consequence, also the events of lower safety significance were reported and analysed using root cause analysis methodology.

This new instruction reflects the recommendations of the Bulgarian Nuclear Safety Authority, but also the IAEA recommendations and the operational experience of Kozloduy NPP. Moreover, the new Instructions were issued to address the objective of a more complete reporting set by the Kozloduy NPP management. As a result, the number of the events which were analysed and reported to the Bulgarian Nuclear Safety Authority was abruptly increased - from about 20 per year before 1997 to about 70 per year in 1998. This increase indeed has nothing to do with any deterioration of safety. It is a direct consequence of the modification of the reporting criteria.

The Kozloduy NPP procedure "Operational experience feedback - analysis of the deviations of equipment operation, procedures and personnel" was implemented in 1999. This procedure also requires reporting (and analysis) of insignificant deviations and "near-miss" type events.

ANNEX 1: List of safety improvement measures for units 3 and 4 associated with the NSCE report.
ANNEX 2: List of safety improvement measures for units 5 and 6 associated with the NSCE report.
ANNEX 3: List of safety improvement measures for Radwaste Processing Facility associated with the NSCE report.
ANNEX 4: Overview of Units 5 and 6 Modernisation Programme
ANNEX 5: Schedule for implementing the recommendations given in the report on nuclear safety in the context of enlargement
ANNEX 6: List of the activities to be performed during preparation of Units 1 and 2 Safe enclosure

ANNEX I

L I S T

of the safety improvement measures for Kozloduy NPP units 3 and 4, associated with the recommendations of AQG report

Recom-mendation No	M E A S U R E S	No	Implemen-tation term	Program
G -I.2.1 S-I.3	The recommendation repeats the meaning of recommendation G-I.2.1 but with details specific for "Kozloduy" NPP. It requires preparing of reports that substantiate the nuclear facilities' safety in accordance with the western standards. Considerable number of modifications is implemented on the nuclear units, and as a result the real project (especially on units 3 and 4) significantly surpass the original one regarding the safety level. The available reports that substantiate the safety either do not fully correspond to the commonly accepted western standards or do not consider the latest implemented modifications. The necessary measures are undertaken for preparing of complete Safety Analysis Report for units 3 and 4, the SAR will be completed in the 2002.			
	Development of complete Safety Analysis Report	M6.4.	2002	PRG'97A, PR-209M
	Additional activities related to the SAR:			
	Optimization of permitted reactor regimes table modes	M.1.3.	2001	PRG'97A, PR-209M
	Justification of reactor core internals strength according to new standards	M.2.3.	2002	PRG'97A, PR-209M
	Analysis of operational reliability of primary circuit pipelines Dn200 and Dn500	M.4.3.	2002	PRG'97A, PR-209M
	Analysis of consequences in case of high energy pipeline rupture in turbine hall	M.4.7	2002	PR-209M
	Defining the parameters in the confinement in case of primary circuit large diameter pipeline break	M.5.2.	2001	PRG'97A, PR-209M
	Analysis of the hazard of inadvertent actuation of the safety systems in case of fire in the Main Control Room and implementation of the necessary measures	M.10.6.	2002	PR-209M
	Installation of the flow restrictors in case of SG Collectors Cover lifts up	M.2.12.	2002	PR-209M

Recom-mendation No	M E A S U R E S	No	Implemen-tation term	Program
G-I.2.3	Symptom based emergency operating procedures, which use the Westinghouse experience and financial aid of DOE USA, are under development in "Kozloduy" NPP since 1994. Thirty-two (32) emergency operating procedures for units 3 and 4 are developed by the end of 2000. The process of development, verification, validation and implementation of emergency operating procedures continues using the American consultant support and American methodology. The work will be completed in the planned scope by the end of 2002. **Specific activities for development of Emergency Operating Procedures** Development and implementation of Symptom Based Emergency Operating Procedures Development of a severe accidents management strategy Assessment of SPDS applicability for post accident parameters monitoring Additional activities related to the problem, including modernization of specific systems are foreseen.	M.13.4 **.**13.16 M.8.12.	2002 2003 2002	PRG'97A PR209/M PR209/M PRG'97A PR209/M

Recom-mendation No	M E A S U R E S	No	Implemen-tation term	Program
G-II.1	Probability analyses			
	Updating of Level 1 Probability Safety Analysis considering the implemented modifications	M.6.1	2002	PRG'97A • R209/M
	Probability analysis of the fire hazard and implementation of the measures	M.10.5.	2002	• R209/M
	Risk analysis for large radiation impact (Level 2 Probability Safety Analysis)	M.6.2.	2003	PRG'97A • R209/M
	Development of Probability Safety Analysis at low power and at shut down reactor	M.12.2.	2001	PRG'97A • R209/M
	Probability Safety Analysis considering passive failure of Boron Acid Tank	M.6.1.	2002	PRG'97A • R209/M

