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# Comparison among different decommissioning funds methodologies for nuclear installations

**Final Report**

## Country Report Bulgaria

on behalf of the European Commission  
Directorate-General Energy and Transport, H2

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Final Country Report (WP 1/WP 3)

Bulgaria

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Bucharest, December 2006

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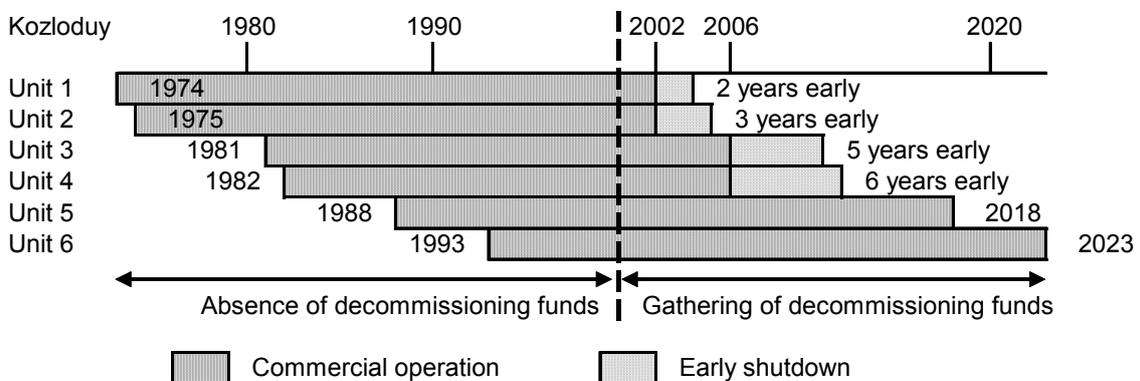


## Summary

This country report on Bulgaria's nuclear installation decommissioning fund methodologies is the result of a review of the limited amount of public information that has been published on various internet sites. The Bulgarian authorities did not respond to requests to provide information for this report, have not yet completed the 2005 Colenco questionnaire and currently appear unwilling to cooperate with the European Commission's nuclear-related policy projects.

Bulgaria's main nuclear facility is the 100% state-owned six-unit NPP near Kozloduy. Safety concerns lead to an understanding with the European Commission in 1999 and as a result, units 1 and 2 (2 x 408 MW) were shut down on 31 December 2002. Accession negotiations with the EU led to a commitment by Bulgaria to ensure that Units 3 and 4 (2 x 408 MW) shall be shut down by the end of 2006. Units 5 and 6 (2 x 953 MW) remain in operation, have undergone extensive modernisation and are not expected to undergo early closure.

Funding for future decommissioning and radioactive waste management activities (based on a percentage of the nuclear company's income from electricity sales) started to be gathered in 2000. Contributions are paid into two state-controlled segregated external funds: a nuclear facilities decommissioning fund and a radioactive waste management fund. Funds have not been set aside to deal with future costs arising from nuclear activities that took place during the period 1974 – 1999.



The Kozloduy decommissioning support fund, to which the EU is the major contributor, provides substantial compensation for the early closure of Kozloduy units 1 – 4, through financial assistance for activities related to NPP decommissioning and strengthening Bulgaria's energy sector.

Decommissioning of the entire six-unit NPP near Kozloduy has been estimated to cost in the region of 2.6 billion Euro. The funds that will be collected during the plant's lifetime, together with the financial contribution of the decommissioning support fund, total approximately half this amount, implying that the Bulgarian state will need to contribute a further 1.3 billion Euro to cover the period 1974 – 1999.

The Bulgarian government is committed to the future of nuclear power and in 2005, a decision was taken to build a further 2 x 1000 MW unit power plant at a site near Belene, where construction was aborted in 1991 due to a lack of funds. These units are expected to be completed by 2011 and 2013. Construction costs have been estimated at 2.68 billion Euro.

In 2005, Bulgaria decided to construct a national repository for low and intermediate level radioactive waste, but plans for spent fuel and high-level radioactive waste are unclear. Spent fuel is currently repatriated to Russia for reprocessing, although regional and international options for the storage and disposal of spent fuel and high-level radioactive waste are being investigated.

Insufficient information is currently available regarding decommissioning costs for Bulgaria's closed uranium mines. However, the Russian provider of nuclear fuel for Bulgaria has suggested that if Bulgaria were to re-open its uranium mines, Russia would use the extracted ore to produce cheaper nuclear fuel for Bulgaria's nuclear power plants.

# 1 Introduction and overview

## 1.1 Overview

Bulgaria has considerable reserves of low-grade coal (primarily lignite that has a low calorific value and high sulphur content) and relies heavily on imports for other primary energy supplies. Bulgaria imports all its petroleum, nuclear fuel, virtually all its gas and about 20% of its coal. According to Bulgaria's national electricity company, in 2004, electricity was produced from coal (45%), nuclear (42%), hydro (7%), gas (4%) and oil (2%).

**Bulgaria's Energy Strategy (2002)** declares that the state's general policy on the future of nuclear power is to continue to supply a significant proportion of the country's future energy needs through the use of nuclear energy. This policy is a key element in Bulgaria's quest for security of supply of energy resources and for compliance with international environmental protection agreements (e.g. on limiting emissions of greenhouse gases, SO<sub>x</sub>, NO<sub>x</sub> and particulates).

### 1.1.1 Installed nuclear power (the plant near Kozloduy)

The most significant nuclear installation in Bulgaria is the Kozloduy nuclear power plant, operated by the 100% state-owned company, Kozloduy NPP plc. Until the end of 2002, the plant had six units (units 1 – 4 are first-generation Russian PWRs - VVER-440/230 models, each with a capacity of 408 MWe and units 5 & 6 are VVER-1000/320 models each with a capacity of 953 MWe). Units 1 & 2 started commercial operation in 1974 and 1975 respectively, units 3 & 4 in 1981 and 1982, and units 5 & 6 in 1988 and 1993. Each of the six units was designed to operate for a 30 year period.

On 31 December 2002, primarily as a result of safety concerns, units 1 & 2 were closed, in accordance with a government decision resulting from EU accession negotiations and the offer of financial assistance for decommissioning and related issues. The Bulgarian Government and the European Commission also signed an understanding, agreeing that units 3 & 4 would be shutdown in 2006. The closure commitments form an integral part (Article 30) of the *Treaty concerning the accession of the Republic of Bulgaria and Romania to the European Union* (see Annex 3).

During the period 1991 – 1997 approximately 129 million Euro worth of work was carried out on Kozloduy units 1 – 4, to improve safety and bring the units closer to international standards, especially for units 3 & 4, in close consultation with the International Atomic Energy Agency, the World Association of Nuclear Operators and the European Commission. During the period 1998 – 2002, a more thorough modernisation was carried out in line with International Atomic Energy Agency safety criteria, to bring the units into conformity with current world standards. This modernisation was only fully implemented on units 3 & 4, replacing control systems and other operational safety improvements. In total, more than 300 million Euro have been spent on modernising units 3 & 4. It is now argued that units 3 & 4 achieve levels of safety comparable with

reactors of a similar age in Western Europe. In 2003, the World Association of Nuclear Operators reported that the units met all necessary international standards for safe operation, confirming the conclusion of the International Atomic Energy Agency Safety Review Mission conducted at Kozloduy in June 2002.

The so-called "Peer Review" mechanism, under the auspices of the EU Council, monitored the implementation status of recommendations contained in the June 2001 Council Report on Nuclear Safety in the Context of Enlargement (and the subsequent Peer Review Status Report of June 2002). In April 2004, the Peer Review Report on Nuclear Safety in Bulgaria was adopted, concluding that most of the recommendations had already been implemented, that those remaining were progressing according to established schedules and that actions that still needed to be carried out seemed adequate and feasible in terms of human and financial resources. The report did not consider that further monitoring would be necessary.

On February 26, 2003 the Bulgarian Nuclear Regulatory Agency issued a 10-year operational license for unit 4 of Kozloduy NPP and on May 23, 2003 Kozloduy NPP plc. received an 8-year license from the Nuclear Regulatory Agency for the operation of unit 3. The licenses were issued based on the new Safe Use of Nuclear Energy Act and on the new Safety Analysis Report of units 3 & 4, developed after implementation of the complex program of upgrading measures at units, and submitted to the Regulatory Body at the end of June, 2002. Despite the fact that these new operational licenses expire in 2011 & 2013 respectively (based on a full 30-year operating life of the units) the Bulgarian government has re-confirmed its commitment to ensure the final closure of both units by the end of 2006.

On 2 June 2006, Radio Bulgaria reported that Energy and Economy Minister, Rumen Ovcharov, told a forum on nuclear energy and ecology issues held in the city of Varna on the Black Sea, "The decommissioning of units 1 & 2 of the nuclear power plant near Kozloduy will begin at the end of the year. This will be a signal to our EU partners that Bulgaria has been fulfilling all commitments to this country's EU accession". He added that discussions about the closure of Kozloduy units 3 & 4 "create problems for Bulgaria", but he was categorical that Bulgaria will fulfil its commitments for the closure of these power units. Bulgaria's future "lies in the construction of the Belene nuclear power plant", he said and stated that Bulgarian nuclear power production should be part of the global solution to energy problems.

Also on 2 June 2006, EU Enlargement Commissioner Olli Rehn sent a letter to Bulgarian authorities, insisting that the country accelerate the decommissioning of the oldest units (units 1 & 2) at the Kozloduy nuclear plant. Noting that the process must begin by the end of the year, he expressed concern over reports indicating preparations remain in a preliminary phase.

Since 2001, Kozloduy units 5 & 6 have undergone a modernisation programme worth 491 million Euro, aimed at improving the safety and reliability of the two units. The investment has been funded by sovereign guaranteed loans from Euroatom (212.5 million Euro), Citibank (77 million USD) and Roseximbank (80 million USD) as well as 153 million Euro from Bulgaria's own funds.

### **1.1.2 New nuclear power (the plant near Belene)**

The Bulgarian Power Sector Least-Cost Development Plan 2004 – 2020 is based on the maximum use of indigenous energy resources, primarily lignite, through the rehabilitation of existing generating capacities and the construction of new capacities. Alternatives for additional power include the import of electricity and new generating capacity from power plants based on nuclear energy, imported natural gas or imported hard coal.

The Development Plan considers three scenarios for the construction of a new nuclear power plant at Belene, based, to varying extents, on making use of the infrastructure and equipment already in place. In early 2005, the Bulgarian government approved the construction of a new 2000 MWe nuclear power plant at Belene and has appointed an architect-engineer to oversee the re-design of the site. Work at the site began in 1980, but was aborted in 1991 due to a lack of funds. The total cost of the new plant has been estimated at 2.68 billion Euro, with the two redesigned 1000 MW reactor units being completed by 2011 and 2013. The construction project will be financed through public-private partnerships, with the state retaining 51% ownership.

