Environmental Impact Assessment Report

for the Decommissioning of Units 1 to 4

at Kozloduy Nuclear Power Plant

TRANSBOUNDARY ASPECTS OF THE INVESTMENT PROPOSAL

CONTENTS

USED ABBREVIATIONS AND ACRONYMS

KNPP	Kozloduy Nuclear Power Plant
NPP	Nuclear Power Plant
ALARA	As Low As Reasonably Achievable
BNRA	Bulgarian Nuclear Regulatory Agency
BAS	Bulgarian Academy of Sciences
SE	Safe enclosure
VVER	Water-Water Power Reactor
WSS	Water Supply and Sewerage
VT	Ventilation tube
HVRF	High volume reduction factor
KPMU	Kozloduy project management unit
SG	State gazette
LLA	Long-lived Aerosols
EIAR	Environmental impact assessment report
SE RAW	State Enterprise “Radioactive Waste”
EBRD	European Bank for Reconstruction and Development
EC	European commission
PG-1	Power generation 1 (Units 1-4)
EU	European union
SEA	Safe enclosure area
PA	Protected area
BEPA	Bulgarian Environmental Protection Act
PT	Protected territory
BEEA	Bulgarian Executive Environment Agency
DECO	Decommissioning
IP	Investment proposal
STC	Secondary treatment chamber
CED	Collective effective dose
CA	Controlled area
VRF	Volume reduction factor
PTC	Primary treatment chamber
CPF	Cellulose and paper factory
IAEA	International Atomic Energy Agency
MDA	Minimum detectable activity
ISAR	Intermediate safety analysis report
MEW	Ministry of Environment and Water
MV	Motor vehicle
KIDSF	Kozloduy international decommissioning support fund for Units 1-4
BAT	Best available techniques
MA	Monitored area

NSI	National statistical institute
NTS	Non-technical summary
ROTPEA	Regulation on the order and terms for performing of environmental assessment
RPA	Radiation protection area
NRSF	National storage facility for low and intermediate radioactive waste
EIAR	Environment impact assessment report
BRPN	Basic radiation protection norms
CMD	Council of ministers decree
RAW	Radioactive waste
RNG	Radioactive noble gases
RIEW	Regional inspection of the environment and water
AB-2	Auxiliary building 2
SCC	Slag Collection chamber
PMF	Plasma melting facility
PT	Plasma torch
SD RAW	Special division “Radioactive waste Kozloduy”
RCC	Reinforced concrete containers
ToR	Terms of Reference
TD	Technical Design
TS	Technical Specification
EWN	Energiewerke Nord (German company)
SSRM	Stations for supervision and radiation monitoring
SISP	System for industrial seismic protection
TLD	Thermo-luminescent dosimeter

1. Introduction

In November 1999, the Bulgarian Government and the European Commission signed a Memorandum of Understanding in which the Bulgarian Government made a commitment to shut down and decommission Units 1 to 4 of Kozloduy Nuclear Power Plant (KNPP) at the earliest possible date, beginning with the closure of Units 1 and 2 at the end of 2002. A commitment for closure of Units 3 and 4 at the end of 2006 was signed later on. As a result, all four Units were shut down at the agreed time.

Taking into account the financial consequences of early closures, as well as the need of a competitive energy sector, the European Commission has offered a multi-annual assistance package for Bulgaria's energy sector, dedicated for assistance to the nuclear energy sector for the decommissioning of Units 1 to 4 of Kozloduy NPP (KNPP), as well as for assistance to the energy efficiency field. In relation to that, the Kozloduy International Decommissioning Support Fund (KIDSF) was established in June 2000, administered by the European Bank for Reconstruction and Development.

In relation to that obligation, the Original Decommissioning Strategy was revised to include the decommissioning of Kozloduy NPP Units 3 and 4 (the Original Decommissioning Strategy is presented the Technical Design for decommissioning of KNPP Units 1 and 2 [8]), in order to reflect:

- The commitment by the Republic of Bulgaria for the earlier shutdown of Units 1&2 and 3&4;
- The application of international decommissioning experience;
- The legislation currently applicable in the Republic of Bulgaria;
- The considerations related to the socio-economic consequences of the earlier shutdown of Units 1&2 and 3&4.

Currently, Units 1 and 2 have a license issued by the Bulgarian Nuclear Regulatory Agency (BNRA) as RAW management facilities subject to decommissioning. Units 3 and 4 also have licenses issued by the BNRA as RAW management facilities subject to decommissioning.

At the moment, the SNF has been removed from Units 1-4 and is stored at the SNF storage.

By a CMD KNPP Units 3-4 are pronounced as a RAW management facility subject to decommissioning. Their property is transferred to SE RAW for administration and management (CMD 1038/19.12.2012).

The investment proposal (IP) envisages the decommissioning of KNPP Units 1-4. In this IP State Enterprise “Radioactive Waste” (SE RAW) is the Employer of the Investment intention.

By implementation of the Best Available Techniques (BAT) and the existing experience in the field, it will be expansion of the plant existing activities for RAW treatment and conditioning. The requirement for BAT application is crucial for minimizing the possibility of negative impact of the KNPP Units 1-4 DECO processes on the environment and provision of protection for the environment and the population.

Based on MEW decision No 26–ПР/2012 for assessing the need for Environmental impact assessment, EIA procedure should be conducted in accordance with the EPA and other legal acts cited in the decision.

The purposes of the future KIDSF project require the implementation of project P16, EIA for KNPP Units 1-4 decommissioning. This EIAR will serve as basis for the EIA procedure conducted by MEW.