Recom-mendation No	M E A S U R E S	No	Implemen-tation term	Program
S-I.5.	**Improvement of units 3 and 4. Specific activities in progress:** **A. Reactor protection system**			
	Modernization of the Emergency Protection Control System	M.8.14	2003	PRG'97A • R209/M
	Improvements of the safety systems in accordance with PSA level 1 results	M.6.5	2002	PRG'97A • R209/M
	Additional activities: Replacement of safety components			
	B. Implementation of the concept Leak Before Break			PRG'97A
	Using of more than one system for leak detection – installation and qualification	M.4.6	2002	• R209/M
	C. Improvement of the confinement leak tightness	M.5.1.	2002	PRG'97A • R209/M

Recom-mendation No	M E A S U R E S	No	Implemen-tation term	Program
S.-II.2	**Surveillance program for units 3 and 4 reactor vessels**			
	Evaluation of reactor pressure vessels rest life time	M.3.2.	2002	PRG'97A • R209/M
	Probability assessment for reactor pressure vessel breakup	M.3.1.	2002	PRG'97A • R209/M
	Program for residual lifetime control and management	M.6.6.	2002	PRG'97A • R209/M

ANNEX II

L I S T
of the Measures that are performed and planned by Kozloduy NPP for Units 5 and 6 meeting the requirements of the Report on Nuclear Safety in the Context of European Union Enlargement

Recom-mendation №*	MEASURES OF NPP №	MEASURES OF NPP Content	Measure №	Implementation term	▪ P R O G R A M
G-I	1	Analyze the recommendations of both IAEA missions in 2000 regarding the Modernization program of units 5 and 6 and implement them in accordance with "Kozloduy" NPP resources Jointly develop with the consultants general work procedures in accordance with the contract conditions.		2002	Activities' Plan for 2001 of Department "M & I" units 5 and 6
G-I.2.1 S-I.3	1.	Performing of full scope calculations and analyses is included in units 5 and 6 Modernization program in order to substantiate the units' safety. A new Safety Analysis Report will be performed based on these analyses and in correspondence with the requirements of the new standards and regulating documents. Main specific measures in this respect are:		2002-2005	Modernization program of units 5 and 6
		Carry out a fire hazard analysis Mechanical analysis of primary circuit piping zones subjected to specific thermal loads. Carry out an analysis of the consequences of internal flooding Study the seismic stability of buildings with the site seismicity of 0.2 g Qualification of computer codes for accident analysis Analyses of pressurized thermal shock A complete list of analyses of design and beyond design accidents should be compiled Bring the safety analyses in conformity with international practice Develop updated Safety Analyses Report based on the form of PNAE G-01-36-95 Accident analyses using validated computer codes Не е пълен и има изменения в имената и номерата на мерките	21111 23431 21121 21241 23131 23240 26111 26120 26122 26221		
G-I.2.2	1.	Start preparing for periodical safety assessment performance after completing of units 5 and 6 Modernization Program			Modernization program of units 5 and 6
	2.	Rank NPP - units 5 and 6 equipment and systems according to its importance to safety, seismicity and quality	23111	2003	
	3.	Analyze documentation concerning safety important equipment qualification available in KNPP	23121	2003	

Recom-mendation №*	№	MEASURES OF NPP Content	Measure №	Implementation term	▪ PROGRAM
G-I.2.3	1	Analytical validation of emergency operating procedures Anticipated Transients Without Scram" – Thermo-hydraulic analyses for validation of emergency operating procedures. Verification Report for using of RELAP5 for WWER Pilot Project of DOE US for preparing of training materials for operators training Implementation of safety functions monitoring system Example of specific measures: Compile a list of initiating events for analysis (design and beyond of design base accidents) Compile a list of additional accident scenarios (included additional beyond design accidents with large leak) Analyze the case of a total loss of electric power supply	 26111 26251 26351	2000 2000-2004	Emergency Operating Procedures development and implementation programme Modernization program of units 5 and 6
G-I.2.4 S-II.2	1.	Adopt the HPES event analyses methodology on human factor causes in order to improve the event analyses system		2002/2003	Programme for improvement of the Event Analyses System and utilization of the Operating Experience in Kozloduy NPP
G-I.1	.	Updating of PSA - level 1 for units 5 and 6			Plan-2002
S-I.6	1.	The recommendation requires reassessment of the already approved solution for high energy pipelines' support (steam and feed water) on elevation 33 of units 5 and 6 where they pass from the reactor building to turbine hall. It is necessary to achieve a technical consent regarding the acceptability of this solution before the measure implementation considering AQG recommendation. Specific activities: Analyze activities for implementation and assessment of measures 18311 и 24211.		2002	Activities' Plan for 2001 of Department "M & I" units 5 and 6