The Plan includes a number of development scenarios and indicates that after the closure of Kozloduy units 3 & 4 at the end of 2006, the backup electricity production capacity may fall below the permissible level during the period 2007 – 2008 and may need to be compensated by a better implementation of energy efficiency improvement programs and electricity imports. Despite the future commissioning of 600 MW of new lignite-fired capacity at Maritsa East and a 80 MW hydropower plant at Tzankov Kamak, one scenario considers that a further 1000 MW of new capacity may still be required during the period after the closure of Kozloduy NPP units 3 & 4 and before the commissioning of a new nuclear power plant (i.e. during the period 2007 – 2010). However, this scenario does not seem to take into account the expected considerable increase in the load factor of Kozloduy units 5 and 6 (increasing the combined power output of the units by about 460 MW), as a result of their modernisation. Furthermore, the Plan considers that the need for commissioning further new nuclear capacities of between 1000 and 2000 MW may arise during the period 2010 – 2015, due to increased electricity demand (forecast to increase by approximately 2% per year until 2020) and the decommissioning of a number of old (primarily lignite-fired) thermal power plants as a result of restrictions imposed by the Large Combustion Plant Directive.

### **1.1.3 Research reactor**

Bulgaria has one research reactor, the IRT-2000 research reactor, close to Sofia. It is a pool type reactor with power capacity of 2 MW using light water as moderator, coolant and above core reflector. It was designed in the former Soviet Union and commissioned in 1961. In 1989, after 28 years of safe operation, the reactor was shut down, based on a recommendation of the Bulgarian Committee on the Use of Atomic Energy for Peaceful Purposes (that identified the difficulties involved in bringing the reactor up to current nuclear safety and radiation protection requirements). In 1999, Council of

Ministers' Decision No. 332 ended the operation of IRT-2000. However, based on a detailed technical and economic analysis of the necessity of a research reactor and the justification of using available fresh fuel, in 2001 the Council of Ministers issued Decision nr. 552 for the reconstruction of the facility into a low power, low-enriched fuel 200 kW research reactor. Works started on this conversion at the end of 2002.

#### **1.1.4 Uranium mines**

Uranium mining began in Bulgaria in 1946 at Bukhovo near Sofia. It was carried out by a Soviet-Bulgarian enterprise under Soviet management. From 1956, uranium mining was continued by the Bulgarian firm Redki Metali (Rare Metals), with input from Soviet consultants. All uranium production was exported to the former Soviet Union for processing, initially as ore, and, after the start of uranium mills at Bukhovo and Eleshnitsa, as uranium concentrate. In return for the uranium deliveries, Bulgaria received fuel rods for the Kozloduy nuclear power plant.

The first uranium mines in Bulgaria were underground mines. From 1979, in-situ leaching was also applied, using wells, drilled from the surface. The leaching agent used in most cases was sulphuric acid. From 1981, in-situ leaching was also used to increase the yield from conventional underground mines. From 1981, 23 ore deposits were mined by conventional underground mining techniques, 17 by in-situ leaching from the surface, and 11 by in-situ leaching in combination with conventional mining techniques. In 1990, 70 % of the uranium produced was from in-situ leaching of very low-grade ore deposits (0.02 - 0.07 % uranium). In the years 1991 - 1992, 14,000 wells in 15 in-situ leaching fields were in operation. The total area used for in-situ leaching totalled six square kilometres.

On 20 August 1992, the Bulgarian government decided to completely shut down all uranium mining activities, due to the high production cost of 62 USD per kilogram of uranium.

According to local press reports in May 2006, the Bulgarian-Russian Intergovernmental Commission for Economic Co-operation recommended the re-opening of uranium mines in Bulgaria. A spokesman for the Russian corporation TVEL, the provider of nuclear fuel for Bulgaria, said that if the mines were re-opened, Russia would use the extracted ore to produce cheaper nuclear fuel for the Kozloduy nuclear power plant. He also stated that, considering the lack of uranium production world-wide, the re-opening and modernisation of the mines would be a wise investment and recommended that Bulgaria start exploring re-opening possibilities as soon as possible.

## **1.2 Legal framework**

The legal basis for the financing of nuclear decommissioning in Bulgaria initially consisted of a 1995 amendment to the Law on Peaceful Atomic Energy Use, which established the Nuclear Facilities Decommissioning Fund and the Fund for the Safe Storage of Radioactive Waste.

These two separate funds were established based on the facts that:

- radioactive waste management is a much longer-term activity than the decommissioning of nuclear installations and
- future new-build nuclear power plants would probably be constructed under public-private partnerships (meaning that future liabilities should no longer be 100% attributed to the state).

The Funds became active in 1999 after approval of Ordinance No 15, regarding the amount of contributions and the methodology for obtaining, spending and control of the Funds' assets and for Fund management. The financial basis for determining the contributions to the Funds was guided by the "polluter pays" principle. The National Electricity Company (and subsequently Kozloduy NPP Plc) started contributing to the Funds in 2000.

The 2002 assessment report of the Council of the European Union Peer Review on Nuclear Safety in Bulgaria, recommended that, "Special attention should be given to the funding of the Radioactive Waste Storage programme".

The Law on Peaceful Atomic Energy Use was subsequently superseded by the Safe Use of Nuclear Energy Act (2002), which specified the rights and duties of licensees implementing radioactive waste and spent fuel management, and names the Nuclear Regulatory Agency as the authority to implement this regulation, including issuing authorisations. The Act specifies that a state-owned radioactive waste company shall be formed (effective from 1 January 2004) and modifies the regulations for the Nuclear Facilities Decommissioning Fund and for radioactive waste management financing (both effective from 1 January 2003). The relevant articles of this Act of related to the nuclear facilities decommissioning fund and radioactive waste management financing are detailed in Annexes 1 and 2 respectively.

The financing of these two funds is implemented through 2 Council of Ministers Decrees:

- Decree nr. 300 of 17 December 2003, which determines the procedure for assessment, collection, spending and control of the Nuclear Facilities Decommissioning Fund under the auspices of the Minister of Energy and Energy Resources, and defines the amount of contributions due. The revenues of the Fund are collected mainly from contributions from nuclear facility operators, as well as from national budget resources. The Fund will be managed in a manner to assure that a nuclear facility permit holder's annual decommissioning program is implemented.
- Decree nr. 301 of 17 December 2003, which determines the procedure for assessment, collection, spending and control of the Radioactive Waste Fund under auspices of the Minister of Energy and Energy Resources, and defines the amount of contributions due. The revenues of the Fund are collected mainly from contributions from legal and physical entities which, as a result of their activities, generate radioactive waste that will be transferred to the state-owned "Radioactive waste" company, as well as from national budget resources. The

Fund will be managed in a manner to assure the implementation of radioactive waste management activities.

The Safe Use of Nuclear Energy Act also states that:

- licensees generating radioactive waste shall be obligated to deliver this waste to the Radioactive Waste State-Owned Company.
- licensees shall be responsible for the safe management of radioactive waste from its generation until its delivery to the Company.
- radioactive waste shall become state property from the time of its delivery to the Radioactive Waste State-Owned Company.

### **1.3 Analysed facilities**

This report focuses on the decommissioning fund methodologies for the six-units of the Kozloduy nuclear power plant.

Table 1 Overview of nuclear installations in Bulgaria (Status: 05/2005)

Nuclear facility	Short name	Country	Kind of facility	Output (Power in MW <sub>el</sub> for NPP)	First criticality (in case of reactors)	Operational period	Operating company	Name of quoted companies holding shares in the nuclear facility, if any**	Percentage of shares held*** [%]	De-comm. started in year	De-comm. stage****	Ana-lysed in this report
Kozoduy unit 1		BG	NPP	408	June 1974	1974-2002	KOZLODUY NPP-plc	Bulgarian State (Ministry of Energy and Energy Resources)	100%	2003	0	X
Kozoduy unit 2		BG	NPP	408	August 1975	1975-2002	KOZLODUY NPP-plc	Bulgarian State (Ministry of Energy and Energy Resources)	100%	2003	0	X
Kozoduy unit 3		BG	NPP	408	December 1980	1981-2006	KOZLODUY NPP-plc	Bulgarian State (Ministry of Energy and Energy Resources)	100%	—	Operat- ing	X
Kozoduy unit 4		BG	NPP	408	April 1982	1982-2006	KOZLODUY NPP-plc	Bulgarian State (Ministry of Energy and Energy Resources)	100%	—	Operat- ing	X
Kozoduy unit 5		BG	NPP	953	November 1987	1988-today	KOZLODUY NPP-plc	Bulgarian State (Ministry of Energy and Energy Resources)	100%	—	Operat- ing	X
Kozoduy unit 6		BG	NPP	953	May 1991	1993-today	KOZLODUY NPP-plc	Bulgarian State (Ministry of Energy and Energy Resources)	100%	—	Operat- ing	X
IRT Sofia		BG	RR	(2 MW <sub>th</sub> )	1961	1961-1989	The Institute for Nuclear Re- search and Nu- clear Energy (INRNE)	—	—	—	Recon- struc- tion	

Uranium mines	—	BG	Mines and leaching facilities	—	—	1946-1992	Various including Redki metali Ltd	—	—	—	—	
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\* Kind of facility: NPP = Nuclear Power Plant

RR = Research Reactor

\*\* Quoted: quoted on the stock exchange. Quoted companies directly or indirectly owning the nuclear installation or at least a part of it.

\*\*\* Percentage of direct or indirect shares held by companies quoted on the stock exchange.

\*\*\*\* Decomm. = Decommissioning. Decommissioning stages:

Operating: Still in operation; not shut down yet

0 Decommissioning announced

1 Decommissioning to stage 1

2 Decommissioning to stage 2

3 Decommissioning to stage 3

3\*Decommissioning to stage 3 without civil engineering

-x Decommissioning in progress towards stage x

Complementary information

- a partly converted into a museum
- b converted into a spent fuel facility
- c Equipment dismantled, building to be reused
- d Contains damaged fuel elements
- e Chimney being partly dismantled
- f used as radioactive waste store

## 2 Decommissioning strategies and costs

### 2.1 Current and past decommissioning activities

#### 2.1.1 Decommissioning strategy

Bulgaria's general policy on nuclear decommissioning is the result of a number of feasibility studies carried out in the 1990s. Initially both immediate decommissioning and deferred dismantling were considered as viable strategies. A second study, including undertaking a material inventory and cost estimates, considered immediate decommissioning, entombment and three variants of deferred dismantling (entire facility, radioactive objects or reactor cavity). Influencing factors (such as no specific decommissioning regulations, no mechanisms in place for the collection of decommissioning funds and the fact that the six reactors would reach the end of their designed life at different times even though they shared some key systems) were taken into account.

The resulting conclusion was that the dismantling of the nuclear power plant's radioactive items should be deferred for 70 years. However, an agreement was later reached with the European Commission concerning early shut down and decommissioning at Kozloduy. The deferral strategy was reviewed, leading to a revised solution in which the deferral period was shortened from 70 to 35 years, as limited benefit from radioactive decay was foreseen after 35 years.

