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COMMISSION STAFF WORKING DOCUMENT

“Kozloduy Programme”

Ex Ante Evaluation

Accompanying document to the

Proposal for a

COUNCIL REGULATION

**on Community financial assistance with respect to the decommissioning of
Units 1 to 4 of the Kozloduy nuclear power plant in Bulgaria**

{COM(2009) 581 final}

Kozloduy Programme – ex ante evaluation

Lead DG: TREN

Other involved services: N.A.

Agenda planning or WP reference: 2009/TREN/050

Executive summary

First generation reactors of Soviet design such as the 4 VVER 440/230 reactors at Kozloday Nuclear Power Plant (KNPP) in Bulgaria are a major safety risk for the citizens and the environment. Whereas units 1 and 2 were shut down in 2002 in the framework of the accession negotiations, Bulgaria closed units 3 and 4 by 2006 and will subsequently decommission all four units as laid down in the Protocol to the Accession Treaty of Bulgaria and Romania.

To alleviate the economic consequences of this early closure the Union provided € 210 million in 2004 prices between 2007 and 2009 for decommissioning of the reactors, but also for security of supply (replacement capacity) and energy efficiency measures through the Kozloduy International Decommissioning Support Fund (KIDSF), managed by the European Bank for Reconstruction and Development (EBRD) in London, to which the EU is the major (but not sole) contributor. Contrary to Slovakia and Lithuania where similar shutdown decisions were taken in the accession process, current funding for Kozloduy is foreseen to stop in 2009.

Up to today, Bulgaria has fulfilled its commitments and all 4 reactor units have been closed. Bulgaria could request, however, the restart of Units 3 and 4 at any moment based on Article 36 of the Protocol to the Accession Treaty, in case of exceptional economical circumstances. However, an unilateral Bulgarian decision would constitute an infringement of the Accession Treaty.

Bulgaria decided in the meantime to accelerate decommissioning, which sound studies showed to be more economic than deferring these activities, but which makes further timely funding necessary. The country asked, therefore, since 2005, the European Commission and Member States for additional support between 2010 and 2013. The final amount for additional financial support would be €300 million, out of which 60% would cover the needs for the implementation of decommissioning projects and 40% measures in the energy sector.

The Commission evaluated five options ("no EU intervention - continue with national funding", "no EU intervention – continue with private funding", "EU limited co financing (pay only safe maintenance)", "EU indirect co-financing (through EBRD)", "EU direct co financing") on whether and to what extent they would help reaching the Commission's objectives, including nuclear safety and the availability of adequate financial resources when needed for decommissioning. Economic studies on the closures of nuclear power plants show that Bulgaria would be hit relatively harder than the Lithuania and Slovakia. The preferred option is actually to continue EU funding via the EBRD. This solution secures a much higher level of safety, keeps expertise on site, ensures de-fuelling, prevents re-opening and allows for a start of actual dismantling works while guaranteeing seamless financing.

Bulgaria has already agreed to accept – as in the past – a stringent monitoring of individual decommissioning steps including clearly timed deliverables. Working through EBRD and KIDSF would allow following these individual steps and enabling annual evaluations of the use of Community funds.

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1. SECTION 1: PROCEDURAL ISSUES AND CONSULTATION OF INTERESTED PARTIES

1.1. Organisation and timing

Agenda planning 2009/TREN/050

A proposal for Council Regulation is foreseen for autumn 2009.

The Council Regulation is foreseen to come into force in 2010.

1.2. Consultation and expertise

The following stakeholders were involved at different levels in the consultation process:

1. The Bulgarian government and in particular the Bulgarian Ministry of Economy and Energy.

The consultation with the Bulgarian government was held through several meetings and exchanges of letters. First contacts go back to 2007 after DG TREN had taken over from DG ELARG the implementation of the EU assistance for Bulgaria following their accession to the EU. In 2008 information was exchanged and meetings held on procedural topics related to an extension of support. Since end 2008 and in 2009 meetings took place to discuss and agree on the technical scope of a possible extension of support.

2. The European Bank for Reconstruction and Development (EBRD)

Exchanges and discussions with EBRD as the manager of the KIDSF took place on a regular basis. This consultation focused on the progress of the works in decommissioning and in the energy sector assisted by the Community and is an integral part of DG TREN's monitoring programme. In addition to the Assembly of Donors meetings twice a year, separate working meetings were arranged, either in the Bank's or the Commission's premises or on site in Bulgaria.

3. EU Member States

Several EU Member States are Donors to the Kozloduy International Decommissioning Support Fund (KIDSF) and are represented in the Assembly of Donors meeting organised twice a year in London. All EU Member States are represented in the Nuclear Decommissioning Assistance Programme Committee (NDAP-C), which is the management committee advising the Commission on the implementation of the financial support to the three beneficiary countries Lithuania, Slovakia and Bulgaria. At the Assembly and NDAP-C meetings the progress of the programme is discussed and the planning for the future is addressed. Bulgaria has raised the issue of extension of financial assistance for the period 2010 – 2013 in order to get the support from the other Member States. Several Member States explicitly expressed their support for the Bulgarian request.

4. The Kozloduy Nuclear Power Plant (KNPP) and State Enterprise of Radioactive Waste (SERAW):

KNPP and SERAW were consulted on the technical aspects and corresponding budget for the extension of the support, as both organisations are the main beneficiaries of the support programme. Meetings and site visits contributed to the consultation process.

5. The technical experts and expertise:

Several national reference documents, that were elaborated to a very large extent with financial support from the Community, provide the basis for technical expertise.

The Updated Decommissioning Strategy of 2006¹ is the approved and official document of the Decommissioning Programme of Units 1-4 of the Kozloduy NPP. It is based on the Decommissioning Strategy of 2002².

The Technical Design of the Decommissioning of Units 1-2 (the basis of the original Decommissioning Strategy of 2002) was financed by PHARE – BG 9608-01-01-L001 and prepared by Consortium Belgatom (Belgium) – EWN (Germany) – Energoproekt (Bulgaria) in 2001.

Additional information was used from the study contracted by the Commission on the "Analysis of Environmental, Economic and Social Issues Linked to the Decommissioning of Nuclear Installations" performed by Plejades. The study contains a separate chapter on Bulgaria addressing the impact of early closure of the KNPP units 1 to 4. The Plejades report was finalised in January 2007³. Extract concerning Bulgaria see annex 3.