Recom-mendation №*	MEASURES OF NPP №	Content	Measure №	Implementation term	▪ PROGRAM
S-I.6	2.	Specific measures from PR5&6: Reduce vibration level of unit 5 steamlines Steam generators behavior in cases of steam-line rupture, feed-water line rupture and in case of large leak Extend residual life of secondary circuit piping operating in two-phase medium Mechanical substantiation of supports of safety important piping in case of earthquake Substantiation of the mechanical behavior of the connection between primary circuit piping and SG headers Limit the effects of secondary circuit water or steam piping breaks in the reactor building Improve stability of main steam lines and feed water lines on the outside wall of compartment A820	 34211 26261 34312 23421 23311 18311 24211	 2005 2004 2002 2003 2003 2005 2005	 Modernization program of units 5 and 6
S-II.3	1.	Measures are recommended in order to prove that the surveillance program for the reactor pressure vessels and the supporting analysis provide adequate safety level regarding integrity of the reactor pressure vessels for all design base events during the entire plant operational life. A measure is included in the modernization program of units 5 and 6 for improvement of the current surveillance program for reactor pressure vessels in correspondence to the IAEA recommendations originating from the conducted missions. The measure is based on the evaluation of the study results for the reactor vessel material samples that are set into the reactor by the project and for additionally installed "modernized" sample's assembly for accelerated irradiation. Develop a program for studying reactor metal samples and determine the critical brittleness temperature for units 5 and 6	23212	2005	Modernization program of units 5 and 6
	2.	Carry out the program for metal control of reactor vessel - units 5 & 6		2001-2007	Plan 2002/2003

S-II.4	1.	Measures for correct plant configuration are recommended in order to provide safe implementation of the planned extensive modifications, particularly the modifications including different technologies and vendors like I&C system replacement. Considering the modifications' complexity "Kozloduy" NPP established a special department for reconstruction and modernization activities management. This department is supported by international team of consultants. Specific measure: Development and implementation of software information system for configuration management (CM)		2003	Plan-2002

ANNEX III

L I S T
of the measures that are performed and planned by "Kozloduy" NPP for the Spent Fuel Storage and Radioactive Wastes Treatment Facility meeting the requirements of the Report on Nuclear Safety in the Context of European Union Enlargement

Recom-mendation No	M E A S U R E S	No	Implemen-tation term	Program
G -II.2	Development of a Program for safe and effective management of the nuclear fuel cycle in "Kozloduy" NPP The AQG recommendations for "nuclear facilities of different type" are significantly addressed by the measures undertaken by "Kozloduy" NPP for commission of the facility for radioactive wastes treatment, building a dry storage for the spent fuel and development of program for safe and effective management of the fuel cycle. It is important to note that these measures are undertaken in correspondence with the National strategy for safe management of he spent fuel and radioactive wastes. Schedules for their implementation are developed and coordinated with the plans for units 1 and 2 decommission.		2001	National strategy for safe management of the spent fuel and radioactive wastes
S-I.4	Development of detailed decommission project for units 1 and 2 Regarding operational safety of "Kozloduy" NPP units 1 and 2 until their final decommission "Kozloduy" NPP has no experience in an activity like decommission of units 1 and 2 nuclear facilities. That is why, a detailed decommission project for these units is developed under the program PHARE by BELGATOM - Belgium, EWN – Germany and ENPRO Consult - Bulgaria. This project includes development of reports for safety substantiation and impact on the environment. A strategy plan is developed for the implementation of agreement between Bulgaria and the European Commission on 29.11.1999 regarding units 1 and 2 where development of a program for staff motivation is included. The financing will be provided using the National fund for decommission of nuclear facilities and the International fund Kozloduy.		2002	

Modernization Program

of Units 5 & 6

Overview

ORIGINAL PLANT SAFETY STATUS

The safety level of VVER1000/B-320 basically complies with international safety requirements:

- defense-in-depth concept is incorporated in the design;
- reactor containment is available;
- use of redundancy, physical separation and plant system tolerance to single-mode failure;
- three-fold redundancy of safety systems.

NEW IMPROVEMENTS NECESSITATED BY:

- New international requirements to safety and reliability of nuclear power plants;
- Deviations from the requirements of the OBP-88, as a new basis for design and construction of nuclear installations;
- Deviations from the contemporary international practice related to the approach, scope and quality of the accident analysis**;**

- Safety assessments of VVER1000/320 based on:

    - Conclusions of OSART and ASSET missions conducted by IAEA in 1991, 1994 and 1997;
    - Conclusions of similar IAEA missions for other plants operating VVER1000/V-320ч
    - Recommendations by the Plant General Designer, based on the improvements of the design systems ‘

- Operating experience of Kozloduy NPP;
- Studies performed in Bulgaria (PSA, seismicity);
- Evaluations of VVER1000/V-320 performed by French and German institutes
- World operating feedback on VVER 1000/V-320.

DEVELOPMENT OF THE MODERNIZATION PROGRAM

Basing on the results of the above assessments, recommendations and requirements, Unit 5&6 Modernization Program was developed.

The Program was developed with the joint efforts of Kozloduy NPP, Energoproject, EDF and Risk Engineering specialists.

The IAEA requirements were taken into account during the Program creation.

Modernization program includes a complex of separate specific technical measures. The Program was developed on the basis of the "defense-in-depth" concept, accounting for the basic safety functions.

AREAS OF MODERNIZATION OF UNITS 5 AND 6

The Modernization Program Measures affect all the areas of plant operation, such as safety and reliability enhancement, safety level justification, enhancement of operational conditions and effectiveness, technical support and maintenance.