The decommissioning plan for Kozloduy units 1 & 2 began in 2003 and consists of the following stages:

- Final shutdown – duration 3 years
- Preparation for safe enclosure - duration 2 years
- Safe enclosure term - duration 35 years
- Postponed dismantling (liquidation of safe enclosure) – the term has not been evaluated due to the difficulty in evaluating activities 40 years into the future, however, according to expert evaluation, using current methods for dismantling and demolition, the duration would be approximately 10 years.

The decommissioning of Kozloduy Units 3 & 4 is expected to begin in 2010-2012 and will follow the same decommissioning plan as for units 1 & 2.

A Decommissioning Division of Kozolduy NPP Plc was established in 2000 with the aim of ensuring safety during the management and implementation of all necessary preparatory and decommissioning activities for units 1 & 2.

### 2.1.2 Waste disposal options

Initially, all spent fuel was stored at Kozloduy for a period of three years before being sent back to the former Soviet Union, free of charge and free of subsequent obligations. In 1988 Moscow suspended the agreement. The spent fuel was held at the Kozloduy on-site interim wet storage facility which, due to the accumulation of spent fuel being stored, was extended and is now being supplemented by an on-site dry storage facility. Following a 1998 agreement, Russia now accepts Bulgarian spent fuel for reprocessing, but in order to comply with Russian environmental legislation, has imposed the condition that the high-level radioactive waste resulting from reprocessing the fuel be returned to Bulgaria at some time in the future. Bulgaria now pays Russia 620,000 USD per tonne of spent nuclear fuel repatriated for reprocessing and according to Bulgaria's National Strategy for Safe Management of Spent Fuel and Radioactive Waste, approved in 1999, the costs of transporting spent fuel from Kozloduy to Russia are estimated to be 68 million USD per year<sup>1</sup>.

The construction of a spent fuel storage facility, designed for the long-term storage of spent nuclear fuel from the WWER-440 and WWER-1000 reactors was granted a ten year operating licence in 2004, on the condition that a long-term programme for spent nuclear fuel transportation is developed.

Bulgaria's future plans for the disposal of spent nuclear fuel are unclear. Repatriation to Russia is currently the only viable option, but the Kozloduy NPP is one of the founding members of ARIUS – an international association with the mission to promote the concept of safe, secure, economic and politically and socially acceptable regional and international storage and disposal of spent fuel and high-level radioactive waste. Bulgaria also participates in the ARIUS-initiated SAPIERR project – support action for a pilot initiative for European Regional Repositories – which has received support from the European Commission's Sixth Framework Programme on research.

In 2005, based on the 1999 Strategy for Safe Management of Spent Fuel and Radioactive Waste, the Government of Bulgaria took the decision to construct a national repository for low and intermediate level waste by the year 2015.

### 2.1.3 Decommissioning cost estimates

During the period 1994-95, a comprehensive study was performed by a Bulgarian company in close cooperation with its affiliates in Russia and Slovak Republic. The study aimed at making a precise material inventory of the nuclear power units and also to make a preliminary cost estimation of their decommissioning. The results have been compared with the similar studies in countries operating WWER-440 reactors and good correlations have been noted. As a result of this study, and according to a 2003 Nuclear Energy Agency publication *Decommissioning Nuclear Power Plants. Policies, Strategies and Costs*, the total decommissioning costs for Kozloduy units 1 & 2 was

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<sup>1</sup> Note that without additional information from the Bulgarian authorities, it is unclear whether the costs for transporting and reprocessing the spent nuclear fuel are paid directly from Kozloduy NPP Plc, from the state budget or from the decommissioning or radioactive waste management fund.

estimated to be 377 million USD. Insufficient information is available to detail what was included in this estimate, although the cost breakdowns presented in sections 3.1.1 and 3.1.2 do provide a partial insight.

At the end of May 2005, a forecast for the resources required for decommissioning all six Kozloduy NPP units, site decontamination and the management of the high-level radioactive waste that will remain on the site after the sixth unit is shut down, totalled 2.6 billion Euro<sup>2</sup>. Based on this assessment, the annual instalments to the Nuclear Decommissioning Fund were increased from 8% to 15% of the Kozloduy NPP annual income from electricity sales, in order to collect the necessary funds in a shorter time frame.

The Kozloduy NPP also pays 3% of the average market price of its power into a radioactive waste management fund managed by the Minister for Energy and Energy Resources.

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<sup>2</sup> Note that without additional information from the Bulgarian authorities, it is unclear whether all spent nuclear fuel is expected to be repatriated to Russia or if Bulgaria is considering other options for spent fuel and high-level radioactive waste disposal. It is therefore unclear whether this cost estimate includes spent fuel management.

Table 2 Overview on decommissioning costs for Kozloduy unit 1 (408 MWe) in Bulgaria (in prices of 2004)

Decommissioning activity	Years the activity took place / is expected to take place	Total decommissioning costs [Mio. Euro]	Annuity of decommissioning costs in relation to output over lifetime [ct/kWh; 4%]	Remarks
Facility shutdown and pre-decommissioning activities	2003 – 2010	N/A	—	Insufficient information available
Spent fuel management (interim storage, reprocessing, waste solidification, storage processed waste streams and disposal of high level waste or spent fuel as such covering the whole lifetime of the NPP)	1990 -	N/A	—	Insufficient information available
Management of other (low and intermediate) radioactive wastes arising from reprocessing, and storage and disposal of these wastes covering the whole lifetime of the NPP	1992 -	N/A	—	Insufficient information available
Management of other radioactive waste from operation of the NPP (processing, storage and disposal of low and intermediate level waste from operation) covering the whole lifetime of the NPP	1992 -	N/A	—	Insufficient information available
Safe enclosure	2010 – 2045	N/A	—	Insufficient information available
Dismantling (nuclear) and decontamination activities	2045 – 2055	N/A	—	Insufficient information available
Decommissioning waste management (processing, storage and disposal of radioactive waste from decommissioning)	2045 – 2055	N/A	—	Insufficient information available
Decommissioning of non-radioactive parts (conventional dismantling)	2045 – 2055	N/A	—	Insufficient information available
Site restoration, cleanup and landscape	2045 – 2055	N/A	—	Insufficient information available
Supporting programmes for employees	N/A	N/A	—	Insufficient information available
Supporting programmes for regional development	2001 - 2010	N/A	—	Insufficient information available
<b>TOTAL</b>				

## **2.2 Future decommissioning strategies**

Future decommissioning strategies are not expected to change significantly from those already in place (i.e. deferred dismantling). However, alternative storage and disposal options for spent nuclear fuel are being investigated, including local and regional (international) repositories.

Table 3 Expected total costs of future decommissioning of nuclear installations in Bulgaria (in prices of 2004)

Short name of nuclear facility	Kind of facility: NPP = nuclear power plant RR = Research reactors Others: please specify	Years decommissioning activities are expected to take place	Total decommissioning costs estimated [Mio. Euro]	Annuity of estimated decommissioning costs in relation to output over lifetime [ct/kWh for NPP; 4%]	Remarks
Kozoduy unit 1	NPP	2003 – 2056	2600	N/A	
Kozoduy unit 2	NPP	2003 – 2056		N/A	
Kozoduy unit 3	NPP	2011 – 2064		N/A	Insufficient information available
Kozoduy unit 4	NPP	2011 – 2064		N/A	
Kozoduy unit 5	NPP	2025 – 2078		N/A	
Kozoduy unit 6	NPP	2025 - 2078		N/A	
IRT Sofia	RR	N/A	N/A	N/A	
Uranium mine	Uranium mine	N/A	N/A	N/A	

## 3 Funds and fund management

### 3.1 Setting aside funds

#### 3.1.1 The Bulgarian nuclear waste programme

The financial objectives for funding the Bulgarian nuclear waste programme are to:

- collect sufficient financial resources during the operating life of the nuclear power plant to cover all expenses related to: decommissioning the units; the long-term management of conventional and radioactive waste from the decommissioning of the units; the safe, long-term management of the spent fuel.
- assure that the fund is independent, that the assets are managed in a transparent way and that they are managed in a way, according to the legislation in force, that ensures their profitability
- assure that expenditures are under control and that the financial resources are directed towards reasonable purposes in compliance with the contributions to the funds.

The Bulgarian nuclear waste programme collects contributions for managing the radioactive waste generated by the Kozloduy NPP (as well as waste from industry, agriculture and other areas) and the decommissioning of the units. Contributions are primarily collected from the Kozloduy NPP operating company. Legal entities financed by the state budget (such as the research reactor, hospitals, etc) are exempt from paying these contributions. With a view to accelerating the collection of the necessary financial resources during the first years, contributions from the state budget were also envisaged, although funding data suggests that no such contributions have been made to date.

The amount of the contributions was determined on the basis of approximate calculations mentioned in the report "Management of Radioactive Waste in Bulgaria" prepared under a PHARE project, contract No: BG9107-02-04-01.

Since 1999, the price of electricity produced from the Kozloduy NPP has included all inherent costs, namely 8% of the electricity price for decommissioning, 3% for the radioactive waste management fund and 7% for spent fuel management during operation (i.e. before the spent fuel is returned to Russia for reprocessing). However, as a result of a detailed decommissioning cost estimate in 2001, the rate of payment into the national decommissioning fund was increased from 8% to 15% of the plant's income from electricity sales.

In 2003, approximately 58 million Euro had been collected for the radioactive waste fund and approximately 226 million Euro had been collected for the decommissioning fund (44 million from the operation of units 1 & 2, 57 million from units 3 & 4 and 124 million from units 5 & 6). At the time, estimates indicated that by 2006, units 3 & 4

would have contributed approximately 120 million Euro, and units 5 & 6 256 million Euro.

According to the annual reports of Kozloduy NPP Plc, contributions from Kozloduy NPP Plc to the Nuclear Facilities Decommissioning Fund and Safe Management of Radioactive Waste Fund amounted to 127 million BGN (approximately 65 million Euro) in 2004 and 117 million BGN (approximately 60 million Euro) in 2005.

Contributions to both funds will be halved from 1 January 2007, based on a decision by Bulgaria's Council of Ministers.

Information presented during a seminar on the Council of the European Union's peer review on nuclear safety in Bulgaria (17-19 November 2003) states that Bulgaria expects to contribute the following amounts towards the expenses of decommissioning nuclear facilities and maintaining the safety of radioactive waste facilities.