6. NGOs, civil society - not consulted given the short timeframe.

¹ Updated decommissioning strategy KPMU, 20 June 2006 ...

² Technical design of the decommissioning of units 1-2, PHARE BG9608-01-01-L001

³ Analysis of Environmental, Economic and Social Issues Linked to the Decommissioning of Nuclear Installations, Plejades, *January 2007*, Europa web DG TREN

2. SECTION 2 PROBLEM DEFINITION

2.1. Background

Nuclear reactors of VVER 440/230 type (first generation reactors of Soviet design) constitute a risk for the citizens and the environment. The safety of those first generation VVER 440/230 reactors is not up to a comparable level with western European nuclear reactors. These reactors have limited confinement function and capability, as well as vulnerability against common cause failures. It does **not appear economically feasible to back fit the plants with a reactor containment** that could provide similar protection to the containments of modern Western PWR reactors.

Bulgaria has 4 VVER 440/230 reactors at Kozlody Nuclear Power Plant (KNPP). Units 1 and 2 of KNPP were shut down in 2002 in the framework of the accession negotiations.

According to the Article 30 of the Protocol to the Accession Treaty of Bulgaria and Romania, Bulgaria committed itself to definitively close Units 3 and 4 by 2006 and subsequently decommission all four units.

KNPP units 1 and 2 have essentially been shut down at the end of their initial design-lifetime of 30 years. Units 3 and 4 were closed 5 years earlier than their design life (early closure). Early closure of the KNPP units puts an economical burden on Bulgaria.

The European Union expressed its willingness to support Bulgaria's efforts to alleviate the consequences of early closure of these 4 units. Therefore Article 30 of the Protocol concerning the conditions and arrangements for admission of the Republic of Bulgaria and Romania to the European Union foresees additional financial assistance up to 2009 as an extension of the pre-accession aid implemented under the Phare programme. The budget for this additional assistance was fixed at €210 million (2004 prices) for the period 2007 to 2009.

EU assistance is not only foreseen for decommissioning of the reactors, but also for security of supply (replacement capacity) and energy efficiency which are a direct consequence of early closure. The amounts fixed for this assistance are not based on a specific proportion of the estimated costs, but recognise the extraordinary burden placed on Bulgaria by the shutdown commitment, and are an expression of solidarity between the EU and Bulgaria.

The assistance is currently delivered through the Kozloduy International Decommissioning Support Fund (KIDSF), managed by the EBRD in London, to which the EU is the major (but not sole) contributor.

Beyond 2009, no additional Community funding is foreseen, no follow-up is planned, unlike the situation for Slovakia and Lithuania where funding is guaranteed until 2013.

2.2. Current status and progress achieved

Today Bulgaria has fulfilled its commitment and all 4 reactor units have been closed.

Units 1 and 2 have been de-fuelled 2 years ahead of the schedule. The reactors of Units 3 and 4 have been de-fuelled and the spent fuel is still in the fuel ponds of the units. Currently, no irreversible dismantling steps have been taken. This means that it is still possible for Bulgaria to request the restart of Units 3 and 4 at any moment based on Art.36 of the Protocol to the Accession Treaty, in case of exceptional economical circumstances. An unilateral decision from Bulgaria to restart the closed units would constitute an infringement of the Accession Treaty.

Decommissioning of KNPP units 1 - 4

Decommissioning of nuclear power plants is a long term process (20-30 years). Bulgaria's initial decommissioning strategy was "*differed dismantling*". This strategy consists of two phases: (1) defueling of the reactor units and establishment of the infrastructures necessary for decommissioning and (2) following a waiting period (for the decay of radioactivity) the dismantling of the installation and the management of decommissioning waste.

The Bulgarian government proposed in 2006 an "*immediate dismantling strategy*" to replace the "*deferred dismantling strategy*" in line with international best practices, based on safety and economical grounds.

Progress achieved by Bulgaria in the decommissioning preparation stage of the Kozloduy Programme utilising the Community funds put in place until 2009 are satisfactory as the four units have actually been closed down and all major preparatory works for decommissioning are very well advanced. However, the real dismantling works have not yet started. Further financial support beyond 2009 is needed in order to allow to progress with the actual dismantling operations and waste treatment.

Mitigation measures in the energy sector

Progress achieved in the energy sector to mitigate the economical consequences of the early closure is very satisfactory. In the period until 2009, the financial support was focused on priorities targeting mainly improvements in industrial and residential energy efficiency and assistance in strengthening the use of renewable energy sources. The corresponding projects were quick start ones, resulting in massive energy savings and CO₂ emission reductions.

Nevertheless, and in particular in the current economical context there remains the need for additional financial support to progress further with mitigating measures in the energy sector given the extent of the capacity loss by the closure of the nuclear units and its impact on the security of supply in the region.

Progress overview on achievements and financial status

In summary, at the end of 2008, the contribution agreements to KIDSF (this is donor contributions to the Kozloduy International Decommissioning Support Fund) total 525 Mio €. Out of that 513 Mio€ have been committed by the EBRD in grant agreements, of which 259.5 Mio € on energy projects, 177.5 Mio € on decommissioning preparation, and 76 Mio € on waste treatment projects. Effective payments amount to 383 Mio €

The status and main achievements of measures implemented from the financial support up to 2009 are listed in the table of annex 1 and 2. Achievements are classified under similar categories of objectives as for the mid term evaluation carried out for Lithuania and Slovakia, which are:

For decommissioning:

- Closure of all 4 reactors
- Dismantling and the treatment of all waste
- Permanent disposal of waste
- Support to plant personnel (safe maintenance)
- Technical assistance

For mitigation measures in the energy sector:

- Environmental upgrading
- Restructuring energy production
- Energy supply
- Energy efficiency

General overview of projects as currently allocated under KIDSF Grant Agreements can be found in annex 2

2.3. Justification for additional support

As mentioned in the precedent section the current financial support allows Bulgaria to maintain safety, to perform and finalise the preparatory works required to be in a position to effectively start with dismantling activities. Due to the change in strategy (from differed to immediate dismantling) funds for the continuation of decommissioning activities are required much earlier in time.

The funds required for continuing decommissioning cannot be made available through the Bulgarian National Fund. Although such a fund is in place, the financial resources are not adequate. This is, to a very large extent, due to the historical context. From the former operation of the nuclear power plants under the Soviet Union no funds are available for decommissioning. Unlike other Member States in a similar situation but without being confronted to early closure of their plants, it was not possible for Bulgaria to accumulate sufficient funds from operation.