On this basis, measures are classified by the areas of improvement as follows:

Group 1

Design-oriented measures to improve plant safety

This group of measures aims at design improvement in order to drive it in compliance with the contemporary international regulations (Units 5 and 6 were designed in compliance with the regulations in force in the 70-ties). The following is envisaged to be installed:

- **New diagnostics & control systems –** control of the leakages form the reactor header, resource monitoring, migrating bodies in the Primary Circuit, safety function monitoring, vibration control of the main equipment, etc.

- **Additional systems for severe accidents-–** additional DG, filtering system for the containment, sampling system for accidents ;

- **Measures for operating conditions improvement and status monitoring of the main equipment** – transition to 3-year fuel cycle, surveillance samples replacement pipelines replacement;

- **Measures aiming at nonconformity elimination with the Regulations in force:** replacement of the Steam Collector of the Steam Generator, seismic stability enhancement of buildings and equipment related to the new Site seismic evaluation, fire resistance enhancement .

Group 2

Measures aiming at justification of the sufficient level of safety through analysis and additional research, in conformance with the internationally accepted documents.

The following is envisaged:

- **Accident analysis** – additional accident analyses, as well as shadowing of the main design-based accident analyses, in order to bring the Safety Analysis Report in conformity with the internationally accepted requirements (including detailed information for on the computer codes utilized, initial and boundary conditions and assumptions made)

- **Mechanical analysis of the equipment important to safety** – stressed areas of Primary circuit, pipelines from the Pressurizer to the Relief Tank, unisolable sections of the suction pipelines from Emergency boron storage tank.

- **Research on the possibility of new design solution implementation** - such as installation of check valves before the Steam Dump System

- **Risk analysis of the external and internal events**– internal flooding analysis, fires, Probabilistic safety analysis, etc.

- **Classification and qualification of the components and equipment.**

Group 3

Measures for safety enhancement through replacement of equipment with design lifetime under expiry and equipment of critical importance.

This equipment is related mainly to the reliable and stable unit operation, decrease of unplanned outages, duration and scope of the planned outages for maintenance and repair.

The measures of this group affect mainly the electrical and I&C equipment of 10-year design lifetime. The following activities are included:

- **Equipment replacement of the Control systems -** YKTS, CIS, ASYT, Neutron flux control system, System for reactor internals control, replacement of the control rods with partial length;

- **Reliability improvement of the measuring devices -** replacement of detectors, boronmeters, radiation monitoring systems, water chemistry control systems of the Primary and Secondary Circuit;

- **Reliability improvement of the Safety System equipment**– UPS replacement, replacement of 6 κV breakers , DG Modernization;

- **Replacement and modernization of the equipment important to Unit availability –** Generator Breaker, Moisture Separator Reheater, tube bundles of the TG Condensers, cooling water filters, Relay protection and Automation modifications, etc.

The high priority of these measures is conditioned by the Regulations of the Safe operation of Units 5 and 6. According to this document, in the event of failure of the equipment important to safety, the load limitations are imposed, including Unit shut down.

Group 4

Measures aiming at improvement of the work effectiveness and operating conditions

The share of these measures in the Modernization program is relatively small. They are related to:

- **Personnel training –** full scope simulator, simulator for maintenance of the reactor upper block, development of symptom – oriented emergency procedures;

- **Maintenance and support optimization**– development of maintenance and testing procedures, delivery of equipment for maintenance and control

- **Documentation improvement, etc.**

Group 5

Measures related to decommissioning of the plant installation

Projects are to be developed for the SG replacement and for the Unit decommissioning. Distribution of the measures by groups is shown on Fig. 1

MODERNIZATION PROGRAM REVIEWS, RESULTS AND RECOMMENDATIONS

The following reviews have been performed:

May 1995 – approved by NEK AD

June 1995 – approved by the CUAEPP

July 1995 – reviewed and approved by IAEA

April 1997 - reviewed by RISKAUDIT

July 2000 – reviewed by IAEA

The IAEA safety review ended with definition of 7 additional items and acceptance of the Modernization Program.

The review by RISKAUDIT ended with positive results. The measures were evaluated as satisfactory from the point of view of safety and methodological and technical recommendations were given for their specific implementation.

The follow-up IAEA review in 2000 confirmed the appropriateness of the approach and work performed and gave recommendations for the future work.

REALIZATION OF THE MODERNIZATION PROGRAM

The total number of the measures included in Modernization program approved by IAEA in 1995 is 204. At present a part of the measures are implemented by NEK, NPP "Kozloduy" NPP and other companies.