	Million Euro
General decommissioning expenses 2008-2010	37.990
General decommissioning expenses 2011-2045	3.674
Safe enclosure and dismantling 2008-2010	5.370
Safe enclosure and dismantling 2011-2045	10.956
New installation / adaptation 2008-2010	6.745
Radioactive waste management 2008-2010	15.096
Radioactive waste management 2011-2045	4.151
Spent fuel storage facility 1990-2003	24.100
Spent fuel transportation back to Russia 2001-2003	39.700
RAW treatment and storage facility at Kozolduy 1992-2003	23.800
RAW storage facility at Novi Han 1999-2003	9.500
<b>Total</b>	<b>181.082</b>

### 3.1.2 The Kozloduy International Decommissioning Support Fund

Safety concerns regarding the original design of Kozloduy units 1 – 4, and Bulgaria's pending accession to the European Union, lead to a political understanding with the European Commission in 1999. As a result, units 1 & 2 were shut down for decommissioning in December 2002 and units 3 & 4 are scheduled to be shut down for decommissioning at the end of 2006.

The EC Phare "Special Programme to Support the Decommissioning of Nuclear Power Plants and Consequential Measures in the Energy Sector" is worth 200 million Euro.

In addition, the European Commission and other western European donors offered the Bulgarian government 140 million Euro worth of further assistance to cope with the early closure of the plant and the development of a competitive energy sector. In June 2001, the Kozloduy International Decommissioning Support Fund was established at

the European Bank for Reconstruction and Development. Donors recognised the need to compensate for the loss of electricity generating capacity in Bulgaria resulting from the loss of the four Kozloduy units and so they allocated almost half of the Fund to strengthening the country's energy sector.

The Fund finances and co-finances selected projects for two main purposes:

- To support the decommissioning of Kozloduy nuclear power plant units 1-4, particularly through the provision of facilities for the storage and treatment of spent nuclear fuel and radioactive waste in a safe and cost effective manner;
- To address issues in the energy sector related to the closure of units 1-4 (modernisation of the conventional energy production, transmission and distribution sectors in Bulgaria; improvements in energy efficiency, use of renewable energy sources and security of energy supply).

Within the framework of Bulgaria's accession negotiations, the EU Member States agreed to a further 210 million Euro of assistance, to be committed in three equal annual tranches of 70 million Euro for the years 2007, 2008 and 2009. In total, the financial assistance in support of the decommissioning efforts at the Kozloduy nuclear power plant, allocated under the principle of solidarity, amounts to 550 million Euro for the period 2000-2009.

Information from the European Bank for Reconstruction and Development, together with information presented during a seminar on the Council of the European Union's peer review on nuclear safety in Bulgaria (17-19 November 2003), indicate that the following amounts have currently been allocated towards the expenses of supporting the decommissioning of nuclear facilities, maintaining the safety of radioactive waste facilities and addressing energy sector issues related to the closure of Kozloduy units 1-4.

	Million Euro
Decommissioning preparation 2003-2008	13.300
Contribution to spent fuel interim storage facility 2003-2008	47.200
RAW treatment and storage at Kozloduy 1992-1998	6.600
RAW storage facility at Novi Han 2003-2005	1.400
Grant for industrial energy efficiency and renewables	10.000
Grant for residential energy efficiency and renewables	10.000
Grant towards rehabilitation of Sofia district heating network	30.000
Grant towards new electricity meters in private households	3.000
<b>Total</b>	<b>121.500</b>

## **3.2 Management of funds**

### **3.2.1 The Nuclear Facilities Decommissioning Fund**

The Nuclear Facilities Decommissioning Fund is a segregated external fund, very much under state control. The financial resources are centralised in a Bulgarian National Bank account, opened in the name of the Ministry of Energy and Energy Resources. The Fund is managed by the Bulgarian National Bank.

The Fund is governed by a Management Board, chaired by the Minister of Energy and Energy Resources, and consisting of a Deputy Minister of Finance, a Deputy Minister of Health, a Deputy Minister of Economy, a Deputy Minister of Environment and Water, a Deputy Minister of Regional Development and Public Works, the Nuclear Regulatory Agency Chairman, a representative of the licensees operating NPPs, and the Director of the Institute of Nuclear Research and Nuclear Energy with the Bulgarian Academy of Sciences.

The annual report of the Fund's activities is submitted to the Bulgarian Council of Ministers.

### **3.2.2 The Radioactive Waste Management Fund**

The Radioactive Waste Management Fund is a segregated external fund, very much under state control, almost identical to the Decommissioning Fund, with the exception of the members of the Management Board. The financial resources are centralised in a Bulgarian National Bank account, opened in the name of the Ministry of Energy and Energy Resources. The Fund is managed by the Bulgarian National Bank.

The Fund is governed by a Management Board, chaired by the Minister of Energy and Energy Resources, and consisting of representatives of the Ministry of Energy and Energy Resources, the Ministry of Regional Development and Public Works, the Ministry of Environment and Waters, the Ministry of Health, the Ministry of Finance, the Ministry of Economy, the Nuclear Regulatory Agency and the Bulgarian Academy of Sciences, designated by the competent ministers or governing bodies.

The annual report of the Fund's activities is submitted to the Bulgarian Council of Ministers.

### **3.2.3 The Kozloduy International Decommissioning Support Fund**

The Kozloduy International Decommissioning Support Fund is a ring-fenced external fund, managed by the European Bank for Reconstruction and Development's nuclear safety team.

### **3.3 Special cases: Fall-back option and transfer of ownership**

Currently the Bulgarian state is responsible for the provision of decommissioning in the case of early shutdown or if the operator is not able to financially provide for the total costs of decommissioning.

Any decommissioning and radioactive waste management funds that have been collected from the operator will remain under state control. Funds are managed by the Bulgarian National Bank (and therefore the Fund Manager cannot become insolvent).

In a special case of solidarity, the European Union and other western European donors that expressed concerns about the safety of Kozloduy units 1-4, have provided supplementary funds to assist with early shutdown.

Kozloduy NPP Plc is a 100% state owned company. There are currently no plans for privatisation and so all liabilities and responsibilities remain with the state. Plans for a future new-build nuclear power plant at Belene involve a public-private partnership. Under current legislation, the Bulgarian state would be liable for any financial resource shortfall in the decommissioning and radioactive waste management funds, in the case of an early shut down at Belene.

Table 4 Base for decommissioning funds required

Short name of nuclear facility	Kind of facility: NPP = nuclear power plant RR = Re-search reactors Others: please specify	Please check if decommissioning funds are based on overnight / undiscounted decommissioning costs	Please check if decommissioning funds are based on net present value / discounted decommissioning costs	Discount rate used for discounting, if any	Reference date used for discounting	Remarks
Kozoduy unit 1	NPP	N/A	N/A	N/A	N/A	No information currently available.
Kozoduy unit 2	NPP	N/A	N/A	N/A	N/A	No information currently available.
Kozoduy unit 3	NPP	N/A	N/A	N/A	N/A	No information currently available.
Kozoduy unit 4	NPP	N/A	N/A	N/A	N/A	No information currently available.
Kozoduy unit 5	NPP	N/A	N/A	N/A	N/A	No information currently available.
Kozoduy unit 6	NPP	N/A	N/A	N/A	N/A	No information currently available.
IRT Sofia	RR	N/A	N/A	N/A	N/A	No information currently available.
Uranium mine	Uranium mine	N/A	N/A	N/A	N/A	No information currently available.

Table 5 Decommissioning funds accumulated in relation to expected total costs of future decommissioning of nuclear installations in Bulgaria (in prices of 2004)

Short name of nuclear facility	Kind of facility: NPP = nuclear power plant RR = Research reactors Others: please specify	Total decommissioning costs estimated [Mio. Euro]	Provisions accumulated by 31-12-2004 [Mio. Euro]	Provisions accumulated in relation to expected costs [%]	Years of operation until 31-12-2004 in relation to total expected lifetime [%]	Remarks
Kozoduy unit 1	NPP	2.6 billion Euro	550 million Euro from EU + 280 million Euro in de-comm. funds + 69 million Euro in radioactive waste management funds	35 %	21/30 as a rough weighted average of the 6 plants.	
Kozoduy unit 2	NPP					
Kozoduy unit 3	NPP					
Kozoduy unit 4	NPP					
Kozoduy unit 5	NPP					
Kozoduy unit 6	NPP					
IRT Sofia	RR					
Uranium mine?	Uranium mine					

Table 6 Management of decommissioning funds in Bulgaria

Short name of nuclear facility	Kind of facility: NPP = nuclear power plant RR = Research reactors Others: please specify	Provisions accumulated by 31-12-2004 [Mio. Euro]	... of which has been accumulated within the own assets of the operator of the facility or its mother company [Mio. Euro]	... of which has been accumulated by the operator of the facility or its mother company within a separated account / segregated fund [Mio. Euro]	... of which has been accumulated in an external fund under public control [Mio. Euro]	... of which has been accumulated in an external fund under mixed private-public control [Mio. Euro]	Share of funds the operator of the facility can access for other activities until the funds are needed for their original decommissioning purpose [%]	Remarks
EBRD funds for Kozoduy 1 to 4	NPP	550 million Euro			550 million Euro		0	
Decomm. Funds for Kozoduy 1 - 6	NPP	280 million Euro		280 million Euro			0	
Radwaste Man. Funds for Kozoduy 1-6	NPP	69 million Euro		69 million Euro			0	
IRT Sofia	RR							Not enough information
Uranium mines	Uranium mine							Not enough information

Table 7 Investment of decommissioning funds until they are used for their original purpose

Short name of nuclear facility	Kind of facility: NPP = nuclear power plant RR = Research reactors Others: please specify	Provisions accumulated by 31-12-2004 [Mio. Euro]	... of which have been invested in secure state bonds [Mio. Euro]	... of which have been invested in other assets with fixed interest rates [Mio. Euro]	... of which have been lent to associated or joined companies or to third parties [Mio. Euro]	... of which have been invested in other means (shares, mergers & acquisitions, etc.) [Mio. Euro]	Interest on invested financial means from decommissioning funds in 2004 [%]	Interest on invested financial means from decommissioning funds in period 2000-2004 [%]	Remarks
EBRD funds for Kozoduy 1 to 4	NPP	550 million Euro							Held by the EBRD
Decomm. Funds for Kozoduy 1 - 6	NPP	280 million Euro							Held by the Bulgarian national bank. Currently no information on interest rate.
Radwaste Man. Funds for Kozoduy 1-6	NPP	69 million Euro							Held by the Bulgarian national bank. Currently no information on interest rate.
IRT Sofia	RR								
Uranium mine?	Uranium mine								

#### **4 Transparency of the funding schemes to the public**

The closure, decommissioning and funding of nuclear power plants in Bulgaria is currently a rather delicate issue. The Bulgarian authorities have not provided information for this report, have not yet completed the Colenco questionnaire and appear unwilling to cooperate with nuclear-related projects of the European Commission.

Very little information about the funding schemes is publicly available. The required contribution to the Nuclear Facilities Decommissioning Fund and the Safe Management of Radioactive Waste Fund (expressed as a percentage of the annual income from electricity sales) from Kozloduy NPP Plc is based on a decision by Bulgaria's Council of Ministers, published in the Official Journal of Bulgaria. Recently the annual reports of Kozloduy NPP Plc have started to state the amount of annual contributions to these funds. In addition, the annual reports of the Nuclear Facilities Decommissioning Fund and the Radioactive Waste Management Fund are submitted to the Bulgarian Council of Ministers.