Based on those considerations, the Bulgarian government has requested the extension of the Community support for the period 2010 - 2013. This would bring the Community support for Bulgaria in line with the support for Lithuania and Slovakia where assistance is granted until the end of the current financial perspective (2013).

The extension of support is proposed for the following activities to be implemented until the end of 2013:

- (1) Project management, engineering and technical assistance for the support of the implementation of the decommissioning programme. It includes
 - the extension of the work of the Project Management Unit (PMU) at the Kozloduy site;
 - the extension of the PMU at the site of State Enterprise Radioactive Waste (SE RAW),
 - assistance to the Bulgarian Nuclear Regulatory Agency in the implementation of the regulatory tasks of the decommissioning;
 - special nuclear technical storage assistance. Special decommissioning process engineering for treatment, conditioning and transport of radioactive soil, radioactive waste, transport of waste and global site cleaning;
 - other technical, safety, environmental impact assessment assistance to the projects of the decommissioning programme.
- (2) The provision of salaries for 715 KNPP (operation, maintenance, technical support, project management) experts at the Kozloduy site, working for the decommissioning of Units 1-4. The active involvement of the plant staff reduces the need for external organisations and highly contributes to the reduction of the cost of decommissioning. It furthermore contributes to maintain a high level of nuclear safety.
- (3) The construction of the National Radioactive Waste Disposal Facility is crucial for the implementation of the decommissioning programme. The waste generation of the decommissioning cannot be managed without this repository. The estimate of the total investment is around €150 million. The facility also will serve for the long term storage of operational waste. The main function however in the first 10 years of operation is the storage of the low and intermediate level waste of the decommissioning process.

Under this item 50% of co-financing is considered and justified by the accelerated decommissioning process. The load of the facility for the first period of its operation should be established by the speed of the decommissioning process to avoid restrictions in waste management in the operation of the KNPP.

- (4) After the installation of the major facilities for decommissioning (fragmentation workshops, waste treatment and conditioning facilities, intermediate waste storages, release control and measuring devices) the advanced stage of the decommissioning programme will focus on the decommissioning process. The decommissioning work process – the working connection at the sites between the facilities, location and the 4 units need precise, regulated and controlled transport routes, devices, equipment and special services. Taking into account that a new process is going to be introduced, there is the need to foresee additional financing of the introduction of strict safety measures in order to minimize the risks. The decommissioning process at Kozloduy site is a new challenge with radioactive and environmental impact hazards. The management of the Kozloduy based transportation, handling and storage process alongside with the existing facilities, control and measurement devices will need specific technical service and technical solutions.

The following table gives an overview on the corresponding budget:

<i>N°</i>	<i>ITEM</i>	<i>EC ASSESSMENT [M€]</i>
1	<i>PROJECT MANAGEMENT, ENGINEERING AND TECHNICAL ASSISTANCE</i>	25
2	<i>PROVISION OF SALARIES OF 715 KNPP STAFF</i>	30
3	<i>CO-FINANCING FOR THE NATIONAL RADIOACTIVE WASTE DISPOSAL FACILITY (TOTAL ESTIMATED COSTS 150 M€)</i>	75
	<i>SITE INFRASTRUCTURE AND TREATMENT OF DISMANTLED WASTE</i>	
4	<i>ADDITIONAL ALLOCATION FOR ALREADY TENDERED PROJECTS TO COPE WITH MARKET RESPONSE (OFFERS) THAT ARE HIGHER THAN THE INITIAL ESTIMATES.</i>	50
	<i>TOTAL - DECOMMISSIONING</i>	180

Moreover, there is also the need for financial support to progress further with mitigating measures in the energy sector given the extent of the capacity loss resulting from the closure of the nuclear units and its impact on the security of supply in the region.

The upgrade and the modernisation of the energy production, transmission and distribution system, the diversification of the energy supply, energy efficiency and the use of renewable energy sources would be a vital part of this additional support.

The final amount for additional financial support would be 300 m€, out of which 180 m€ (60%) would cover the needs for the implementation of decommissioning projects and 120 m€(40%) for measures in the energy sector.

2.4. Conclusions

Bulgaria has demonstrated effective and efficient implementation of the Community support in the decommissioning and in the energy sector. Under the provisions of the Treaty of Accession support is granted only until end of 2009. Most of the decommissioning related preparatory works are finalised or close to completion and additional financial resources are required to ensure seamless continuation of decommissioning.

Without additional EU funding, the consequences would be the following:

- (1) There would be no sufficient funds available to continue with the decommissioning of the 4 units with a risk for the citizens and the environment due to the unfinished decommissioning status of the units;
- (2) No funds would be available to cover the salaries of the experienced KNPP staff performing the decommissioning with the risk that they might leave the nuclear facility and that the expertise and knowledge of the plant would get lost.;
- (3) Risk of re-opening the reactors 3 and 4 where no irreversible activities were performed;
- (4) The liability and responsibility for decommissioning the units would be shifted to future generations;

It is in the highest interest of the European Union that Bulgaria continues to decommission in a timely manner these 4 reactors, in order to ensure safe dismantling and to avoid any attempt to restart units 3 and 4 again in the future.

The Community has the right to act for several reasons

- To ensure that the 4 KNPP units remain closed;
- To support Bulgaria in their efforts to safely decommission the four units;
- To express its solidarity in line with the Lisbon Treaty;

3. SECTION 3: OBJECTIVES

The objective for providing additional EU funding for the period 2010 – 2013 is to continue supporting Bulgaria in its efforts to (1) guarantee sufficient funds for the continuation of safe decommissioning of units 1 – 4 of KNPP and (2) to support measures in the energy sector to mitigate the economical consequences of the early closure.

In the context of the renewed interest in nuclear power expressed by a number of Member States the role of the European Union is to ensure that this source of energy is developed while meeting the highest level of safety. Consequently a Council Directive on establishing a community framework for the nuclear safety of nuclear installations has been adopted on June 25, 2009⁴.

Effects of radiological incidents do not stop at the borders and can have potential consequences both for the health of workers and citizens, but also wide ranging economic implications for the energy generating industry. Therefore measures must be put in place to guarantee safety.

After the Chernobyl accident in 1986, the European Union has adopted with new vigour, a policy towards safer nuclear installations. The Commission's position on VVER 440/230 reactors has remained consistent and in line with the G7 multilateral programme of action adopted at the Munich G7 summit in 1992: these first generation reactors of Soviet design cannot be economically upgraded to a required level of safety and should be closed.