NPP decommissioning is included in Appendix I of the Espoo convention [184]. In this relation EIA procedure in a transboundary context has been initiated and a notification of the IP has been sent to Romania, being a stakeholder under the Convention on EIA in a transboundary context.

Upon receipt of the relevant notification, the Romanian government decided to participate in the EIA procedure. The specific requirements of Romania have been considered in the present EIAR.

The purpose of the section is to analyze and assess the environmental impacts in transboundary aspect resulting from the implementation of the Investment Proposal for Decommissioning of KNPP Units 1 to 4, also providing answer to the Romanian requirements.

2. Location of the facility

The total area of the KNPP site is approx. 2 km^2 and together with the channels for circulation and technical water supply it reaches 4 km^2.

Kozloduy NPP has been constructed in north-western Bulgaria on the right bank of the Danube river 5 km to the south-east from the town of Kozloduy. The site is located at the 694th km from the Danube estuary at a distance of 3.7 km from the river midstream and the state border with Romania. The NPP is located in the northern part of the first non-flooded (loess) terrace of the Danube river at an absolute elevation of +35.00 m. The site area is flat, with an average altitude ranging from +28.00 m to +36.00 m according to the Baltic altitude system. The lowland and the site are protected from the Danube river by an embankment reaching an absolute elevation of +30.40m. To the north it borders on the Danube Lowland. To the South of the site the slope of the watershed plateau is relatively high (100-110 m), to the West it is about 90 m, while to the East it is relatively lower and goes down to a 30 m altitude above the sea level.

The site is located 120 km away from the city of Sofia in a direct line, and 200 km by road. The area within a 30 km radius around the site includes municipalities with the following centers: Kozloduy, Valchedrum, Hayredin, Mizia (entirely) and Lom, Byala Slatina and Oryahovo (partially). The 30-km area around the site also includes a sparsely populated part of the territory of Romania where a total of 23 settlements are located, of which 2 towns – Dabuleni and Bechet, and 21 villages. The closest settlements to KNPP are: Kozloduy town located 2.6 km south-west, Hurletz village located 3.5 km south-east, Glozhene village 4.0 km south-east, Mizia 6.0 km south-east, Butan village 8.4 km south and Oryahovo town located 8.4 km east of the site.

The regional location of Kozloduy NPP is shown on fig. 2-1 and fig. 2-2 presents the territory of Romania in the 30-km KNPP area.

Fig. 2-1 Regional location of KNPP site

Fig. 2-2 Territory of Romania around 30-km zone of Kozluduy NPP

3. Alternatives for the IP implementation

The alternatives for KNPP Units 1 to 4 decommissioning are as follows:

- Alternative 0 (Without decommissioning);
- Alternative 1 (Deferred Dismantling);
- Alternative 2 (Continuous Dismantling).

Brief description and comparison of the above alternatives is given below and the main advantages and disadvantages of each alternative are outlined. The alternatives described below are compared to the so-called "zero alternative", representing the situation when Units 1-4 decommissioning is postponed indefinitely.

Alternative 0: Without decommissioning

The "zero alternative" represents the status that would arise after KNPP Units 1 to 4 final shutdown and the subsequent consequences if the proposed decommissioning activity does not take place.

The Alternative 0 does not require availability of decommissioning financing but financing of the maintenance of the Units will nevertheless be required.

Site release for further use would be postponed for the indefinite future. In addition, the risk of possible releases of radioactive substances into the environment will be increased (the tanks where RAW is presently stored are not designed for long-term storage). This is not an advantageous alternative with regard to the costs for maintenance, reconstruction of buildings and equipment and institutional control needed for an indefinite period of time.

In accordance with the national legislation and regulatory requirements, the nuclear power Units must be operated in a manner that ensures that their radiation safety will be guaranteed and continuously monitored after the reactor final shutdown. Thus, under Alternative 0 some systems will have to be permanently operated.

All these concerns (increased radiological risks and related costs) compromise the Alternative 0 concept for decommissioning of the nuclear facilities.

Alternative 1: Deferred Dismantling

A basic feature of Alternative 1 - Deferred Dismantling is the Safe Enclosure (SE) of the equipment of the primary circuit for a predetermined time period (35 years) and after that the dismantling works shall start up.

The spent fuel shall be removed from each Unit within the period of validity for the operational license.

This alternative is reviewed in the latest revision of the Decommissioning Project from 2005 [3] and includes the following three stages:

Stage 1: 5-year transition period including:

- Post operation period;
- Safe Enclosure Preparation;

Stage 2: Safe Enclosure Operation for 35 years;

Stage 3: Deferred dismantling.

These three stages are consecutive, i.e. are performed sequentially. The two phases of Stage 1 - Post-operational period and Safe Enclosure Preparation may also overlap partially.

The Safe Enclosure Area according to Alternative 1 - Deferred Dismantling includes the two Reactor Buildings (RB-1 and RB-2), the two auxiliary buildings (AB-1 and AB-2), the two ventilation stacks (VS) and the interconnecting passageways.

The deferred dismantling shall begin after the long lasting (35 years) Safe Enclosure. When the 35 years period of SE under surveillance expires, the facilities shall be dismantled, indicating the decreased radiation because of the isotopes natural decay. Therefore, this alternative can be characterized as a decommissioning process with a time lag, during which the radioactive equipment shall be under SE mode and shall be monitored for a specific period of time and after the expiration of which dismantling shall be performed in order to release the site from regulatory control for unrestricted use.

The key features of this alternative are:

- Decrease of dose levels;
- Development of new dismantling techniques;
- Accumulation of financial resources.