Under the current situation, with 100% state-ownership of Kozloduy NPP, the public is aware that all responsibilities and liabilities for decommissioning are attributed to the state.

## 5 Stakeholder analysis

The main stakeholders with regard to decommissioning financing are currently:

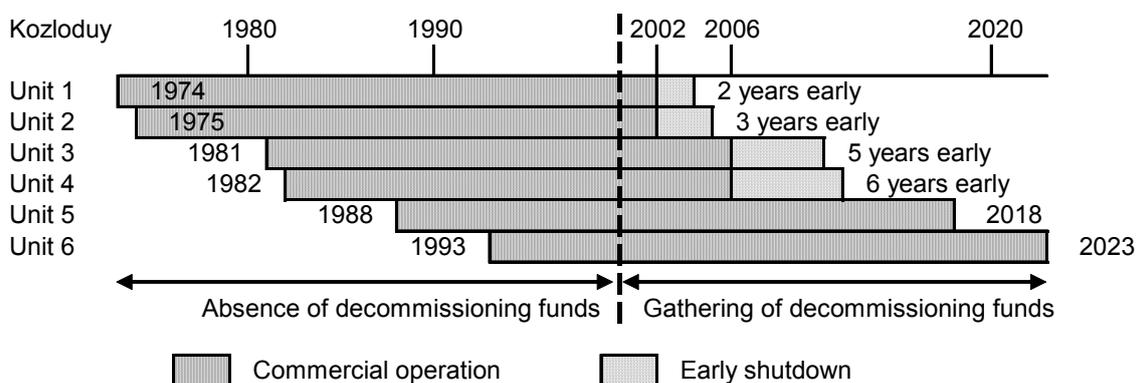
- The Decommissioning Division of Kozloduy NPP Plc
- The Bulgarian Nuclear Regulatory Agency
- The Management Board of the decommissioning fund:
  - the Minister of Energy and Energy Resources
  - a Deputy Minister of Finance
  - a Deputy Minister of Health
  - a Deputy Minister of Economy
  - a Deputy Minister of Environment and Water
  - a Deputy Minister of Regional Development and Public Works
  - the Nuclear Regulatory Agency Chairman
  - a representative of the licensees operating NPPs
  - the Director of the Institute of Nuclear Research and Nuclear Energy with the Bulgarian Academy of Sciences
- The European Commission (through EC PHARE programme support).
- The European Community, joined by Denmark, Greece, Ireland, the Netherlands, Switzerland and the United Kingdom, who have contributed to the Kozloduy International Decommissioning Support Fund.
- The European Bank for Reconstruction and Development who manage the Kozloduy International Decommissioning Support Fund.

## 6 Conclusions and recommendations

Under current conditions (100% state ownership) the Bulgarian state is responsible for the decommissioning and radioactive waste management for all its historical nuclear power plant operation. However, the gathering of funds for nuclear decommissioning (and for radioactive waste management) started in 2000, twenty-six years after Bulgaria's first nuclear power plant reactor started commercial operation.

Fund contributions are based on a percentage of the value of electricity sales from Kozloduy NPP, but it was envisaged that the state would make a substantial initial payment to the Funds to compensate for the absence of contributions during the period 1974 – 1999. To date, the state does not appear to have made such a contribution.

Based on agreements with the European Commission, units 1 & 2 were shut down two and three years earlier than anticipated (taking into account the planned 30 year operational lifetime of the units). Closing down units 3 & 4 at the end of 2006 will end the production of electricity from these units five and six years earlier than anticipated.



As compensation for early shutdown, the Kozloduy decommissioning support fund is worth 550 million Euro, with almost half being allocated to strengthening Bulgaria's energy sector. If units 1 – 4 had not been required to close early, the decommissioning and radioactive waste management funds would have benefited from a combined additional contribution of (approximately) 100 million Euro (assuming that contributions to the funds would have been halved from 1 January 2007 onwards, in accordance with the decision of Bulgaria's Council of Ministers).

Under current early closure agreements, at the end of 2006, the Kozloduy NPP will have contributed approximately 385 million Euro to the Decommissioning Fund and approximately 90 million Euro to the Radioactive Waste Fund. If the contributions to the Funds are halved for the rest of the operational life of the remaining two units (units 5 & 6) and the units continue to produce similar amounts of electricity as in recent years until the end of their operational life, in 2023, neglecting inflation, Kozloduy NPP will have contributed approximately 645 million Euro to the Decommissioning Fund and approximately 142 million Euro to the Radioactive Waste Fund.

Without additional funding, the amount of financial support that will become available for decommissioning and radioactive waste management for the Kozloduy nuclear power plant appears to be approximately half the 2.6 billion Euro cost estimate. The outstanding 1.3 billion Euro corresponds, almost exactly, to the amount of contributions that would have been gathered if the historical contributions from units 1 – 6 were equal to those gathered today (i.e. approximately 10 million Euro per year per unit for units 1 – 4 and approximately 21.5 million Euro per year per unit for units 5 & 6).

1.3 billion Euro, even if collected over several years, would place a significant burden on Bulgaria's state budget. Consideration should be given to setting aside these outstanding contributions over an extended period of time and also to safe investment mechanisms that will inflation-proof the funds until they are required.

## 7 References

European Commission, 2003 Regular report on Bulgaria's progress towards accession, 5 November 2003.

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International Atomic Energy Agency, Selection of decommissioning strategies: issues and factors, IAEA-TECDOC-1478, IAEA, Vienna, November 2005

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The Government of the Republic of Bulgaria, "Second National Report on the fulfilment of the obligations on the Joint Convention on the safety of spent fuel management and on the safety of radioactive waste management", Sofia, September 2005.

Council of the European Union, Peer review status report, Brussels, 5 June 2002

Presentation, Nuclear Safety Peer Review of Kozloduy NPP, 17-19 November 2003

**Internet sites:**

The Bulgarian Ministry of Energy and Energy Resources

<http://www.doe.bg>

The Western European Nuclear Regulator's Association (WENRA)

<http://www.wenra.org>

Bankwatch network

<http://www.bankwatch.org>

European Bank for Reconstruction and Development

<http://www.ebrd.com>

Kozloduy Nuclear Power Plant

<http://www.kznpp.org>

Bulgarian Nuclear Regulatory Agency

<http://www.bnsa.bas.bg/>

Bulgarian Atomic Forum (BULATOM)

<http://www.bulatom-bg.org>

Bulgarian Ministry of Economy and Energy

<http://www.mi.government.bg>

World Nuclear Association

<http://www.world-nuclear.org>

Bulgarian National Electricity Company

<http://www.nek.bg>

## **Annex 1 – Nuclear Facilities Decommissioning Fund**

(Effective as from 1 January 2003)

### **Article 48**

A Nuclear Facilities Decommissioning Fund, hereinafter referred to as "the Fund," shall be established under auspices of the Minister of Energy and Energy Resources for the purpose of financing activities relating to decommissioning of nuclear facilities.

### **Article 49**

- (1) The revenues of the Fund shall be raised, accounted and centralised in the Single Budget Account System through use of a separate transit account, opened in the name of the Ministry of Energy and Energy Resources within the Bulgarian National Bank, from the following sources:
1. contributions from nuclear facility operators, in amount specified by the Council of Ministers;
  2. national budget resources, allocated annually by the National Budget Act for the relevant year;
  3. interest accruing on the management of the financial resources raised in the Fund and on overdue payments of the contributions referred to in Item 1;
  4. donations;
  5. other revenues accruing as a result of management of Fund financial resources.
- (2) Legal entities financed by the state budget shall be exempt from payment of contributions referred to in Item 1 of Paragraph (1).
- (3) The contributions to the Fund, referred to in Item 1 of Paragraph (1), shall be allowed as running operating expenses deductible for taxation purposes and as economically justified costs for the purposes of pricing according to the Energy and Energy Efficiency Act.
- (4) The contributions referred to in Item 1 of Paragraph (1) shall be public state receivables, which shall be ascertained and collected by the tax administration according to the procedure established by the Taxation Procedure Code.

### **Article 50**

- (1) The financial resources of the Fund shall be expended solely for the purpose of financing nuclear facilities decommissioning activities, including:
1. the annual programme of the licensee, operating the nuclear facility, which is being under decommissioning;
  2. expenses on the storage and disposal of radioactive waste generated as a result from the decommissioning activities;
  3. management of the Fund;

4. other activities, provided for in the law and associated with the safe decommissioning.
- (2) The expenditures covered under Paragraph (1) shall be provided for annually within the budget of the Ministry of Energy and Energy Resources and shall be effected by means of assignment of a unique payment code in the System for Electronic Budget Payments.
- (3) Any unutilised portion of the financial resources accruing under Article 49 herein, including resources brought forward, shall be accounted for as off-balance sheet items. Any such resources shall constitute an integral part of the Single Account and shall be expended solely in accordance with the provisions of this Act.
- (4) The financial resources of the Fund shall be kept at the Bulgarian National Bank and shall be managed according to a procedure provided for in an agreement between the Fund Management Board of and the Bank, approved by the Minister of Finance.

**Article 51**

- (1) A Management Board consisting of nine members, including a Chairman shall govern the Fund.
- (2) The Minister of Energy and Energy Resources shall chair the Management Board.
- (3) Any person, who has been sentenced for an offence or who is a spouse or a lineal or collateral relative up to the fourth degree of consanguinity or a relative by marriage up to the third degree of affinity inclusive to any other member of the executive bodies of the Fund, shall be ineligible for membership of the Management Board.

**Article 52**

- (1) Members of the Fund Management Board shall be a Deputy Minister of Finance, a Deputy Minister of Health, a Deputy Minister of Economy, a Deputy Minister of Environment and Water, a Deputy Minister of Regional Development and Public Works, the NRA Chairman, a representative of the licensees operating NPPs, and the Director of the Institute of Nuclear Research and Nuclear Energy with the Bulgarian Academy of Sciences.
- (2) The ministers covered under Paragraph (1) shall designate the representatives thereof to the Fund Management Board.
- (3) The Management Board Chairman shall issue an order designating by name all members.

**Article 53**

- (1) The Management Board shall meet at least once in three months.
- (2) Any meeting of the Management Board shall be considered as legal if not less than two-thirds of the members thereof are present.

- (3) The Management Board shall make decisions by open ballot and by a simple majority of the total number of members thereof.