Main improvements already implemented

- partial trip of the reactor by emergency drop of control rods (URB system), modernization of the reactor scram system on "SG level" signal]
- replacement of the neutron flux control system (for unitUnit 5) and application of new three -channel reactivity measurement system;
- transition to new refueling cycle (3 year's one);
- replacement of control rods position indicators;
- replacement of spent fuel pool racks;
- improvement of diesel generator reliability,
- development of a method to rapidly check fuel element integrity,
- improvement of the unit dynamic stability during transients - implementation of new digital control algorithms for automatic turbine control system, updating of SG "level" protections,; replacement of motor-actuated SG feedwater control valves with pneumatic- actuated ones;

- improved cooling of the emergency boron injection pumps and design improvements of the ESSS (HPI and LPI) pumps TQ2 and TQ3;
- application of ultrasonic testing inspection for the reactor vessel internals and SG;
- Implementation of rapid detection of primary coolant leaks from the reactor top,
- putting in service implementaiton of an off-site automatic radiation monitoring system in 3 km exclusion area,
- performance completion of PSA Level 1,
- Updating of New Technical Specifications and SAR on basebasing on of start-up & operation experience;
- Implementation of full-scale scope simulator for operation personnel.

The share of the implemented measures is shown on Figure 2.

Contractor Selection s for the Units 5&6 Modernization Program of units 5&6 implementation

In 1996 a tender was held auction for selection of Contractors for the Modernization Program..

For As main contractors the European Consortium – Kozloduy (Siemens, Framatom, Atomenergoexport) and Westinghouse were selected.

The Main Contracts scopes include comprises 106 measures, 8 of them being performed under the. Westinghouse Contract. is performed 8 of them.

Phases of the Modernization Program implementation contracts phases

Phase 1 – Basic Engineering

This phase includes collection and submittal of the input data, development of the Terms of Reference and the Technical Projects (analyses reports) for each measure.

The Basic Engineering Phase Contracts were signed in the first quarter of 1998, the first quarter..

PHASE 2 – Implementation

The Implementation Phase includes development of the detailed designs, equipment manufacturing and delivery, installation and testing, licensing and commissioning of the equipment.

The contracted scope for the Implementation Phase is defined basing on the of BEP results analysis. The Implementation Phase Contracts are signed in 1999, their effectiveness being dependent on the completion of the set of preliminary conditions including the provision of the necessary financing, final scope definition and work organization, etc.

CURRENT STATUS OF KOZLODUY UNITS 5&6 MODERNIZATION PROGRAM

The current status of the Modernization Program implementation is shown on Figure 2.

Part of the Program measures have already been implemented using the plant's own resources. In particular, the replacement was completed of the Boron Concentration Measurement System for the Safety Systems, of the Turbine Installation Reheaters , and of the UPS for Safety Systems.

In the middle of 2000, the Basic Engineering Phase of the ECK and Westinghouse Contracts was completed. As a result, there were developed Technical Projects and Specifications necessary for implementation of the next Main Contract Phase.

Upon separation of Kozloduy NPP from NEK in April'2000, the newly established company started simultaneous negotiations with all the Contractors, aiming at adaptation of the already signed Contracts to the performed restructuring and provision of conditions for the actual commencement of activities in 2001. Two IAEA Missions were invited to evaluate the adequacy of the Technical Specifications developed. As a result, Priority (Fixed) Measure Packages were formed for each of the Contractors and the conditions were agreed for the actual commencement of the modernization.

In 2000, Loan Agreements with CITIBANK, EUROATOM and ROSEXIMBANK were are signed and ratified, for Modernization Program financing.

Part of the Program work scope is included in the NPP "Kozloduy" NPP Iinvestment Pprogram. It is planned to It is to be performed financed by KNPP own resourcses and performed by Bbulgarian Ccontractors.