A significant issue associated with this Alternative 1 is that it shall create a heavy impact on the local community in terms of the very low employment during the 35 years of Safe Enclosure. Furthermore, the operational experience necessary for planning of the decommissioning process will be lost, and the radioactive waste treatment infrastructure will remain unused for a long period of time between the end of operation and the deferred dismantling of Units 1 to 4. In practice this would require re-building of the waste treatment infrastructure, hiring of new workers and full training of the operating staff.

Alternative 2: Continuous Dismantling

The main feature of this alternative is the continuous dismantling of equipment and facilities and uninterrupted waste management as well as Safe Enclosure Operation meeting all the requirements of environmental and radiation protection. During the SE stage dismantling works of the equipment shall also be performed outside the SE Area. The subsequent stage shall include deferred dismantling inside the Safe Enclosure and the release of the site and the buildings for use for other industrial purposes.

The Continuous Dismantling is a selective combination of two possible options:

- Immediate dismantling for some facilities or equipment;
- Deferred dismantling for other facilities or equipment.

The stages of Safe Enclosure Preparation and Safe Enclosure Operation from the Original Decommissioning Strategy are combined together into the single Stage 1.

Under this alternative the preparatory works shall start earlier and shall be followed by the continuous dismantling. The work load of the equipment involved in the waste treatment shall be more uniform.

Shortening by 2 years of the preparatory activities such as removal of combustible and flammable materials, removal of asbestos and other hazardous materials is possible (and should be completed by the end of 2012). Potentially, these activities can be extended by other pre-decommissioning activities.

It is planned that the decommissioning license for Units 1 and 2 should enter into force in the middle of 2013, and for Units 3 and 4 – at the end of 2013, as RAW management facilities, in order to prepare the documentation and technical resources necessary for decommissioning.

In this case the dismantling activities could then commence in 2013 which is four decades earlier than planned according to Alternative 1.

The Continuous Dismantling Alternative shall progress in two stages:

- Stage 1: Safe Enclosure of Reactor Buildings and dismantling of equipment outside of the Safe Enclosure Area;
- Stage 2: Deferred Dismantling of the equipment within the Safe Enclosure and release of the site and buildings from regulatory control for reuse for other purposes.

The scope of the SE shall be limited to the RB of the Units, of the Sanitary Buildings (SB) and the connecting passageways. The Auxiliary Buildings shall remain special statutory facilities in order to be used during the different phases of the decommissioning activities. The scope of the SE for Units 1 to 4 corresponding to this alternative is shown on fig. 3-1.

The end of Stage 1 shall be marked by the completion of the dismantling outside of the Safe Enclosure Area.

The dismantling of the equipment from the Auxiliary Buildings must be implemented at the end of Stage 2 according to the Continuous Dismantling Alternative. The end of Stage 2 shall be marked by the completion of the dismantling within the Safe Enclosure Area.

An important goal of the dismantling process is to achieve maximum reuse and recycling of the dismantled materials, especially metals. This requires procurement and installation of appropriate infrastructure for dismantling, fragmentation, sorting, volume reduction, decontamination, and of free-release measurement equipment before the beginning of the decommissioning activities.

For the implementation of these stages, the necessary projects are planned. The most important are:

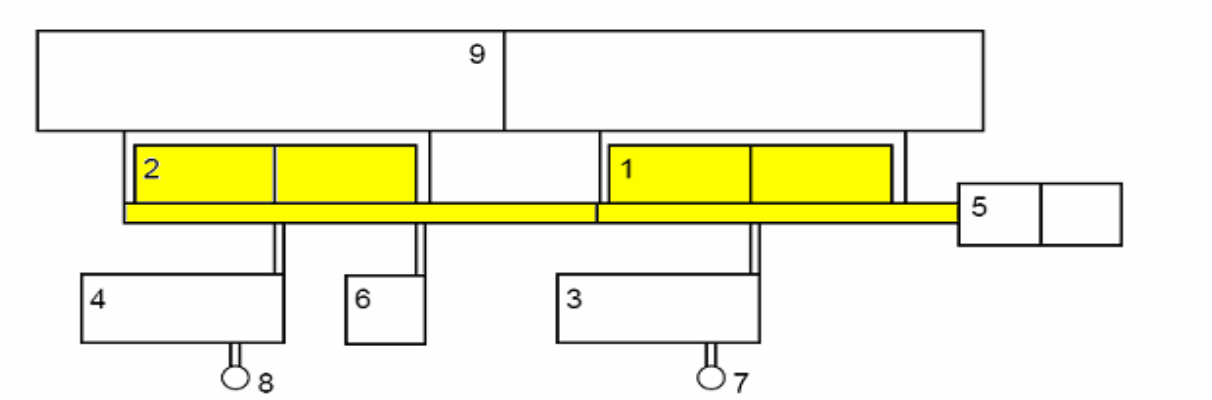
- Size Reduction and Decontamination Workshop;
- Sites for management of materials from the decommissioning activities of KNPP Units 1-4;
- Facility for treatment and conditioning of radioactive waste with high volume reduction factor at KNPP (Plasma melting facility - PMF).

During the continuous dismantling, reclamation of any contaminated soils may be carried out.

Upon commissioning of the National storage facility for low and intermediate radioactive waste (NRSF), the stream of conditioned radioactive waste will be directed to the NRSF enabling removal of RAW from the site.

During Stage 2, dismantling of the equipment in the SE Area, i.e. radioactively contaminated equipment of the primary circuit shall start. It shall be followed by the dismantling of the reactors and the surrounding activated components. At the end of this stage the site and buildings shall be released from regulatory control for further industrial use.