In order to achieve the above mentioned objectives in the given context, additional support of €300 million will be needed for the period 2010 - 2013, covering decommissioning needs as well as measures in the energy sector in Bulgaria.

- The extension of support is in accordance with the following objectives:
- The general objective of the EU decommissioning policy is nuclear safety and the availability of adequate financial resources when needed for decommissioning.
- The specific objective is to accompany and to ascertain the safe decommissioning of all 4 VVER 440/230 type reactors of the first generation, including the safe management of the decommissioning waste.
- The operational objectives are
 - (a) Not to lose the necessary expertise
 - (b) To continue with decommissioning works;
 - (c) To advance in the approved decommissioning plan. This includes the safe maintenance, the actual physical decommissioning and dismantling of the nuclear power plant – units 1 to 4 – as well as the waste treatment.

⁴ OJ L 172, 2.7.2009, p.18

- (d) To assure the non-nuclear window, security of supply needs to be guaranteed after the shutdown (sufficient replacement capacity for the closed down capacity).
- (e) To continue during the period 2010-2013 with the safe maintenance including the payment of staff salaries.
- (f) To avoid the risk of reopening.

These objectives are consistent with the other Community assistance programme provided to Lithuania and Slovakia as well as the EU energy policy (energy efficiency and the use of renewables) as well as the Lisbon Treaty (solidarity principle).

It guarantees the seamless continuation of the support under the Accession Treaty.

4. SECTION 4: POLICY OPTIONS

4.1. Background

- Bulgaria requested initially for the nuclear sector 202 m€ and for the non-nuclear sector 494 m€
- Following a more detailed analysis it appeared that 180 m€ is in fact needed for the decommissioning sector.
- Finally it was agreed that 60 % of the additional support would go to decommissioning (180 m€) and 40 % to energy sector measures (120 m€).
- The Community support must be provided to ensure closure and to cover part of the costs of decommissioning (waste management included), which otherwise could not be paid by the Bulgarian government alone in the tight timeframe.
- The Community support should be dedicated in priority to achieving real progress in decommissioning; decommissioning progress is paramount for nuclear safety.
- The calculation of the financial needs can also be made through a comparison with the decommissioning costs in Slovakia, because the reactor units that were closed down are of the same design (VVER). Lithuania cannot be used for comparison because the reactor units are of a completely different design (RBMK).
- Bulgaria has received less Community support than Slovakia. Slovakia has since the start of Community support in 1999 received **614 m€** for **two units** that were closed. Bulgaria has received for **four units** of the same kind only **550 m€** up to now.
- Under this consideration the request from Bulgaria for additional funding for the nuclear sector (decommissioning and waste management) is duly **justified**.
- The Community provided Bulgaria since accession with the following support: 74 m€ in 2007, 76 m€ in 2008 and 77.5 m€ for 2009 (210 m€ plus inflation). The continuation of support at this level **until 2013** would amount to **300 m€** (75 m€/year).
- If an additional support of **300 m€** would be acceptable for the EU Member States, this extension would
 - (a) cover the full needs for decommissioning until 2013 and
 - (b) provide additional money for measures in the energy sector (replacement capacity and security of supply).

Additional support of 300 million € is justified, covering decommissioning needs as well as measures in the energy sector which are estimated to amount to:

<i>MEASURE</i>	<i>OBJECTIVE</i>	<i>COSTS</i>	<i>TIMING</i>
<i>PROVISION OF SALARIES KEEP</i>		<i>30 MILLION €</i>	<i>2010-2013</i>

<i>OF DECOMMISSIONING KNOWLEDGE STAFF (715)</i>	<i>AND EXPERTISE ON SITE + SAFE MAINTENANCE</i>		
<i>SAFE MAINTENANCE</i>	<i>AVOID ACCIDENTS</i>	<i>INCLUDED</i>	<i>2010-2013</i>
<i>PROJECT MANAGEMENT, ENGINEERING TECHNICAL ASSISTANCE</i>	<i>PROVIDE AND INTERNATIONAL SUPPORT AND EXPERTISE</i>	<i>25 MILLION €</i>	<i>2010-2013</i>
<i>TENDERING DISMANTLING WORKS</i>	<i>OF APPLY STANDARDS</i>	<i>EU INCLUDED</i>	<i>2013</i>
<i>NATIONAL RADIOACTIVE WASTE FACILITY (CO-FINANCING)</i>	<i>SAFE WASTE DISPOSAL TREATMENT (CO-FINANCING)</i>	<i>75 MILLION €</i>	<i>2013</i>
<i>DRY STORAGE</i>	<i>SPENT FUEL SAFE TREATMENT</i>	<i>WASTE 50 MILLION €</i>	<i>2010</i>
<i>DECOMMISSIONING WORKS</i>	<i>START DISMANTLING WORKS</i>	<i>INCLUDED</i>	<i>2011</i>
<i>ENERGY REPLACEMENT CAPACITY AND ENERGY EFFICIENCY MEASURES</i>	<i>REPLACEMENT OF CLOSED CAPACITY</i>	<i>120 MILLION €</i>	<i>2013</i>

The Bulgarian programme should also be assessed against the recommendations given in the mid-term evaluation of the Slovak and Lithuanian program. In the following, the conclusions for Slovakia and Lithuania are listed and their relevance for Bulgaria is assessed at the end.

4.2. Conclusion of mid term evaluation Slovakia and Lithuania

The mid term evaluation for Slovakia and Lithuania showed that a majority of the projects has been well implemented in so far as the results match the objectives. The costs of the projects, to the extent that it could be assessed within the evaluation, are fair when compared to the results.

The recommendations were as follows, including the follow up actions taken:

- (1) That the EC develops a consistent strategy with goals and criteria for the decommissioning assistance programme(s), against which any ongoing and future assistance could be judged and evaluated. The strategy should include objectives for any related energy system and social measures that are justified as a consequence of

the shutting down of 1st generation units that (were) operate(d) in countries becoming members of the EU. – A strategic plan has been drafted.