PROGRAM IMPLEMENTATION ORGANIZATION

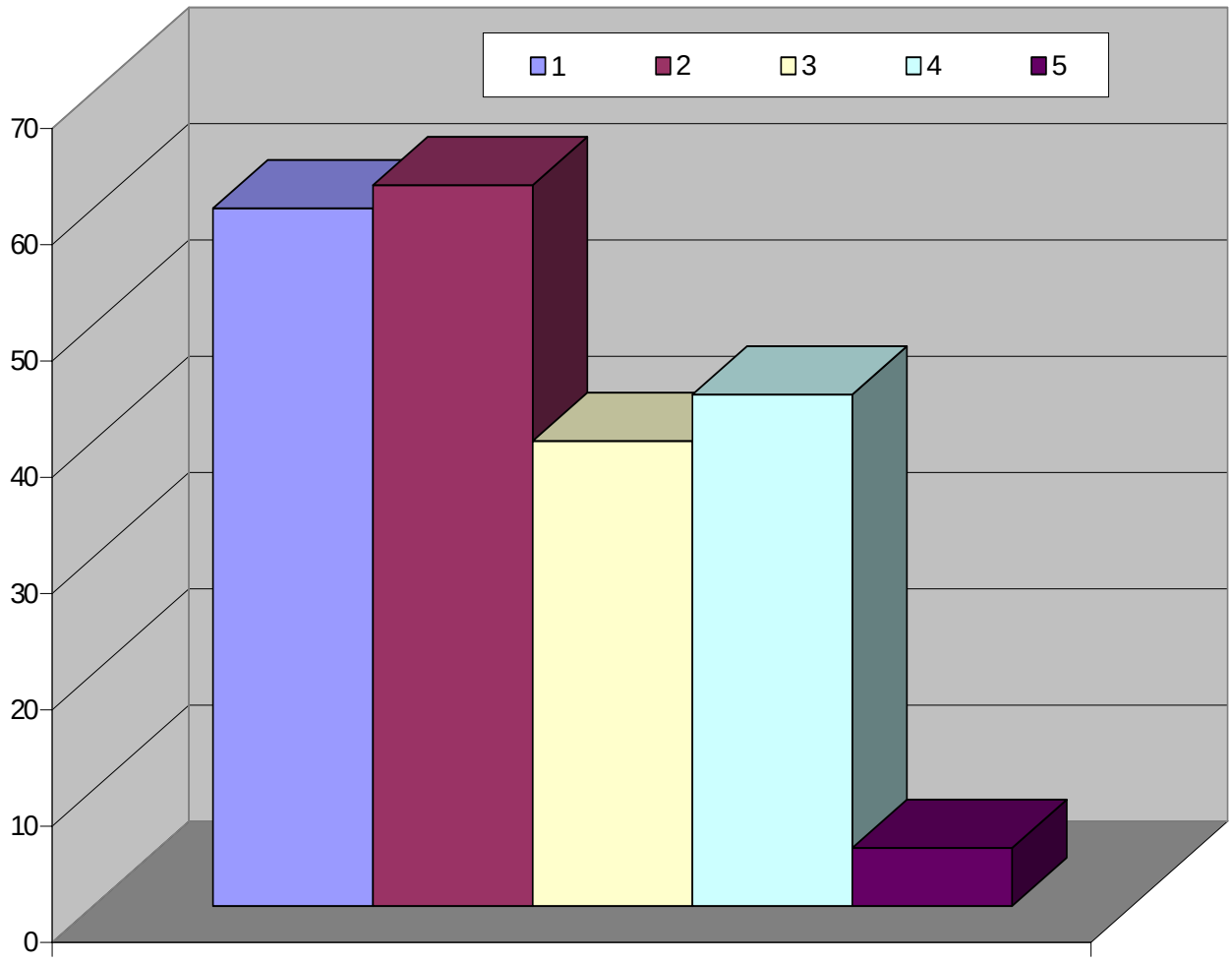
Organization of the Program implementation activities is assigned to Reconstruction & Modernization Directorate of KOZLODUY NPP Plc. In the Frames of the Directorate, a special organizational structure is established which performs the necessary coordination and interface functions, and provides quality control of the activities performance.

The technical aspects of the development and implementation of the corresponding projects are coordinated with the Unit operation specialists form the Production Directorate, which manage as well the process of modification implementation in the Unit systems.

The Project Management activities are supported by international consultant team leaded by the American company PARSONS. The experience is utilized of such companies as EDF- France, UFC – Spain and ANSALDO – Italy.

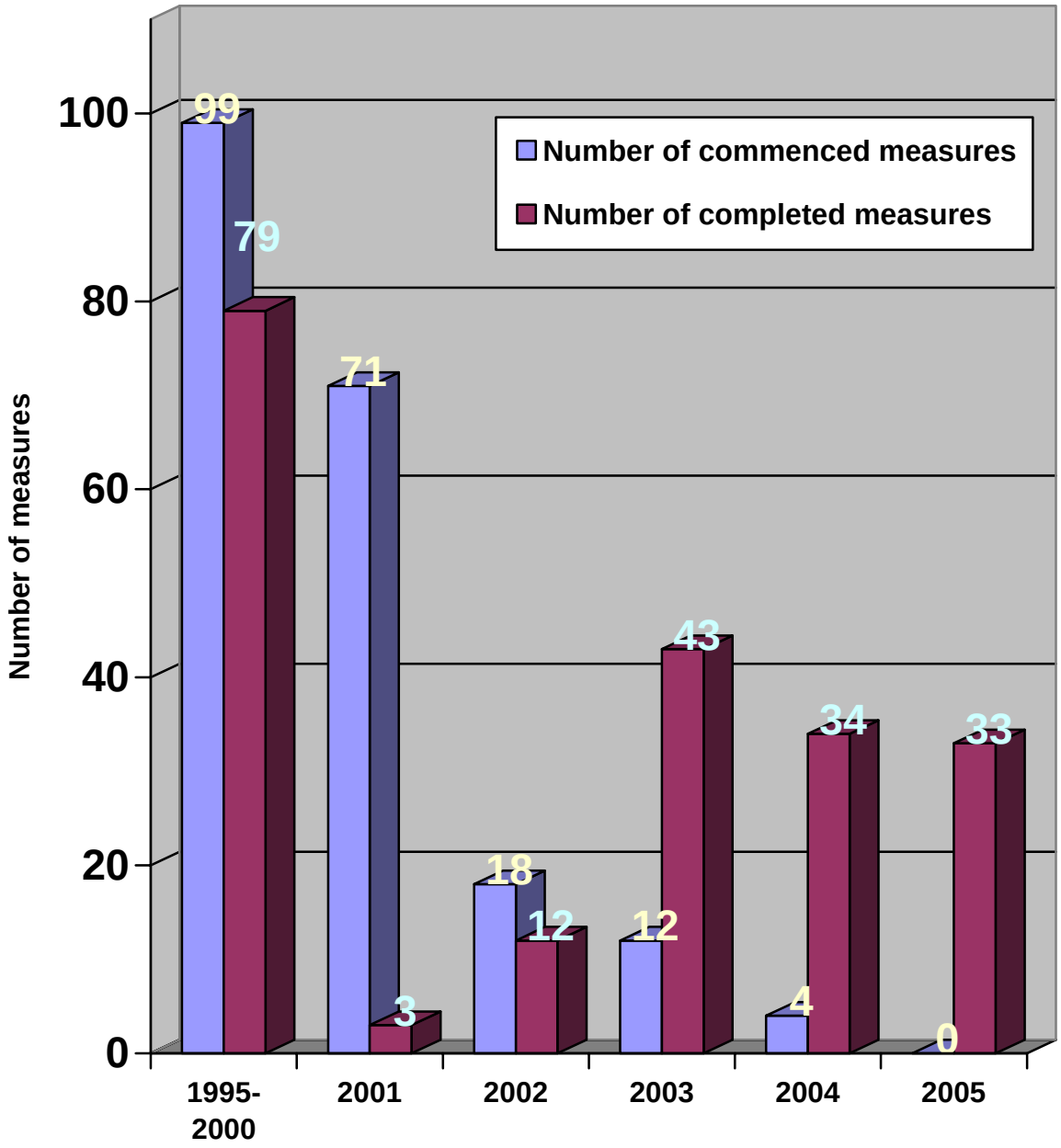
The Modernization Program – related activities of SAEER are supported by the consultancy of the Consortium established by two companies – BRITISH ENERGY – UK and EMPRESAROIS AGRUPADOS – Spain.