The last stage in the decommissioning process is closure and reclamation. During this stage the site and buildings will be reconstructed in order to increase their efficiency and to improve the ecological indicators. The long term end state of the KNPP site in this stage is planned to be "brown lawn". This state will be achieved by implementation of the following activities: dismantling of the equipment not necessary for further use; free release of the buildings and facilities remaining in operation; processing and removal of all radioactive waste from the site and bringing the site to a condition suitable for the needs of nuclear power or other economic activities. What remains are the buildings and the underground communication infrastructure, which will be used for servicing of the operating Units 5-6.



1 – Reactor Building I (Units 1 & 2)
2 – Reactor Building II (Units 3 & 4)
3 – Auxiliary Building 1
4 – Auxiliary Building 2
5 – Laboratory/sanitary building 1
6 – Laboratory/sanitary building 2
7 – Ventilation Stack 1
8 – Ventilation Stack 2
9 – Turbine Hall

**The yellow area is the SE area, including SB 1.*

Fig. 3-1 Planned Safe Enclosure area under Alternative 2 - Continuous Dismantling of Units 1 to 4

Comparison of the alternatives and justification of the Alternative for Continuous Dismantling

The comparison is made for the three alternatives based on different factors.

The increased radiological risks and the related costs for risks limitation and for maintenance of the Units in a safe state make Alternative Zero unsuitable for decommissioning of nuclear facilities. Therefore, the comparison will be made basically between Alternative 1 and Alternative 2.

The substantial difference between the schedules of decommissioning of the Original Decommissioning Strategy [3] (Alternative 1 - Deferred Dismantling) and of the Updated Decommissioning Strategy [4] (Alternative 2 - Continuous Dismantling) is illustrated on fig. 3-2. The figure shows that in case of Alternative 1 there is a time lag of 35 years between the preparation works and the start of dismantling, which is not the case according to Alternative 2.

The comparison of the two alternatives is made based on the assessment of the economic, social and radiological consequences and the environmental impacts.

Economic consequences

The Safe Enclosure Stage shall be considerably shorter under Alternative 2 for Continuous Dismantling since the activities involving dismantling outside the Safe Enclosure Area shall start earlier and the dismantling within the Safe Enclosure Area is planned to start immediately after their completion (see fig. 3-1). Another advantage proposed in Alternative 2 is the gradual, uniform and continuous use of human and financial resources, as well as of the waste processing facilities (because of which this alternative is called “Continuous Dismantling”). These are the most important differences between the two alternatives considered so far.

The most obvious economic result from the delay of any project is the increase of costs with the rate of inflation. The average inflation rate in Bulgaria within the next decade is estimated at 6 %.

Social consequences

The proposed philosophy behind the Updated decommissioning strategy [4], respectively Alternative 2, is that the continuous dismantling process implies gradual, uniform and continuous usage of the human and financial resources, as well as of the waste treatment facilities.

The assessment of the social consequences from the delay in the decommissioning projects is not synonymous to the assessment of the other impacts because of the following considerations:

- The long-term maintenance of shut-down reactors is not motivational for the workers; the loss of involvement in the work shall lead to a loss of experience, which in turn shall result in loss of operational knowledge, which is needed for the successful decommissioning. The experienced people will soon understand that they have to leave and to make career changes. Alternative 2 provides opportunity to prevent these consequences. It is planned, for instance, and is being realized, to transfer part of the personnel of KNPP Electricity Production 1 (EP-1) to SE “RAW”, preserving their working status and social services already used by them.
- The delay of the pre-decommissioning activities may force experienced operational personnel, who are needed for the successful decommissioning, to leave the plant. They will have to be replaced by new operational personnel, who must gain knowledge through training and studying of the plant documentation.
- The decommissioning project itself will create hundreds of jobs, for which various skills and qualifications are required. This figure will not be as big

as in case of the operational mode/electricity generation/, but will mitigate the social consequences of the Units shutdown.

Environmental and human health impact consequences

The environmental impact from the decommissioning depends mainly on:

- The scope of the equipment used in the controlled area and the manner in which it is operated;
- The amounts of radioactive materials that are dismantled;
- The method of management of the radioactive waste during the decommissioning.

The principal source of radioactive emissions shall be the treatment and conditioning of radioactive waste, the decontamination of radioactive materials and the dismantling. The gaseous and liquid emissions generated shall depend on the technologies used. In addition the distribution in time of the amounts of generated emissions shall also depend on the selected decommissioning alternative.

The distribution of the radioactive emissions in time is in principle similar to the distribution of the radiation load on the personnel in time. The biggest amounts are generated during dismantling of the contaminated and activated equipment, during decontamination and conditioning of the radioactive waste.

One of the strongest arguments in favor of the Deferred Dismantling Alternative is the reduction of the radiological consequences during the dismantling. It is clear, however, that the overall radiological impact resulting from the delay of the dismantling activities will be a balance between the positive and the negative factors. The most significant of these factors are:

- The reduction of the occupational exposure dose will only be significant in those cases when the main share of the dose formation is determined by short-lived isotopes (mostly ^{60}Co);
- The dose rate in the buildings will predominantly depend on the ^{137}Cs containing contamination.

If the technology is properly adhered to and the processes of decontamination and dismantling are monitored, the decommissioning can be implemented with the expectation that the radioactive gaseous emissions will be within the permissible boundaries and that the air pollution in the NPP area will be less than the air pollution during the period of operation. Therefore, the risk for the population will be considerably lower in comparison to the period of normal operation.

The complex analysis of the proposed alternatives for decommissioning of KNPP Units 1 to 4 has found that in terms of the impact on the environmental components, Alternative 0 raises the risk of potential discharges into the environment (for instance, the RAW storage tanks design characteristics do not allow for long-time storage, the other facilities also have limited capacity).