- (2) To assure that any assistance provided is consistent and complementary with the national activities (implemented via national decommissioning funds and/or other national means). – This is assured through the monitoring meetings.
- (3) With the consideration that the conceptual decommissioning plans for both Bohunice and Ignalina were developed and decommissioning strategies selected in both countries, a more accurate estimate of actual decommissioning and related energy sector costs (against which the needs for financial assistance commitments could then be assessed) should be developed. – Estimates of decommissioning costs are being made within the framework of the Decommissioning Funding Group (DFG).
- (4) The EC shall consider to modify the implementation rules for the provision of assistance to allow for adjustments with actual costs dynamics for the decommissioning activities (e.g. to allow for lower utilization in the years when only preparatory activities take place). – Annual budget provisions are set by the budgetary authority. A fluctuation in function of the annual needs would require a modification of the Financial Regulation.
- (5) Investigate measures that could lead to an increased effectiveness and efficiency of the activities of the PMUs operating within the International Decommissioning Support Funds. – Being investigated.
- (6) Investigate the merits of having two assistance vehicles operating in parallel (in Lithuania) with a view to possibly integrating these, while preserving the benefits offered by each. – Such dual system is not considered for Bulgaria.
- (7) In light of the changing framework conditions, it is suggested to carry out an assessment to identify an optimal vehicle for providing assistance in the future. – EBRD seems to be the appropriate choice for Bulgaria.

4.3. Assessment of the mid-term recommendations for Bulgaria

- Recommendations 1, 2, 3 and 5 are applicable for Bulgaria.
- Recommendation 4 can not be implemented under the current financial Regulation.
- Recommendation 6: such dual system is not considered for Bulgaria.
- Recommendation 7: EBRD seems to be the appropriate choice for Bulgaria.

4.4. The policy options are:

- (a) no EU intervention - continue with national funding
- (b) no EU intervention – continue with private funding;

- (c) EU limited co financing (pay only safe maintenance);
- (d) EU indirect co financing (through EBRD);
- (e) EU direct co financing

Exclusive funding through the national or private decommissioning fund is not considered as the operational lifetime has expired and insufficient funding was available at the time of early closure upon Accession. Currently only 280 Mio € is available in the fund for reactors 1 to 6 (14 % of the estimated decommissioning costs).

The option A (no EU intervention) is a theoretical option, as actually EU must intervene in order to ensure the level of required nuclear safety.

5. SECTION 5: ANALYSIS OF IMPACTS

5.1. SWOT Analysis

A. no EU intervention – continue with national funding

In the case funding has to come from the national budget, the "immediate decommissioning" strategy will not be pursued, especially given the current economical context and the energy needs. Talks about re-opening have already been held, and technical verifications for re-opening were executed. The re-opening of these potentially unsafe nuclear reactors poses a serious threat to the environment

STRENGTHS:

- NATIONAL RESPONSIBILITIES TAKEN

WEAKNESSES:

- INSUFFICIENT NATIONAL FUNDING AVAILABLE IN THE FUND
- ECONOMICAL CONTEXT OF WEAK NATIONAL BUDGETS

OPPORTUNITIES:

- LESS COSTS ON THE EU BUDGET

THREATS:

- POSTPONEMENT OF THE DECOMMISSIONING
- RESTART OF THE REACTORS
- UNSAFE DECOMMISSIONING
- UNEMPLOYMENT OF STAFF

B. no EU intervention – continue with private funding

In the case funding has to come from the private owner, the immediate decommissioning strategy will not be pursued. It is unlikely that a private company will commit the significant funds necessary without any identifiable economical benefit. The consequence would be the risk of re-opening these potentially unsafe nuclear reactors.

STRENGTHS:

- POLLUTER PAYS PRINCIPLE WOULD BE FULLY ENDORSED

WEAKNESSES:

- INSUFFICIENT FUNDING POSSIBILITIES
- EARLY CLOSURE WAS AN EU CONDITION
- TIME SPAN BETWEEN OPERATION AND DECOMMISSIONING – HISTORICAL OWNER?

OPPORTUNITIES:

- LESS COSTS ON THE EU BUDGET

THREATS:

- UNEMPLOYMENT OF STAFF
- POSTPONEMENT OF THE DECOMMISSIONING
- RESTART OF THE REACTORS
- UNSAFE DECOMMISSIONING

*- NOT A SINGLE ECONOMIC BENEFIT
FOR THE OWNER TO ENGAGE IN THESE
HUGE INVESTMENTS*

C. EU limited co financing (pay only safe maintenance)

In this case limited funding has to come (partially) from the EU budget. It is impossible to continue immediate decommissioning. This would simply mean a status quo. The threat of re-opening of these potentially unsafe reactors remains.

STRENGTHS:

- USE OF AVAILABLE EXPERTISE*
- REDUCE UNEMPLOYMENT BY USING OWN SKILLED STAFF WHEN IMMEDIATE DISMANTLING*

WEAKNESSES:

- EU RATHER THEN NATIONAL MONEY*
- POLLUTER PAYS PRINCIPLE LESS APPLIED*

OPPORTUNITIES:

- RELATIVELY SMALL SAVING OF FUNDS FOR THE EU BUDGET*
- MAINTAINED SAFETY*

THREATS:

- CONTINUOUS REQUEST FOR FULL FUNDING*
- RE-OPENING*
- NO DISMANTLING WORK*

D. EU indirect co financing (through EBRD)

In the case funding has to come (partially) from the EU budget, it is likely that the immediate decommissioning strategy can be continued, especially given the political context. The funding would mean equal treatment (Lithuania and Slovakia), create an economical benefit for Bulgaria, and eliminate the threat of re-opening of these potentially unsafe reactors that would pose a serious threat to the general public and the environment. Funding would continue, as is the case at present, through the EBRD.

STRENGTHS:

- IMMEDIATE DECOMMISSIONING*
- MAKE IT IMPOSSIBLE TO RESTART THE REACTORS*
- USE OF AVAILABLE EXPERTISE*
- MORE ECONOMIC APPROACH*
- REDUCE UNEMPLOYMENT BY USING OWN SKILLED STAFF WHEN IMMEDIATE DISMANTLING*

WEAKNESSES:

- EU RATHER THAN NATIONAL MONEY*
- POLLUTER PAYS PRINCIPLE LESS*

OPPORTUNITIES:

- BETTER CHECK ON THE OPTIMAL ADVANCEMENT OF THE DECOMMISSIONING*
- INCREASED SAFETY*
- ACTUAL PROGRESS WITH DE-FUELLING AND DISMANTLING WORKS*

THREATS:

- CONTINUOUS REQUEST FOR FULL FUNDING*

E. EU direct co financing

In the case funding has to come (partially) from the EU budget, it is likely that the immediate decommissioning strategy can be continued, especially given the political context. The funding would mean equal treatment (Lithuania and Slovakia), create an economical benefit for Bulgaria, and eliminate the threat of re-opening of these potentially unsafe reactors that would pose a serious threat to the environment. Funding would have to go through a national agency, which would have to be created. This would require a long term time perspective, time which is not available. Financing would not be controlled by EBRD and a risk of deviation of funds cannot be excluded.