#### **Article 54**

- (1) The Management Board shall:

1. adopt Rules of Organisation and Operation of the Fund;
2. adopt a draft budget, accompanied by a report and estimates specifying the particular revenues and expenditures of the Fund for each budget year;
3. distribute and allocate financial resources for implementation of decommissioning related activities and projects in accordance with licensees decommissioning programmes;
4. control the expedient spending of the financial resources in the Fund;
5. conclude contracts for management of the financial resources of the Fund with the Bulgarian National Bank in co-ordination with the Minister of Finance;
6. submit an annual report for its activities to the Council of Ministers;
7. perform any other functions associated with the management of the Fund, in compliance with the effective statutory legislation.

- (2) The draft budget of the Fund, as adopted by the Management Board, shall be incorporated into the draft budget of the Ministry of Energy and Energy Resources and shall be submitted to the Ministry of Finance according to the procedure established by the National Budget Procedures Act.

#### **Article 55**

The procedure for ascertainment, collection, spending and control of the financial resources, as well as the amount of contributions due, shall be established by a regulation adopted by the Council of Ministers on a motion by the Minister of Energy and Energy Resources and the Minister of Finance.

## **Annex 2 – Radioactive waste management financing**

(Effective as from 1 January 2003)

### **Article 90**

Licensees generating radioactive waste shall meet all expenses incurred in connection with management of radioactive waste from its waste generation to its disposal, including monitoring of repositories after closure and the necessary tests and improvements by:

1. reserving funds that would be necessary for waste generation to the expenditures as shall be necessary for safe storage of the radioactive waste from the point of waste generation to the point of delivery to the Company, and
2. contributing to the Radioactive Waste Fund established by this Act.

### **Article 91**

A Radioactive Waste Fund shall be established under the Minister of Energy and Energy Resources to finance activities associated with radioactive waste management.

### **Article 92**

- (1) The revenues of the Radioactive Waste Fund shall be raised from the following sources:
  1. contributions from legal entities and persons conducting activities resulting in the generation of radioactive waste under this chapter;
  2. national budget resources, allocated annually by the National Budget Act for the relevant year;
  3. interest accruing on the management of the financial resources raised in the Fund and on overdue payments of contributions referred to in Article 92(1)1 above;
  4. donations and other contributions;
  5. other revenues accruing as a result of management of the financial resources of the Fund.
- (2) The revenues of the Radioactive Waste Fund shall be raised, accounted for and centralised in the Single Account System through use of a separate account, opened in the name of the Ministry of Energy and Energy Resources in the Bulgarian National Bank.
- (3) The financial resources of the Fund shall be kept solely at the Bulgarian National Bank and shall be managed according to a procedure set forth for in a contract between the Management Board of the Fund and the Bank, approved by the Minister of Finance.
- (4) Any unutilised portion of the financial resources accruing under Paragraph 1, including resources brought forward, shall be accounted for as off-balance sheet

items. Any such resources shall constitute an integral part of the Single Account and shall be expended solely in accordance with the provisions of this Act.

### **Article 93**

- (1) The financial resources of the Fund shall be expended solely for the purpose of financing:
  1. the operation and financial management of the Radioactive Waste Company;
  2. other activities involving in radioactive waste management outside the activities of the Company, including research and scientific developments;
  3. decommissioning of radioactive waste management facilities;
  4. management of the Fund.
- (2) The expenditures covered under Paragraph 1 shall be included annually in the budget of the Ministry of Energy and Energy Resources and shall be assigned a separate payment code in the System for Electronic Budget Payments.

### **Article 94**

- (1) The procedure for assessing, collecting, spending and control of the financial resources, as well as the amount of contributions due, shall be established by a regulation adopted by the Council of Ministers on a motion by the Minister of Energy and Energy Resources and the Minister of Finance.
- (2) Contributions to the Fund by legal entities and persons conducting activities resulting in generation of radioactive waste shall be allowed as operating expense deductible for taxation purposes regarding the generation of such radioactive waste.
- (3) The contributions under Article 92(1)1 shall be public state revenues, which shall be assessed and collected by the tax administration according to the procedure established by the Taxation Procedure Code.
- (4) Legal entities financed by the national budget shall be exempt from payment of contributions under Article 92 (1)1.

### **Article 95**

- (1) A Management Board consisting of nine members, including the Chairman, shall manage the Fund.
- (2) The Minister of Energy and Energy Resources shall chair the Management Board.
- (3) The members of the Management Board shall be representatives of the Ministry of Energy and Energy Resources, the Ministry of Regional Development and Public Works, the Ministry of Environment and Waters, the Ministry of Health, the Ministry of Finance, the Ministry of Economy, the Nuclear Regulatory Agency and the Bulgarian Academy of Sciences, designated by the competent ministers or governing bodies.
- (4) Any person, who has been sentenced for an offence or who is a spouse or a lineal or collateral relative up to the fourth degree of consanguinity or a relative by mar-

riage up to the third degree of affinity to any other member of the executive bodies of the Fund and the Company, shall be ineligible for membership of the Management Board.

#### **Article 96**

- (1) The Management Board shall meet at least once every two months.
- (2) A Management Board meeting shall be considered lawful if not less than two-thirds of its members have been present, either in person or by proxy. A member present in person shall act as proxy for not more than one absent member, and must be authorised in writing for each particular meeting.
- (3) Decisions of the Management Board shall be made by open ballot and by a qualified majority of two-thirds of the members.

#### **Article 97**

- (1) The Management Board shall:
  1. adopt Rules of Organisation and Operation of the Fund;
  2. determine the allocation of financial resources for the operation of the Radioactive Waste State-Owned Company, as well as for other activities included in radioactive waste management;
  3. control the proper expenditure of the financial resources in the Fund;
  4. adopt a draft budget, accompanied by a report and estimates specifying the particular revenues and expenditures of the Fund for each budget year;
  5. adopt a budget of the Company for each year;
  6. approve annual and triennial plans for operation of the Radioactive Waste State-Owned Company;
  7. conclude contracts for management of the financial resources of the Fund with the Bulgarian National Bank in co-ordination with the Minister of Finance;
  8. adopt periodic and annual reports on the operation of the Radioactive Waste State-Owned Company;
  9. submit annually a report on the Fund's activities to the Council of Ministers;
  10. perform any other functions associated with the management of the Fund and of the Radioactive Waste State-Owned Company, in accordance with the applicable statutory framework.
- (2) The draft budget of the Fund, as adopted by Management Board, shall be incorporated into the draft budget of the Ministry of Energy and Energy Resources and shall be submitted to the Ministry of Finance according to the procedure established by the National Budget Procedures Act.

## **Annex 3 – Article 30 of the Treaty concerning the accession of the Republic of Bulgaria and Romania to the European Union**

1. Bulgaria, having closed – in line with its commitments – definitively for subsequent decommissioning Unit 1 and Unit 2 of the Kozloduy Nuclear Power Plant before the year 2003, commits to the definitive closure of Unit 3 and Unit 4 of this plant in 2006 and to subsequent decommissioning of these units.

2. During the period 2007-2009, the Community shall provide Bulgaria with financial assistance in support of its efforts to decommission and to address the consequences of the closure and decommissioning of Units 1 to 4 of the Kozloduy Nuclear Power Plant.

The assistance shall, inter alia, cover: measures in support of the decommissioning of Units 1 to 4 of the Kozloduy Nuclear Power Plant; measures for environmental upgrading in line with the acquis; measures for the modernisation of the conventional energy production, transmission and distribution sectors in Bulgaria; measures to improve energy efficiency, to enhance the use of renewable energy sources and to improve security of energy supply.

For the period 2007-2009, the assistance shall amount to EUR 210 million (2004 prices) in commitment appropriations, to be committed in equal annual tranches of EUR 70 million (2004 prices).

The assistance, or parts thereof, may be made available as a Community contribution to the Kozloduy International Decommissioning Support Fund, managed by the European Bank for Reconstruction and Development.

3. The Commission may adopt rules for implementation of the assistance referred to in paragraph 2. The rules shall be adopted in accordance with Council Decision 1999/468/EC of 28 June 1999 laying down the procedures for the exercise of implementing powers conferred on the Commission 1. To this end, the Commission shall be assisted by a committee. Articles 4 and 7 of Decision 1999/468/EC shall apply. The period laid down in Article 4(3) of Decision 1999/468/EC shall be six weeks. The committee shall adopt its rules of procedure.

**Annex 4 – Annual Report 2005, Kozloduy NPP**

**Annex 5 – Annual Report 2005, Nuclear Regulatory Agency**

**Annex 6 – Annual Report 2005, National Electricity Company**



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**ANNUAL REPORT**

**K O Z L O D U Y   N P P**

## FINANCIAL STATUS

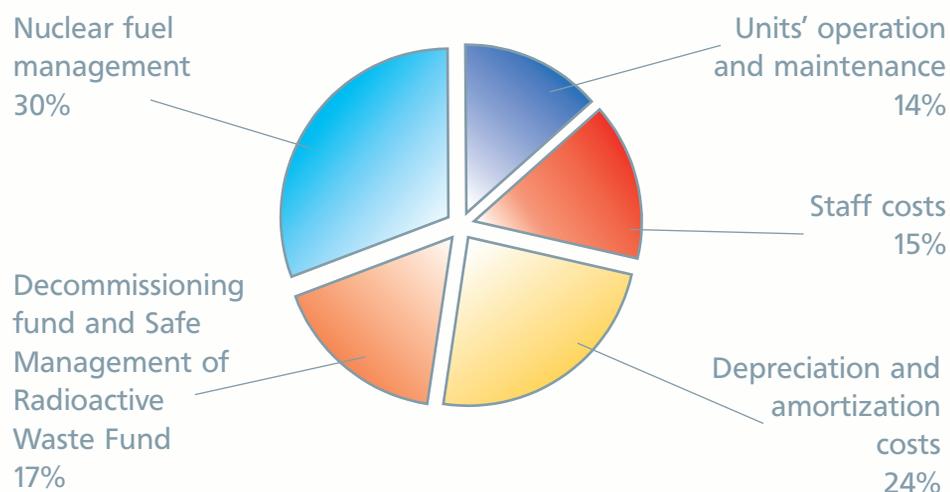
Finance-wise, 2005 was among the most difficult years for Kozloduy NPP. The company makes 92 percent of its revenues from selling electrical power. The balance is formed by the difference between the sales income and the expenditures, or between sale price and cost price.

Kozloduy NPP has been selling electricity on the deregulated market but production quotas have been set by the state. Indeed, in 2005 the major part of our sales, 94.2 percent, was on the regulated market at prices determined by the State Commission for Energy and Water Regulation. Only 5.8 percent of the sales were made on the liberalized market at freely negotiated prices, thus ensuring 8 percent of the income. The record-low regulated sale prices from October 1, 2005 (enforced for one year) had a negative impact on the financial status of the company. The extra income from above - plan sales and sales on the open market could not make up for the losses due to the lower prices on the state-regulated market. Therefore, Kozloduy NPP calculated a loss of BGN 27 million before taxes.

Regardless of the unfavorable financial conditions, the production plan was met together with safety upgrades and fulfillment of obligations to trade partners, state budget, social funds and personnel. This was possible thanks to well-structured business goals and successful management of resources.