As for the impact on the environment and the human health resulting from the generation of conventional waste and harmful physical factors – noise, vibrations and non-ionizing radiation, both alternatives are equal, as far as in both cases an excess of the regulatory limits of admissible releases are not expected and no significant

adverse impact is expected of these conventional sources of pollution. The basic impacts are expected during the construction works related to the preparation of the decommissioning infrastructure and they can be characterized as acceptable, localized, temporary and short-term, and reversible.

The justification of the choice of the appropriate alternative for decommissioning of Units 1 to 4 is based on the advantages and disadvantages of the two alternatives in the above mentioned social and economic aspects, and the assessment of their impact on the environment and on the human factor (non-radiation and radiation).

The choice of Alternative 2 as the most suitable one is based on a number of advantages, as compared with the rest of the assessed Alternatives, namely:

- Under Alternative 2 the preparatory works shall start immediately after the reactor shutdown including: radiological inventory of the Units and removal of the hazardous and other operational waste from the units; activities related to the collection, sorting, processing and transportation of the decontamination waste; RAW management activities and subsequently the dismantling is performed without considerable interruption.
- The dismantling activities of some facilities according to Alternative 2 shall start in 2012, which is almost four decades earlier than the planned schedule corresponding to Alternative 1.
- The SE stage is considerably shortened in the case of the Continuous Dismantling Alternative, because the dismantling activities outside the SE area can start earlier and, immediately after their completion, the start-up of the dismantling inside the SE area is planned.
- The time schedule for implementation of the decommissioning activities is distributed uniformly for the sake of the efficient utilization of the highly-skilled work force. The complexity of the tasks will be increasing gradually, and thus experience will be accumulated on a step-by-step basis for the decommissioning of ever more complex, in terms of radiation, unit components.
- This alternative is more suitable from a technical point of view as well, because it takes into account the current status of the technical procurement of equipment for the decommissioning process.
- An important aspect is the preservation of the experience and knowledge of the current personnel, who can be effectively used for the development of specific working procedures for specific tasks associated with the decommissioning (continuity in knowledge of the equipment and the site).
- Another advantage offered by Alternative 2 is the gradual, uniform and continuous utilization of human and financial resources throughout the entire process of decommissioning of the units, as well as of the waste treatment facilities.
- The implementation of the selected alternative provides a reasonably long period for supply of the necessary equipment for RAW treatment, as well as uniform use of the RAW treatment capacities during the entire project, thanks to the uninterrupted RAW management process.

In conclusion, because of the advantages of Alternative 2 and the disadvantages of the other two alternatives, Alternative 2 is considered as the most appropriate for the implementation of the decommissioning project for Kozloduy NPP Units 1 to 4.

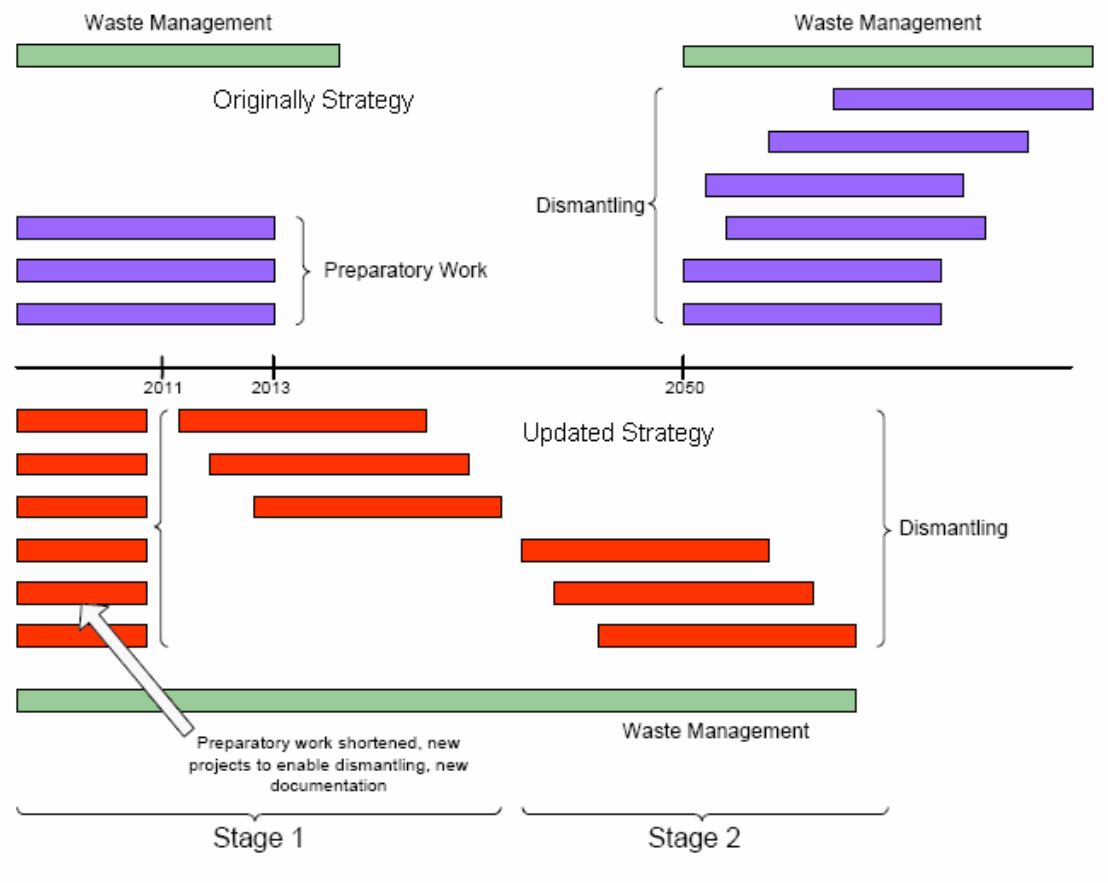


Fig. 3-2 A comparative scheme between Alternative 1 "Deferred dismantling" (Original Strategy) and Alternative 2 "Continuous dismantling" (Updated Strategy)