STRENGTHS:

- IMMEDIATE DECOMMISSIONING
- MAKE IT IMPOSSIBLE TO RESTART THE REACTORS
- USE OF AVAILABLE EXPERTISE
- MORE ECONOMIC APPROACH
- REDUCE UNEMPLOYMENT BY USING OWN SKILLED STAFF WHEN IMMEDIATE DISMANTLING

WEAKNESSES:

- EU RATHER THEN NATIONAL MONEY
- POLLUTER PAYS PRINCIPLE LESS APPLIED
- NO EXISTING NATIONAL CHANNEL YET

OPPORTUNITIES:

- BETTER CHECK ON THE OPTIMAL ADVANCEMENT OF THE DECOMMISSIONING
- INCREASED SAFETY
- ACTUAL PROGRESS WITH DE-FUELLING AND DISMANTLING WORKS

THREATS:

- CONTINUOUS REQUEST FOR FULL FUNDING
- CREATION OF A NATIONAL AGENCY

6. SECTION 6: COMPARING THE OPTIONS

It is important to realise that all impacts of safe maintenance and decommissioning itself are equal wherever the financing comes from. The main concern is to continue the decommissioning process.

Cost – benefit analysis of EU funding

COSTS

- *EU SUBVENTION OF 300 MIO € OVER THE PERIOD 2010-2013 (75 MIO € PER ANNUM)*

BENEFITS

- *SECURE A MUCH HIGHER LEVEL OF SAFETY*
- *KEEP EXPERTISE ON THE SITE*
- *ENSURE DE-FUELLING OF THE PONDS*
- *PREVENTION FROM RE OPENING*
- *START OF ACTUAL DISMANTLING WORKS*

Cost – benefit analysis of no funding

COSTS

- *MAJOR SAFETY RISK*
- *RISK OF RE-OPENING UNSAFE REACTORS*
- *NEED TO GO TO A "MINIMUM SAFETY" PLATFORM COMES WITH A COST*
- *SAFE MAINTENANCE IS A DEAD COST THAT IS ADDED TO THE OVERALL DECOMMISSIONING COSTS*
- *STAFF UNEMPLOYMENT*
- *LOST EXPERTISE => HIGHER COSTS TO RESTART THE DECOMMISSIONING AFTERWARDS*
- *COSTS ARE MORE THAN INFLATED IF LEFT TO FUTURE GENERATION*

BENEFITS

- *"EXCUSE" FOR BULGARIA TO RE-OPEN THE REACTORS*

EU added value:

In case no funding would be available, safe maintenance would be endangered. The risk of re-start of the reactors, with possible major accidents, is actual. Also loss of expertise would delay, render more difficult and more costly the whole decommissioning process.

Taking into account the necessary safety requirements and the general interest; EU financing would be the appropriate solution. Option D (optimal EU funding managed in an indirect

way, via EBRD) is indeed the best viable option as it is vital to have seamless financing available in order not to risk losing the on site expertise and put safe maintenance in danger.

7. SECTION 7: MONITORING AND EVALUATION

- The core indicators of progress towards meeting the objectives are the advancement in the decommissioning plan as well as avoidance of accidents (safe maintenance)
- The monitoring and evaluation arrangements are as follows: 2 times per year a monitoring committee with EU takes place on the spot to verify the advancement of the decommissioning works. The Commission Decision on Procedures is in place including monitoring provisions for the 3 decommissioning funds. Yearly combined programming documents, attached to the Commission Decision on financing state the progress towards decommissioning. A mid term evaluation of the programme should be foreseen.

Milestones:

- safe maintenance = no accidents
- de-fuelling reactor ponds 1-4 by 31/12/2012
- start dismantling works by 01/01/2011 (non contaminated parts)

The timeline of the decommissioning programme until 2013 is as follows:

Zero power operation unit 1-2	2003-2009
<i>ZERO POWER OPERATION UNIT 3-4</i>	2007-2012
<i>REMOVAL OF THERMAL INSULATION, ASBESTOS OF UNITS 1-4</i>	UNTIL 2009
<i>REMOVAL OF TOXIC MATERIALS IN UNITS 1-4</i>	UNTIL 2008
<i>REMOVAL OF FLAMMABLE MATERIALS IN UNITS 1-4</i>	UNTIL 2009
<i>REMOVAL OF HAZARDOUS WASTE UNITS 1-4</i>	UNTIL 2008
<i>DISMANTLING OF NON-SAFETY RELATED EQUIPMENT OF UNITS 1-4</i>	UNTIL 2009
<i>COMMISSIONING OF THE DRY SPENT FUEL STORAGE FACILITY</i>	2009
<i>RADIOLOGICAL INVENTORY AND DATABASE OF UNITS 1-4</i>	UNTIL 2010
<i>DEFUELLING OF THE REACTOR PONDS OF UNITS 1-2</i>	2007-2008
<i>DEFUELLING OF THE REACTOR PONDS OF UNITS 3-4</i>	2011-2012
<i>DECOMMISSIONING PERMIT FOR UNITS 1-2</i>	2010
<i>DECOMMISSIONING PERMIT FOR UNITS 3-4</i>	2012

*COMPLETING OF THE WASTE BACKLOG TREATMENT AT 2012
THE KOZLODUY SITE*

*INVENTORY, TREATMENT AND CONDITIONING OF UNTIL 2013
CONTAMINATED SOIL*

•

Annex 1

Status and main achievements of measures implemented from the financial support up to 2009