The company undertook measures to optimize its expenditures but they could not fall below certain levels that guarantee safe operation.

*Structure of Operating costs for 2005*



Kozloduy NPP fulfilled its obligations with regard to the spent fuel management; the cost of activities related to spent fuel amounts to 12 percent of the operating costs structure.

Since 1999, two special funds have been established: Nuclear Facilities Decommissioning Fund and Safe Management of Radioactive Waste Fund. In 2005, Kozloduy NPP deposited in both funds BGN 117.250 million, and BGN 1.329 million was taken from the funds for company needs. Following a decision of the Council of Ministers, the installments to both funds were cut by half, effective of January 1, 2007.

According to the strategy for postponed decommissioning of Units 1 and 2 (with a 5-year license for zero-power operation) the expenses for their maintenance are covered by the income from operating Units. Only part of these expenses comes from the Nuclear Facilities Decommissioning Fund. Kozloduy NPP uses only 1.5 - 1.7 percent of the decommissioning installments it has made to the budget.

The depreciation costs were increased by 4 percent in 2003-2005 due to implementation of various modernization measures on Units 5 and 6.

The company fulfilled its obligations to the staff as required by relevant legislation.

Kozloduy NPP paid a total of BGN 29.167 million to the social funds and met its duties to social insurance, re-qualification and unemployment funds, health insurance funds, etc. The company also paid BGN 8.369 million for additional insurances.

Kozloduy NPP paid taxes amounting to BGN 146.763 million.

In two consecutive years Kozloduy NPP has received the Big Taxpayer Award from the Financial Ministry, which proves the great contribution to the state budget.

Since January 2005, Kozloduy NPP has been applying the International Standards on Financial Reports approved by the EU Commission. The financial report for 2004 was restated according to these standards, too.

The Balance Sheet and the Income Statement presented hereby reflect the financial status of the company in a summarized form. Following the requirements of the Accountancy Act, the full financial report will be also published on the Kozloduy NPP's site [www.kznpp.org](http://www.kznpp.org).

## FINANCIAL STATUS

### BALANCE SHEET AS PER DECEMBER 31, 2005 (in thousands of BGN)

ASSETS	2005	2004
<b>Non-current assets:</b>		
Tangible assets	1 407 506	1 410 884
Intangible assets	69 178	64 595
Financial assets	75	75
Investments in associates	929	197
Deferred tax assets	4 535	0
Deferred expenses	42	84
<b>Total non-current assets</b>	<b>1 482 265</b>	<b>1 475 835</b>
<b>Current assets:</b>		
Inventories	178 706	185 504
Trade debtors and other receivable	88 818	117 182
Cash and cash equivalents	100 570	126 054
Tax receivables	4 942	2 900
Deferred expenses	45 094	3 784
<b>Total current assets</b>	<b>418 130</b>	<b>435 424</b>
<b>Total assets</b>	<b>1 900 395</b>	<b>1 911 259</b>
<b>EQUITY AND LIABILITIES</b>		
<b>Equity:</b>		
Share-capital	101 716	101 716
Reserves	992 961	1 004 447
Retained earnings from prior period	(9 245)	(11 726)
Retained earnings from current period	(28 844)	3 971
<b>Total equity</b>	<b>1 056 588</b>	<b>1 098 408</b>
<b>Liabilities</b>		
<b>Non-current liabilities:</b>		
Bank loans and borrowings	546 327	480 271
Deferred tax liabilities	77 496	75 098
Provisions	11 569	1 407
Contingent liabilities	42 524	67 478
<b>Total non-current liabilities</b>	<b>677 916</b>	<b>624 254</b>
<b>Current liabilities:</b>		
Trade and other payables	90 717	63 340
Bank loans and borrowings	17 827	14 584
Current portion of interest bearing borrowing	18 875	13 223
Tax payables	25 639	28 386
Provisions	12 525	39 815
Other payables	308	29 249
<b>Total current liabilities</b>	<b>165 891</b>	<b>188 597</b>
<b>Total equity and liabilities</b>	<b>1 900 395</b>	<b>1 911 259</b>

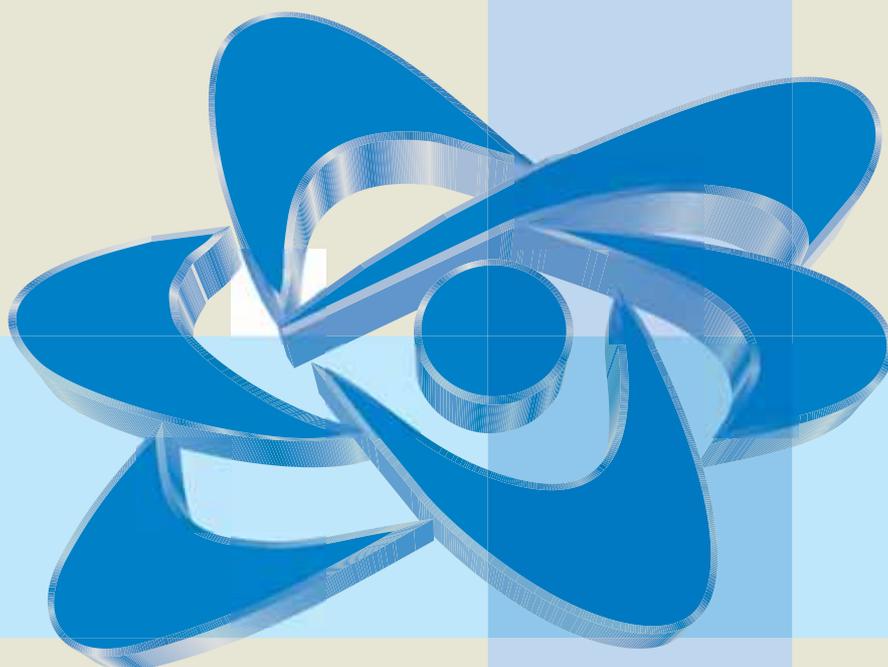
### INCOME STATEMENT FOR THE YEAR ENDED 31 DECEMBER 2005 (in thousands of BGN)

	2005	2004
Revenue	719 949	644 969
Cost of sales	(681 880)	(627 222)
Gross profit/(loss)	38 069	17 747
Other operating income	10 260	9024
Administrative expenses	(32 949)	(21 256)
Profit/(loss) from operations	15 380	5 515
Financial income/(expenses)	(41 904)	(2 492)
Revaluation of assets	(783)	(319)
Income of associates companies	3	-
Profit/(loss) before taxes	(27 304)	2 704
Tax expenses	(1 540)	(3 663)
Net profit/(loss) for the year	(28 844)	(959)

# NUCLEAR REGULATORY AGENCY

REPUBLIC OF BULGARIA

2005  
REPORT



## SAFETY OF NUCLEAR FACILITIES

### POWER UNITS OF THE KOZLODUY NPP



The operation of the power units in Kozloduy NPP is based on the issued by NRA long term licenses for operation and on observing the limits and conditions for operation.

During the planned outages in the year 2005, all planned activities on structures, systems and components that provide for the necessary reliability and safety of the units for the next fuel cycle were fully performed. All activities foreseen in the programmes for base metal control, control of the welded surfaces and welds on the equipment and pipelines in the primary and secondary circuits were performed in such volume and quality as the prescribed in the legislative documents.

The functional tests of structures, systems and components important to safety before start-up and operation of the units after maintenance, as well as the periodical tests, demonstrate the effectiveness of the physical barriers and the readiness of the levels of protection.

On the basis of the findings from the inspections and the submitted reporting documents in the process of fulfilling the license conditions, the general conclusion of the NRA is that during 2004 all physical barriers were maintained operational and all levels of protection – in stand by condition. Presented below are the specific aspects of the operation of the different power units.



## UNITS 1 AND 2

By a decision № 848/19.12.2002 of the Council of Ministers of the Republic of Bulgaria in the end of year 2002 Units 1 and 2 were shut down from operation for production of electricity after completing their XXIII-rd and XXIV-th fuel cycle respectively. The issued in 2004 five year licenses for operation of the units limit their use only for storage of irradiated and spent nuclear fuel in the Spent Fuel Pools.

In accordance with the conditions of the licence by the end of 2005 a general plan for decommissioning of units 1&2 was submitted to the NRA. This plan is based on the approach delineated in the technical design for decommissioning as of 2001 and envisages delayed dismantling with a 35-year period of safe storage.

The submitted general plan is in a process of evaluation at the NRA. The chosen variant for decommissioning may be modified by the licence for the installations. In this case the plan for decommissioning should be updated, so that it will reflect the modifications introduced in the chosen variant for decommissioning and should be submitted to the NRA not later than the date for application for issuing permit for decommissioning.

At the present moment the lower racks of spent fuel pools 1 & 2 contain respectively 317 and 329 assemblies with spent fuel. The heat released from this fuel at the end of 2005 has decreased to 99 kW, decreasing by 0,3 kW every day. This heat power will be decreased additionally after the extraction of 60 more assemblies from each pool, which will be used for loading units 3 & 4 in 2006. The low heat release and the diversity of technological patterns for feedwater of the pools from different sources, allow a long term cooling of the SNF even in the absence of patterns for standard and emergency cooling.

An appropriate water chemistry regime is maintained along the primary and secondary circuits of the units, for suppression of the corrosion processes in long term storage. Programmes for periodical assessment of the corrosion processes are carried out. The results from the investigations of the processes do not present substantial corrosion deviations.



## UNITS 3 AND 4

### Operational safety

With regard to the characteristic “stable and effective operation” the year 2005 has been highly successful for units 3 and 4. The total number of forced power decreases and shut downs due to internal reasons has decreased 4 times in comparison to 2004. One shut down of turbine generator (TG) 6 has been registered and 3 unloadings of TG 7. During the year the units have operated at nominal power and only in May and September have they been working at low power due to a dispatcher’s order. No reactor scram has been reported and actuation of reactor protection system, level 1.

### Functioning of the protection barriers

The indicators which characterize the functioning of the physical barriers and the factors of non preparedness of the safety systems are of primary importance for the condition of safety of every nuclear power plant.

### Nuclear fuel

During the PAO-2005 of the two units, all assemblies that have worked in the previous fuel cycles were subjected to individual inspection of tightness. The control was carried out through a combination of the newly introduced sipping method and the design method.

The indicator for nuclear fuel reliability (FRI) of unit 3 is below the average value stipulated by WANO for 2004 for reactors of the same type. For unit 4 following refuelling the indicator is around the average value, and its value in the beginning of the XX fuel cycle is decreasing around 20 times as a result of the elimination of untight assemblies. By the end of the year the FRI values were respectively for unit 3 – 0.481 Bq/g and for unit 4 – 22.57 Bq/g.