4. Description of the Investment Proposal

Description of the decommissioning stages and activities

The entire preparation and decommissioning process according to the adopted Continuous Dismantling Alternative can be sub-divided into the following three main stages including the respective activities:

TRANSITIONAL STAGE (PRE-DECOMMISSIONING STAGE):

- Preparation of the documentation for issuance of a decommissioning permit (Decommissioning Plan, EIA Report, updated: Safety Analysis Report, Technological Specification and Operating Instructions) and
- Pre-decommissioning activities (provision and construction of suitable infrastructure for dismantling, cutting, fragmentation, sorting, volume reduction, decontamination and free release measurement; removal of flammable and hazardous materials and conventional waste, thermal insulation, operational RAW, retrieval and conditioning of spent ion-exchange resins, system isolation and draining).

DECOMMISSIONING STAGE
This stage includes the following two sub-stages:

STAGE 1

- Preparation of Safe Enclosure
- Safe Enclosure of the Reactor Buildings (the RB of Units 1 and 2 and the RB of Units 3 and 4 and the interconnecting passageways are included in this area) and
- Dismantling of the equipment outside the Safe Enclosure Area.

STAGE 2

- Deferred dismantling of the equipment within the Safe Enclosure Area and
- Release from regulatory control of the site and the buildings for use for other industrial purposes.

During the implementation of the above mentioned stages: Transitional (Pre-decommissioning) stage, Stage 1 and Stage 2 of the decommissioning, different types of waste management activities will be carried out.

After sorting of the dismantled materials, depending on its contamination rate the waste can be:

- Free released and transported outside the KNPP site without or after decontamination;
- Stored temporarily for natural decay;
- Handed over as RAW for further treatment and conditioning.

CLOSURE AND LAND RESTORATION STAGE

The DECO process will end in 2037, after which the site and buildings will be reconstructed in order to increase their efficiency and to improve the ecological indicators. The long-term state of the industrial site where KNPP Units 1-4 are being

decommissioned is defined as "brown lawn". This state will be achieved by implementation of the following activities: dismantling of the equipment not necessary for further use; free release of the buildings and facilities remaining in operation; processing and removal of all radioactive waste from the site and bringing the site to a condition suitable for the needs of nuclear power or other economic activities. What remains are the buildings and the underground communication infrastructure, which will be used for servicing of the operating Units 5-6.

4.1 Projects supporting Kozloduy NPP Units 1 to 4 decommissioning

In relation to the decommissioning activities on the power Units, the implementation of preparatory supporting projects during the Pre-Decommissioning Stage is planned. They can be sub-divided into: Projects for removal of the hazardous materials, Projects for processing of the accumulated operational RAW, Projects for pre-decommissioning activities and Projects for additional infrastructure construction.

During the decommissioning stage activities will be implemented for the RB SE Preparation and SE Operation and for dismantling of the equipment outside the SE area (Decommissioning Stage 1), as well as for the Deferred Dismantling inside the SE area and the release of buildings for use for other purposes (Decommissioning Stage 2).

The most important projects, which are presently planned to be implemented during the above mentioned stages (Pre-Decommissioning Stage, Decommissioning Stages 1 and 2), and for some of which the EIAR will provide an assessment concerning the probability to have or not to have impacts on the people and on the environment, are described below.

Project: Size Reduction and Decontamination Workshop (SRDW)

The SRDW is planned to be used for size reduction and decontamination of the dismantled radioactively contaminated materials from TH, AB-1, AB-2 and the RB.

Project: Facility for Treatment and Conditioning of solid RAW with High Volume Reduction Factor (PMF)

This project should provide a high volume reduction factor (HVRF) facility for the processing of solid low level radioactive waste currently stored in a number of locations on the KNPP site. The project envisages a separate EIAR.

Project: Design and construction of Sites for management of materials from the decommissioning activities of KNPP Units 1-4

This project envisages storing of solid radioactive materials (RAM) generated from the decommissioning activities of KNPP Units 1-4 at two separate sites. RAM will be temporarily stored in containers for a period of 5 years, until their specific activity decreases below the free release levels. The sites for temporary storing of RAM from the decommissioning activities of KNPP Units 1-4 are designed and operated in a manner ensuring minimal risk for the personnel, the population and the environment, in accordance with the ALARA principle. This project also envisages selection of a site for storage of conventional (non-radioactive) waste generated by the decommissioning of the Units.

Project: Construction of a Heat Generation Plant

The purpose of this project is the design, construction and commissioning of a Heat Generation Plant as a back-up source of steam and central heating water for the consumers at Kozloduy NPP in case of simultaneous outage of KNPP Units 5 and 6. According to MEW Letter No B-1214/29.07.2009 the Investment Proposal is subject to a mandatory EIA. Therefore, this project requires the elaboration of a separate EIAR.

Project: National Disposal Facility for short-lived low and intermediate RAW

The purpose of this facility is storage of short-lived low and intermediate RAW. The facility is in the process of preparing of the technical design and the safety analysis report. A separate EIAR has been prepared for this project with positive decision by the Minister of the environment and water.

Project: Spent Fuel Dry Storage Facility

The KNPP Spent Fuel Dry Storage Facility (SFDSF) will store spent nuclear fuel cartridges in specially designed storage casks. The design period of operation of the facility is at least 50 years. Fuel cartridges will be sealed into purpose-built storage casks, which will ensure their safety during the storage period. A separate EIAR has been prepared for this project and there is a positive decision from the MEW on it.