MEASURES	STATE OF PLAY	FUNDING USED (MIO €)	IF DELAY, REASONS
• CLOSURE OF ALL FOUR REACTORS	DONE	NA	NA
DEFUELING OF UNITS 1-2			
DISMANTLING AND THE TREATMENT OF ALL WASTE	ONGOING	72,90	
• DRY FUEL SPENT STORAGE		99,96	
• DECOMMISSIONING DESIGN (INITIAL AND SECOND STAGE)		35,00	
• IMPLEMENTATION OF DECOMMISSIONING PROGRAMME USING HR AVAILABLE AT UNITS 1-4		LAST ASSEMBLY APPROVED +15,00	
•		39,00	
CONSTRUCTION OF HEAT GENERATION PLANT			
PERMANENT DISPOSAL OF WASTE SITE SELECTION FOR NATIONAL RADIOACTIVE DISPOSAL FACILITY	ONGOING	3,00	
SUPPORT TO PLANT PERSONNEL (SAFE MAINTENANCE)	DONE		
TECHNICAL ASSISTANCE TO REGULATORY BODIES	DONE	4,00	
PMU		38,50	
ENVIRONMENTAL UPGRADING	DONE		
• SOFIA DISTRICT HEATING		30,00	
• PERNIC DISTRICT HEATING		10,95	
• VARNA HEATING DISTRIBUTION NETWORK		0,45	
RESTRUCTURING ENERGY PRODUCTION	ONGOING	19,50	
• MARITZA EAST		25,43	
• REFURBISHMENT SUBSTATIONS DISTRIBUTION SYSTEM		20,00	
• GAS PIPELINE SILISTRA		15,00	
• MINES ENERGY EFFICIENCY		1,80	
• CONTROL ELECTRICITY LOSSES VARNA/GORNA		0,82	
• REPLACEMENT OLD TRANSFORMERS		1,30	
• GAS SYSTEM 13 CITIES SOUTH-CENTRAL		2,05	
• GAS NETWORK DIMITROVGRAD/CHIRPAN/RAKOVSKI		0,48	
• GAS SUPPLY ETROPOLE/SVILENGRAD/KARDJALI			
• GAS PIPELINE RAZLIV ENERGY SUPPLY			

• TRYAVNA HEATING PLANT WOOD BIOMASS	ONGOING	0,85	
• RUSSE INTEGRATED ENERGY FARM	STOPPED	1,61	MISSING OWN FINANCING PART
		(0 DISBURSED)	
ENERGY EFFICIENCY	ONGOING		
• ENERGY EFFICIENCY MEASURES IN POWER DISTRIBUTION SYSTEM		5,30	
• BULGARIAN ENERGY EFFICIENCY RENEWABLE ENERGY CREDIT LINE		35,20	
• ENERGY EFFICIENCY MEASURES IN PUBLIC BUILDINGS		23,95	
• BULGARIAN RESIDENTIAL ENERGY EFFICIENCY CREDIT LINE		14,60	
• ENERGY EFFICIENCY FACILITY		3,20	
• REHABILITATION STREET LIGHTING		5,50	
TOTAL		513,00	

Annex 2

General overview of decommissioning projects as currently allocated under KIDSF Grant Agreements:

- | | | |
|----|---|---|
| 1 | <i>DESIGN AND CONSTRUCTION OF A DRY SPENT FUEL STORAGE FACILITY</i> | <i>STORAGES</i> |
| 2 | <i>DECAY STORAGE AT THE KNPP SITE FOR TRANSITIONAL WASTE</i> | |
| 3 | <i>SITE STORAGE FOR CONVENTIONAL WASTE OF DECOMMISSIONING</i> | |
| 4 | <i>STORAGE OF VERY LOW LEVEL RADIOACTIVE WASTE AT THE KNPP SITE</i> | |
| 5 | <i>INVENTORY, TREATMENT AND CONDITIONING (STORAGE) OF CONTAMINATED SOIL</i> | |
| 6 | <i>FRAGMENTATION AND DECONTAMINATION ACTIVE WORKSHOP</i> | <i>WORKSHOPS FOR FRAGMENTATION, DECO AND PACKAGING</i> |
| 7 | <i>HAND HELD EQUIPMENT FOR THE ACTIVE WORKSHOP</i> | |
| 8 | <i>DISMANTLING AND FRAGMENTATION TOOLS FOR THE REACTOR BUILDING</i> | |
| 9 | <i>WASTE MONITORING EQUIPMENT FOR FREE RELEASE FROM THE ACTIVE WORKSHOP</i> | |
| 10 | <i>FRAGMENTATION WORKSHOP IN THE TURBINE HALL</i> | |
| 11 | <i>DISMANTLING AND FRAGMENTATION TOOLS FOR THE TURBINE HALL</i> | |
| 12 | <i>DISMANTLING AND FRAGMENTATION TOOLS FOR THE AUXILIARY BUILDINGS</i> | |
| 13 | <i>LIQUID RADIOACTIVE WASTE TREATMENT FACILITY</i> | <i>CLEANING DEVICES – LOCAL TREATMENT OF LIQUID AND SOLID RADIOACTIVE WASTE</i> |
| 14 | <i>FACILITY FOR RETRIEVAL AND CONDITIONING OF ION EXCHANGE RESINS</i> | |
| 15 | <i>FACILITY FOR TREATMENT AND CONDITIONING OF SOLID RADIOACTIVE WASTE WITH HIGH VOLUME REDUCTION FACTOR</i> | |
| 16 | <i>EQUIPMENT FOR RETRIEVAL OF LIQUID PHASE OF EVAPORATOR CONCENTRATES TANKS</i> | |
| 17 | <i>EQUIPMENT FOR RETRIEVAL OF SOLIDIFIED PHASE OF EVAPORATOR CONCENTRATE TANKS</i> | |
| 18 | <i>CLEANING EQUIPMENT OF EMERGENCY BORON TANKS</i> | |
| 19 | <i>DECONTAMINATION AND CLEANING EQUIPMENT</i> | |