### Condition of primary circuit

During the XXI fuel cycle untightness of steam generator 5 of unit 3 was registered from primary to secondary circuit. Mainly  $^{133}\text{I}$  and  $^{42}\text{K}$  were registered in its bleed water forming a total activity of about 37 Bq/l. The calculated leakage from primary to secondary circuit in the steam generator is about 0.05 l/h, the permissible limit being 5 l/h. In the blow water of the other steam generators of unit 3 and all SG of unit 4 no radioisotopes in the primary circuit were registered.

The random leaks from the primary circuit of the two units have been decreased two times (0.6 and 0.4 m<sup>3</sup>/day respectively).

The water chemistry regime of the primary and secondary circuits of the units have been maintained in accordance with the requirements of the technical specifications and the operational instructions. The positive trend for decreasing the chemical index, by which the quality of the maintained water chemistry regime is ascertained, continued. (0.33 in 2004 and 0.26 in 2005).

### Confinement premises

The system of confinement premises has an increased factor of tightness compared to the initial design. The new criteria for untightness less than 100% is being fulfilled. During the functional tests carried out 89.72 % and 82.25 % have been registered for units 3 and 4 respectively.

### Functioning of the safety systems

The number of defects found out in the safety systems is 38 % less than in the previous year. There are no unfulfilled safety functions during actual necessity or during testing. There are also no non planned actuations of the safety systems. The total time during which there has been a non-functioning channel from all safety systems is 73 % of that for 2004. This result is mainly due to the replacement of reversible DG with static convertors.



The number of unplanned actuations of protection barriers in the main equipment has also been decreased two times compared to 2004. The main contribution for this success has been the implemented modification in the automated functions of the main circulation pumps.

The calculated average non preparedness of diesel generators for units 3 and 4 is about  $3 \cdot 10^{-4}$ , while the average world level for reactors of this type is  $7 \cdot 10^{-4}$  (according to WANO). The same indicator for the remaining safety systems is by far lower than the values stipulated by WANO.

### **Implementation of the modernization programmes**

The implementation of some activities on specific programmes for modernization in the framework of the investment plans of the Kozloduy NPP on units 3 and 4 continued.

In 2005, 59 technical decisions were implemented, and in 2006 the implementation of further 16 technical decisions will be continued. The major part of the technical decisions was implemented during the planned annual outages of the units. Following the start up of the units, the implementation of a technical decision for setting up of power relays of MCP was carried out, which improved their operational reliability. A technical decision for additional seismic strengthening of spray devices is being implemented.

The activities on the modernization of the systems for localizing of accidents have been completed (systems for control and management of hydrogen and a system for forced filter ventilation of the system of tight compartments which is common for the two units have been implemented).

The implementation of some other measures from the programme for future activities on seismic qualification of building constructions, technological equipment and distribution systems has been discontinued. A statement has been submitted to the NRA accompanied by logical substantiation demonstrating the minimal remaining risk from this decision.



## UNITS 5 AND 6

### Operational safety

The date 22 December 2005 marked 9 years without actuation of the emergency reactor scram system of unit 6. The lack of serious failures of important systems and equipment certifies the reliable operation of the two units, which can be seen from the volume of electricity produced throughout the year. It is 69.76 % of the total production of the NPP and the increase compared to last year is 14.42 %. During the year there was one shut down of Turbine Generator 9 and one unloading of turbine generator 10 down to 26 % of nominal power.

During the past fuel cycle, the loading of the reactor core with assemblies with integrated in the fuel burning absorber gadolinium was gradually initiated. These have zirconium construction with an increased mechanical resistance, thus solving construction and production problems that have occurred earlier. The assemblies are with a lower neutron leakage as a result of replacement of stainless steel grids with zirconium such, and a number of other advantages, related to the operation and safety of the reactor (high burnup, up to 55 MWd/kgU, a possibility for a 4 year fuel cycle and more flexible patterns for refuelling)

On the basis of the operational experience and the analyses of the effectiveness of the control rods, the monitoring and collection of data on their performance will continue, namely measurement of free fall speed, forces of friction, ensuring minimal power peaking factors and choice of optimal patterns for refuelling.



### Functioning of the protection barriers

#### Nuclear fuel

Thermal and mechanical loads of the fuel as a result of the power cycling for units 5 and 6 for 2005 are less than the design limits. There is no surpassing of the limits for permissible levels for burn up, power peaking factors and other operational limitations.

The main indicator for tightness of the cladding of fuel elements in a working reactor is the level of specific activity of the coolant of the primary circuit according to standard isotopes. The results of the radiochemical analyses of the coolant show values far less than the limit for normal operation and confirm the reliable operation and condition of nuclear fuel.

During the Planned annual outage – 2005 a monitoring was carried out by video cameras of part of the fuel assemblies for the purpose of assessment of their mechanical state. The tightness of the cladding of the fuel elements of all assemblies remaining in the reactor core has been assessed by a standard method. Additional operative control is introduced through sipping test, which will further optimise the activities on fuel control.

### **Condition of primary circuit**

During the Planned annual outage, a programme for eddy current control of the heat exchange pipes and the collectors of the steam generator was carried out. No indications and cracks were registered in the cool collectors of the inspected steam generators of the two units. With regard to the heat exchange pipes of the SG a conclusion has been made that no increase in the indications is registered and there are practically no preconditions for corrosion processes under the regime maintained for operation of the SG. The tightness of the primary circuit is confirmed by the gamma spectrometric measurements in the general blow up of the steam generators, where no activity has been registered surpassing the minimal detectable activity by the measuring devices.

The chemical index is an indicator, which represents the quality of the water chemistry regime during operation with the purpose of decreasing the speed of corrosion of the construction materials. The calculated values for units 5 and 6 are respectively 0.249 and 0.242 (the maximum permissible value being  $CI_{\max} = 1.0$ ) and show an even and precisely kept regime.

The radiation control of the network water includes constant automated radiation control and periodical laboratory control. During the reported period no actuation of signalling has been registered, preventive threshold and emergency threshold on the controlled parameters. No deviations of the volume activity of secondary circuit and the system network water have been registered too. No actuation of the interlock for automatic switch off of the system because of high activity has been registered either.

### **Containment concrete**

The pre-strained state of the containment concrete of units 5 and 6 during operation is controlled constantly by a system for automatic control. No deviations from the requirements for minimum permissible level of strain from the design level of 1000 tons have been registered. The results from the carried out measurements and tests of the containment of units 5 and 6 show that they correspond to the requirements of the technical specifications and can carry out their design purpose for all design regimes and beyond design basis accident. Following PAO – 2005, tests for tightness of the containment concrete volumes and the elements taking part in the system for localization of accidents have been carried out. The conclusions are that the failures do not surpass the permissible value (<0.3% per day).

### **State of the safety systems**

The indicator for non-preparedness of the safety systems characterizes the capacity of the systems to implement their design functions and the assessment of the effectiveness of the activities on maintaining these design functions. The calculated values of the safety systems – TQ1,2,3,4 TX,VF and DG (sprinkler system, emergency cooling low pressure, emergency feedwater for primary circuit medium and high pressure, emergency feedwater of steam generators, service water for consumers and diesel generators) for units 5 and 6 have practically zero indications. The extremely good values show the high level of preparedness of the systems to carry out their functions in case of necessity, which is owed to the good maintenance and operation.

Failure of a whole safety system has not been registered. Six cases have been registered in 2004 of failures of separate channels of the safety systems, the main failures registered are mainly breakers.

The number of unplanned actuations of the safety systems remains the same – 7 in all for the passed year. Seven are the cases for unplanned actuation due to human factor during planned annual outage in a state of stopped reactor.

### Implementation of the programme for modernization (PM)

In 2005 the implementation of the envisaged measures for modernization of the units continued as well as the development and implementation of additional technical decisions planned in the investment programme.

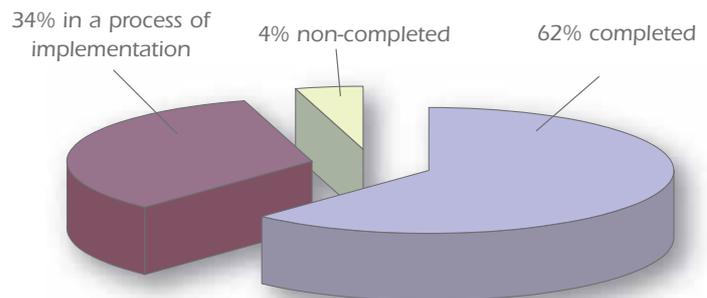
One hundred eighty one technical decisions were developed in 2005, 5 of them temporary and 176 permanent. The NRA chairman has issued a permit for the implementation of 68 technical decisions rated as being safety significant.

Until the end of 2005, 206 technical decisions have been implemented and reported by an act of implementation.

Due to the large volume of work on 6 of these technical decisions, they will be implemented in stages along a number of subsequent planned annual outages.

The design modifications developed in 2005 according to stage of implementation are presented in the figure below.

*Design modification in 2005 according to stage of implementation*



During the PAO-2005 the following major measures were implemented on units 5 and 6, namely:

1. Installation of automated system for protection from cold pressurization.
2. Modernization of the system for radiation control.
3. Replacement of UCTM (unified complex of technical means). A complex realization is envisaged to be carried out at stages in the framework of three years. At the present moment only the UCTM of the system for normal operation of unit 6 has been replaced.
4. Installation of a system for control of the appearance of steam-gas mixture and change in the level of the coolant in the reactor pressure vessel.
5. Analyses of the system for emergency feedwater and the peculiarities of the technological regimes of the system for make up water of the steam generators.
6. Installment of filtering ventilation.
7. Improvement of the reliability of the relay protection and automatics of main electrical pattern.
8. Improvement of the reliability of breakers 6kV.
9. Improvement of the reliability of diesel generators and their protection.
10. Replacement of an automated system for turbine control.

Some major modifications in the design outside the Programme for modernization of units 5 and 6 in 2005 were:

1. Replacement of equipment for emergency scram/non urgent alarm.
2. Replacement of the equipment of the system for management of control rods with a modernized version of the same equipment.
3. Modernization of a system for control and management of polar crane.
4. Retrieval of information for actuated defenses "Closure of 2 out of 4 stop valves of the turbine with an impediment to open steam dump system into condenser. (Unit 6).
5. Introduction of an emergency protection of the reactor "Switching off of two turbo feeding pumps at a reactor power higher than 35 % nominal power with a hold up period of up to 4 seconds (Unit 6).



6. Ensuring of signals “Closure of 2 out of 4 stop valves of the turbine” and “Switch off of generator breakers and power breaker for two sets of unit power discharge device” (Unit 6).
7. Modification in the pattern for centralized testing of safety systems protections.
8. Ensuring of signals from 3 independent sensors for temperature in the pressurizer.
9. Repairing of the sealing surface of primary seal of the reactor of unit 6.
10. Construction of a new heat exchange installation for the town of Kozloduy and others.



# NATSIONALNA ELEKTRICHESKA KOMPANIA EAD

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ANNUAL REPORT 2005



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