Project: Ion exchange Resins Retrieval and Conditioning Facility

The Project shall ensure the supply of equipment for the retrieval and treatment of spent ion-exchange resins from the existing storage facilities.

Project: Liquid Radioactive Waste Treatment Facility

This project should provide equipment for the treatment of low contaminated water from active laundry, hot showers and floor drains from KNPP Units 1 to 4, and the conditioning of the generated radioactive waste. Currently, this waste is being treated by the operating KNPP SWT-3 of Units 1 to 4, which will become non-operational upon completion of the treatment of all operational liquid RAW.

Project: Delivery of mobile equipment for decontamination and purification of water

The project should provide the delivery of mobile equipment for decontamination of the reactor shaft, spent fuel storage pond (SFSP) and the racks, and other open and covered tanks, the water in them, as well as for conditioning of the generated RAW. According to MEW letter No 26-00-2555 to KNPP, the project could not be referred to the investment proposals set out in Appendices 1 and 2 to the EPA, and is therefore not subject to mandatory environmental impact assessment.

Projects: Free Release Measurement Facilities

This project should provide equipment for measuring of γ-activity for the purpose of releasing dismantled equipment and other materials from regulatory control. These projects will provide the delivery of an additional equipment to obtain accurate analysis and recording of radioactive nuclides on dismantled equipment and other materials allowing the free release of the latter.

Project: Facility for Retrieval and Processing of the Solidified Phase from Evaporator Concentrate Tanks

This project should provide the delivery and installation of a Facility for Retrieval and Processing of the Solidified Phase from Evaporator Concentrate Tanks currently stored in tanks in Auxiliary Buildings 1 and 2.

Project: Optimization of Liquid and Gaseous Discharge Monitoring System

The purpose of this project is to meet the requirements of the European Commission that are listed in the European Commission Recommendation 2004/2/EURATOM and by the BNRA concerning the KNPP Discharge Monitoring System. These requirements will be met by upgrading of the existing monitoring system for the liquid and gaseous emissions of KNPP Units 1 to 4. The intended purpose of this system is to improve and optimize the existing system for monitoring (control) of the liquid and gaseous emissions from KNPP Units 1 to 4.

4.2 Generation of RAW and conventional waste, harmful emissions and harmful physical factors by the decommissioning

In the EIAR there is a summary of the expected types of waste, harmful emissions and harmful physical factors, which will be generated during the Transitional stage (Pre-decommissioning stage), during Stage 1, Stage 2 of the Decommissioning and the Closure and land restoration Stage, based on the information available up to now.

I. Waste, harmful emissions and harmful physical factors generated during the Transitional stage (Pre-decommissioning stage)

Conventional waste, harmful emissions and harmful physical factors

Generated solid waste

The implementation of the activities during the transitional stage is expected to generate conventional waste: municipal, construction, industrial waste, hazardous waste from insulation containing asbestos, combustible and flammable waste etc.

Generated waste water

The implementation of the activities during the transitional stage is expected to generate non-radioactive waste water, such as spent industrial water (purified waste water, conditionally clean waters from the spent cooling water flow), domestic sewage water and rainfall water flows.

Waste gases

The implementation of the activities during the transitional stage is expected to generate non-radioactive organized and unorganized gaseous emissions from processing, transport, construction equipment, dust (particulate matter – PM) from material and equipment processing, odors, etc.

Harmful physical factors

The implementation of the activities during the transitional stage is expected to generate noise and vibrations mainly in result of new buildings construction and preparation, reconstruction of existing buildings or solid waste treatment.

Radioactive waste, emissions and harmful physical factors,

Generated solid RAW

Such waste will be generated from the processing of solid and liquid waste, as well as from dismantling of contaminated equipment and contaminated construction materials. The RAW will be appropriately conditioned in the relevant facilities and handed over for further storage (disposal).

Generated liquid RAW

The operational liquid RAW is stored in the AB storage areas of Units 1 to 4: in the Low Activities Sorbents Tanks (LAST), in the High Activities Sorbents Tanks (HAST) and the Evaporator Concentrate (Bottoms) Tanks (ECT). It is expected that during the pre-decommissioning period RAW will be generated mainly from the equipment decontamination process and ion-exchange resins and bottom treatment etc. This liquid RAW will be collected and processed.

Waste gases

The expected generation of waste gases will be mainly the result of treatment of operational RAW, equipment, etc. These emissions will be captured and treated by the relevant ventilation systems of Units 1 to 4 and by the ventilation systems of the new facilities, and will be released under control in the environment in strict compliance with the established regulatory limits.

Harmful physical factors

Sources of ionizing radiation. Total activity on the operational site is generated by the operation of Units 5 and 6 and the decommissioning activities in the area of Units 1-4. Residual activity during Stage 1 and Stage 2:

- Contaminated equipment in SE area;
- Contaminated surfaces in the area of SE, TH, AB and supporting RAW treatment facilities (SRDW, PMF)
- RAW in the area of SE, TH, AB and regulated storage facilities.

All active releases are controlled and captured by the relevant above mentioned treatment facilities. The residual activity remains in the regulatory limits.

II. Waste, harmful emissions and harmful physical factors generated during Stage 1 and Stage 2 of the decommissioning

These pollutants will be generated as a result of the implementation of different decommissioning activities. They are expected to be generated primarily during the dismantling and decontamination processes.

Conventional waste, harmful emissions and harmful physical factors

Generated solid waste

During the decommissioning activities, after free release and decontamination significant amounts of solid conventional waste are expected to be generated from dismantling of the technological equipment and the demolition of the auxiliary concrete structures.