- 20 ASBESTOS REMOVAL EQUIPMENT
- 21 SINGLE VEHICLE MOUNTED BOOM LIFT
- 22 DEMOLISHING EQUIPMENT
- 23 SUPPLY OF TANK LEVEL MEASUREMENT INSTRUMENTATION
- 24 SUPPLY OF CONTAINERS FOR TRANSPORT OF DISMANTLED WASTE
- 25 COMPUTER SIMULATOR FOR REACTOR DISMANTLING
- 26 EQUIPMENT FOR RADIOLOGICAL MEASUREMENT - LABORATORY LEVEL
- 27 SUPPLY OF CONSUMABLES AND DEVICES - FOR LABORATORY LEVEL MEASUREMENTS
- 28 CONSUMABLES FOR THE RADIOLOGICAL INVENTORY OF UNITS 1-4
- 29 LABORATORY EQUIPMENT FOR THE RADIOLOGICAL INVENTORY OF UNITS 1-4
- 30 EQUIPMENT OF ON-SITE RADIOLOGICAL MEASUREMENT SAMPLING AND ANALYSIS
- 31 COMPLEX VEHICLE WEIGHBRIDGE FOR THE CONTROL OF CONVENTIONAL WASTE
- 32 PORTABLE GAMMA IN-SITU CONTROL MEASUREMENT DEVICE
- 33 SUPPLY OF EQUIPMENT FOR LOW LEVEL RADIOLOGICAL DOSE MEASUREMENT
- 34 CONCRETE CORE SAMPLING ANALYSIS FOR CONTAMINATION CONTROL OF BUILDINGS
- 35 MOVEABLE PERSONNEL REDRESSING AND CONTAMINATION MONITORING FACILITY
- 36 CONTROL DEVICES FOR MEASUREMENT OF LIQUID AND GASEOUS RELEASES
- 37 FACILITY FOR FREE RELEASE MEASUREMENT
- 38 VEHICLE EXIT MONITORS
- RADIOLOGICAL INVENTORY – LABORATORY MEASUREMENTS FREE RELEASE MEASUREMENT – CONTROL OF TRANSPORT DEVICES

- 39 *MEASUREMENT OF HEAT, FLUID FLOW, ELECTRICITY USED FOR DECOMMISSIONING*
- 40 *DESIGN AND INSTALLATION OF NEW SERVICE WATER PIPELINE FOR DECOMMISSIONING*
- 41 *DESIGN AND INSTALLATION OF HEATING SYSTEM AND HOUSE LOAD STEAM FOR DEC*
- 42 *DESIGN AND INSTALLATION OF HEAT FEEDING SYSTEM FROM THE HEATING PLANT*
- 43 *SECURITY PERIMETER SEPARATION (UNITS 1-4)*
- 44 *REPLACEMENT OF ARTESIAN WATER PIPELINES*
- 45 *SUPPLY OF SECURITY EQUIPMENT*
- 46 *DESIGN SUPPORT TO INSTALLATION OF THE NEW PIPE SYSTEMS OF THE SEPARATION*
- DECOMMISSIONING
OPERATION WITHIN
THE
DECOMMISSIONING
INFRASTRUCTURE*

Annex 3

7.1. Plejades study

The potentially mostly affected countries, Bulgaria, Lithuania, and Slovakia were analysed more deeply using macroeconomic models in the aforementioned Plejades study of 2007 "analysis of environmental, economic and social issues linked to the decommissioning of nuclear installations".

The objective of the study was to compare the environmental, economic and social issues of the decommissioning of nuclear power plants for the different Member States.

The analysis was done in different steps, and country profiles for each Member State were drawn up.

Conclusions: The highest shut-down numbers per million capita are found in Lithuania (0.57) and in Bulgaria (0.50). Bulgaria faces a much higher challenge to overcome its relative smaller amount of shutdowns, as it also has a much smaller absorption capacity. It is obvious from the study that the economic indicators (number and capacity per GDP) show the highest economic impact potential in Lithuania and Bulgaria followed by Slovakia and Belgium. Compared to the EU average all indicators are higher by orders of magnitude. It shall be further noted that in those indicators the financing provisions available are not included. This means that the situation in the countries where historically no appropriate financing means could be collected to finance later shut down and decommissioning as is the case in Lithuania, Slovakia and Bulgaria there is an additional threat. In conclusion it should be noted that the newly accessed EU Member States Lithuania, Slovakia and Bulgaria will have to face the highest economic challenges.

Besides the technical issues of decommissioning and dismantling, key societal questions such as funding, social and economic burdens and replacement energy supply arise on national and local level. These challenges are higher, if larger plants are shut down. Only within the last few years a discussion about possible radioactive and non-radioactive environmental impacts of shut-down decisions and decommissioning and dismantling activities has evolved.

Decommissioning of a NPP always leads to a need for high investments. These are investments for decommissioning and investments for the replacement of capacities of the NPPs. These investments have positive impacts on the GDP. In all calculated scenarios of the Plejades study the positive effects of investment are stronger than the negative aspects such as lay-offs, social transfers, price increases, and the negative effects of financing. Nevertheless it shall be noted that although the overall balance in the economy tends to be positive, the negative impacts may have serious negative impacts at the local level. A main part of these investments are imported. Further electricity has to be imported or the exports of electricity reduced. Hence the net exports decrease in the considered countries.

The main results for the three countries, provided decommissioning funding is continued, are as follows:

- In the three considered countries decommissioning of NPPs very rarely leads to strong frictions of economic growth.

- Decommissioning of a NPP leads to higher investments. These are investments for decommissioning and investments for the replacement of the NPPs. These investments implicate positive impacts on the GDP.
- A main part of these investments are imported. In Bulgaria the exports of electricity were reduced. Hence the net exports decrease in the considered countries.
- The effects on the labour market are small. The lay-offs which results from the shut down of the NPPs are mostly compensated by more employment due to higher investment.
- Decommissioning has only moderate effects to prices and inflation.
- The economic development in these three countries is not endangered by the decommissioning of NPPs. On the contrary, decommissioning may lead to even stronger economic growth in most simulations. However the financial source of decommissioning and replacement investments may have some negative secondary effects.

For Bulgaria two specific dates of decommissioning of VVER 440 units at Kozloduy NPP have been compared in the Plejades study of 2007. Two scenarios – one describing a deferred shut-down and the other one describing an early shut-down – were compared with each other. In the early closure scenario earlier replacement investments and resulting higher energy prices were taken into account. Transfers from the European Union to assist Bulgaria's economy have been kept identical in both scenarios. The comparison of these two scenarios shows, that earlier decommissioning leads to earlier investment which creates a positive demand shock that is enforced by multiplier-accelerator effects and results in higher output and employment. Investments for decommissioning and for replacement have to be made earlier. Both result in higher GDP, in higher electricity prices and in a slightly higher inflation rate. Lay-offs resulting from decommissioning are smaller than the employment increases from the high investments. In the deferred scenario similar effects will happen but on a lower level. Hence earlier decommissioning is the proposed option in Bulgaria.

Kozloduy region is mostly affected as far as social and economical issues are concerned.

However the whole South-Eastern European region, even outside Bulgaria, is concerned by the early closure of the reactors (around 15% of electricity production capacity) as Bulgaria is an electricity exporter and after the closures electricity export margins became tighter.