Figure 1 - Distribution of measures as per areas for improvement



1. Design-oriented measures to improve plant safety
2. Studies and additional investigations
3. Measures related to improving plant availability
4. Measures to improve plant operating conditions
5. Measures related to decommissioning of plant installations

Figure 2 – Current completion status of the Modernization Program measures



ANNEX V

SCHEDULE FOR IMPLEMENTING THE RECOMMENDATIONS GIVEN IN THE REPORT ON NUCLEAR SAFETY IN THE CONTEXT OF ENLARGEMENT

No	RECOMMENDATION	MEASURE FOR RECOMMENDATION IMPLEMENTATION	TERM FOR IMPLEMENTATION	RESPONSIBLE AUTHORITY
	TYPE I RECOMMENDATIONS			
1.	*Second general recommendation:* **Regarding safety reassessment practice**s: Implementation of national safety re-assessment practices on a recurrent basis, co-ordinated, as appropriate, with national licence renewal schedules and with on-going plant-specific safety improvement programmes.	Within the framework of development of a new Regulation on assurance nuclear power plant safety during design, construction and operation to insert requirements for periodic reassessment of its safety.	November 30, 2002	CUAEPP
2.	**Regarding feedback of experienc**e: Continued implementation of systematic analysis of operating experience and new research information both at the nuclear power plants and at the regulatory authorities, to ensure continued learning and improvement as an element of a national safety culture.	Within the framework of the annual programme for CUAEPP inspectors training to conduct workshops for summurising operational experience and introducing new information related to safety culture.	May 31, 2002 at first and annually afterwards	CUAEPP
3.	*Bulgaria should, as a short term priority* **Regarding the nuclear legislation:** Implement the proposed revision of the nuclear law, *inter alia* to improve the independence and financial situation of the regulatory body (CUAEPP).	Discussions and adoption of the draft law on the use of nuclear energy for peaceful purposes.	March 30, 2002 (provisional term)	National Assembly

4.	**Regarding resources of the Regulator:** Develop and implement an action plan to ensure that the regulatory body (CUAEPP) has adequate resources to carry out all its duties and responsibilities and resources to recruit and retain qualified staff in adequate numbers and to obtain the necessary independent technical support. The action plan should be based on an appropriate analysis of the regulatory needs involved.	Elaboration of analysis of CUAEPP needs in human and financial resources in order to continue quality fulfilment of future obligations.	March 30, 2002	CUAEPP
		Elaboration of a schedule for implementation measures for provision of needed human and financial resources.	April 30, 2002	CUAEPP
		Submission of the analysis and schedule to the Council of Ministers.	April 30, 2002	CUAEPP
		Discussion and approval of the schedule by the Council of Ministers.	May 30, 2002 (provisional term)	Council of Ministers (CM)
		Implementation of the schedule.	After its aproval	CM, CUAEPP
		In parallel to it, to propose in the draft law on the use of nuclear energy for peaceful purposes to include provisions for establishing a respective fund which to be governed by the regulatory body for financing its activities.	November 30, 2001	Permanent Commission on Energy of the National Assembly
5.	**Regarding the regulatory framework:** Bulgaria should, when implementing the first two country-specific recommendations of type I given in section III.1 above, regarding revised legislation and the independence and the resources of the regulatory authority, ensure that the requirements with respect to regulation of other nuclear installations than nuclear power reactors are also respected.	Elaboration of a plan for development of legislative documents pursuant to the adopted Law on the use of nuclear energy for peaceful purposes, which takes into account all nuclear facilities in Bulgaria.	30 days after adoption of the law	CUAEPP
		Development of legislative documents according to the plan.	1 year after adoption of the law	CUAEPP and other bodies addressed in the law

	TYPE II RECOMMENDATIONS			
6.	Third general recommendation **Regarding regulatory quality management:** Measures to implement a modern, well documented quality management system for the regulatory authority.	Appointment of CUAEPP quality management manager.	November 30, 2001	CUAEPP
		Approval of a plan for updating the documents in force and development of new documents on quality management in CUAEPP.	December 20, 2001	CUAEPP
		Fulfilment of the approved plan.	November 30, 2002	CUAEPP
		Elaboration and approval of a plan for development of new documents.	December 20, 2002	CUAEPP
7.	*Bulgaria should report on progress in the following:* **Regarding national emergency exercises:** Measures to conduct and evaluate full-scope national emergency exercises on a regular basis in order to verify the adequacy of the planned emergency arrangements.	Updating of the National emergency plan.	December 20, 2001	State Agency Civil Protection, CM
		Elaboration and approval of a plan for periodic full-scope national emergency exercises including analysis of the achievements, deficiencies and adequacy of the emergency planning.	March 31, 2002	State Agency Civil Protection, CM
		Updating of the National emergency plan according to the results of the full-scope national emergency exercises.	60 days after having conducted a full-scope national emergency exercises	State Agency Civil Protection, CM

ANNEX VI

LIST[1]

of the activities to be performed during preparation of Units 1 and 2 Safe enclosure

No	Activity	Start	Finish
1.	**LICENSING**		
1.1	Conceptual planning submitted to Regulatory authority	End 2001	
1.2	Application for prolongation of outage license for 3 years	Mid 2002	
1.3	Application for license for Safe enclosure preparation	Mid 2003	
1.4	Application for license for operation Safe enclosure	End 2006	
2.	**MILESTONES**		
2.1	Units 1 and 2 reactor final shut down	End 2002	
2.2	Commissioning of dry spent fuel storage facility	Mid 2003	
2.3	Unit 1 fuel free	Mid 2006	
2.4	Unit 2 fuel free	End 2006	
2.5	Start operation of Safe enclosure	End 2007	
3.	**SPENT FUEL**		
3.1	Unit 1 core unloading in the spent fuel pool	Mar 2003	Apr 2003
3.2	Unit 2 core unloading in the spent fuel pool	May 2003	Jun 2003

[1] The list represents the conceptual design.

3.3	Decay storage of spent fuel in the pools		Jun2006
3.4	Transfer of the fuel from the pool Unit 1 to wet storage	Apr 2006	Aug 2006
3.5	Transfer of the fuel from the pool Unit 2 to wet storage	Aug 2006	Dec 2006
4.	**PREPARATION**		
4.1	Validation of radioactivity inventorization	Jun 2003	Dec 2005
4.2	Planning of decontamination activities	Jan 2003	Dec 2003
4.3	Decontamination primary circuit +waste treatment	Jun 2003	Dec 2004
4.4	Decontamination other equipment + waste treatment	Jan 2004	Dec 2007
4.5	Handling of activated core material	Jan 2004	Dec 2005
4.6	Removal of flammable material	Jan 2004	Dec 2005
4.7	Removal of hazardous material and thermal insulation	Jun 2003	Dec 2007
4.8	Reduction of cooling water	Jun 2003	Dec 2007
4.9	Reduction of emergency power supply	Jun 2003	Dec 2007
4.10	Reduction electrical supply	Jan 2006	Dec 2007
4.11	Planning part dismantling	Jan 2003	Dec 2004
4.12	Analysis of building status	Jan 2002	Dec 2003
4.13	Primary civil engineering measures when requested	Jun 2003	Dec 2007
5.	**DISMANTLING**		
5.1	Cutting, closing and sealing of the pipes at the boundary of SE	Jan 2004	Dec 2007
5.2	Closing of all openings (doors, windows cable and other openings)	Jan 2006	Dec 2007
5.3	Part dismantling of electrical systems	Jan 2005	Dec 2007
5.4	Cutting of small and not easy decontaminable equipment	Jan 2004	Dec 2007

6.	**SAFE ENCLOSURE ZONE PREPARATION**		
6.1	Building structure (construction works, etc.)	Jan 2006	Dec 2006
6.2	Conservation of process and handling equipment	Jan 2006	Dec 2007
6.3	Modification of electrical and I&C systems	Jan 2006	Dec 2007
6.4	Modification of radiological monitoring systems	Jan 2006	Dec 2007
6.5	Modification of fire protection	Jan 2006	Dec 2007
6.6	Installation of site surveillance systems	Jun 2003	Dec 2004
6.7	Adaptation of ventilation systems	Jun 2005	Jun 2006

NOTE: The activities and time for implementation are taken from "Technical design for decommissioning Kozloduy NPP Units 1 and 2", PHARE Project BUL 9809-02-03, Interim report, September 2001