Generated liquid waste

During the decommissioning activities non-radioactive waste water is expected to be generated, such as spent industrial water (purified waste water, conditionally clean waters from the spent cooling water flow), domestic sewage water, and rainfall water flows.

Waste gases

During the implementation of the decommissioning activities generation of non-radioactive organized and unorganized emissions from processing, transport, dust (particulate matter – PM) from material and equipment processing, odors, etc. is expected.

Harmful physical factors

During the decommissioning activities noise and vibrations will be generated from the processing of solid waste. Generation of non-ionizing radiation is not expected during the decommissioning.

Radioactive waste, emissions and harmful physical factors

Generated solid RAW

Generation of solid RAW from SE preparation and operation activities, from dismantling of the technological equipment and the demolition of auxiliary concrete structures is expected. This waste will be treated by the existing facilities for processing and storage owned by State Enterprise "Radioactive Waste" (SE "RAW").

Generated liquid RAW

It is expected that liquid RAW (spent water, oils) will be generated by the SE preparation and operation, as well by the decontamination of the dismantled contaminated equipment.

Waste gases

During Stage 1 and Stage 2 of the decommissioning gaseous waste emissions are expected to be generated. They will be captured and purified by the ventilation systems of Units 1 to 4 and the ventilation systems of the new facilities, then released under control into the environment in strict compliance with the established regulatory limits.

Harmful physical factors

Sources of ionizing radiation. Total activity on the operational site is generated by the operation of Units 5 and 6 and the decommissioning activities in the area of Units 1-4. Residual activity during Stage 1 and Stage 2:

- Contaminated equipment in SE area;
- Contaminated surfaces in the area of SE, TH, AB and supporting RAW treatment facilities (SRDW, PMF)
- RAW in the area of SE, TH, AB and regulated storage facilities.

All active releases are controlled and captured by the relevant above mentioned treatment facilities. The residual activity remains in the regulatory limits.

III. Waste, harmful emissions and harmful physical factors generated during the closure and land restoration stage

These pollutants will be generated as a result of the closure and land restoration activities.

Conventional waste, harmful emissions and harmful physical factors

Generated solid waste

During the closure and land restoration activities generation of solid conventional waste – domestic and construction, is expected.

Generated waste water

During the closure and land restoration activities generation of non-radioactive liquid effluents, such as domestic sewage water and rainfall water flows, is expected.

Waste gases

During the closure and land restoration activities generation of non-radioactive organized and unorganized emissions from processing, transport, dust (particulate matter – PM) from material and equipment processing, odors, etc. is expected.

Harmful physical factors

During the closure and land restoration activities noise and vibrations are expected to be generated primarily from transportation equipment and during reconstruction of existing buildings.

Radioactive waste, emmissions and harmful physical factors

Generated solid RAW

Solid RAW will be generated during removal of contaminated equipment from the sites. This waste is planned to be properly processed in the relevant facilities and submitted for further storage.

Generated liquid RAW

It is expected that liquid RAW will be generated by decontamination of the equipment. This liquid waste will be collected and conditioned.

Waste gases

During the closure and land restoration stage gaseous waste emissions are expected to be generated. They will be captured and purified by the ventilation systems of the new facilities, and then released under control into the environment in strict compliance with the established regulatory limits.

Harmful physical factors

Sources of ionizing radiation during removal of contaminated equipment from the sites.

5. Description of the Protected Areas and Protected Territories in the 30-km zone around Kozloduy NPP in Romanian territory

Three protected areas are located within the 30-km zone around the Kozloduy NPP. Protected area ROSCI0045 is under the Directive on the conservation of natural habitats and of wild flora and fauna, and Protected Areas ROSPA0010 and ROSPA0023 are under the Birds Directive.

Their location to Kozloduy NPP site is given in fig. 5-1.

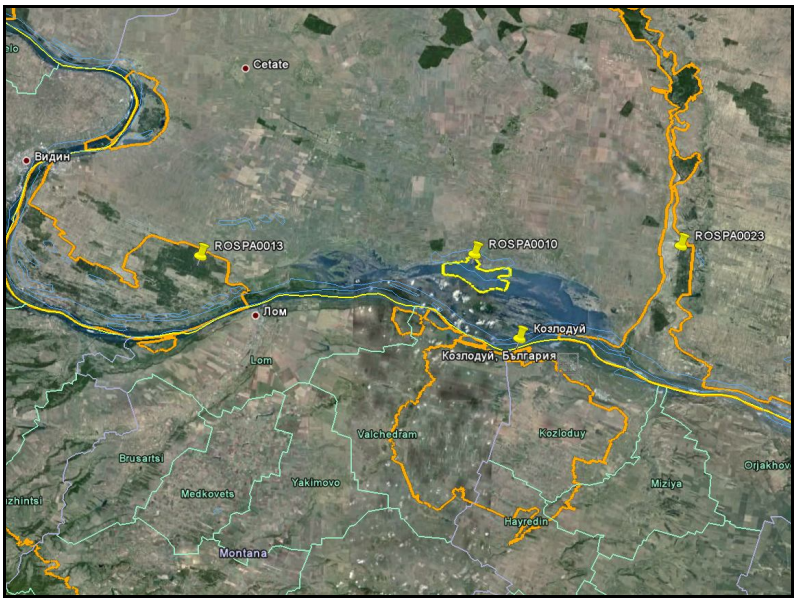


Fig. 5-1 Protected Areas under the Birds Directive on the left bank of the Danube in the area of Kozloduy NPP

Protected area ROSCI0045

Protected area codenamed ROSCI0045 **Coridorul Jiului** occupies an area of 71.394 ha. It is situated in Dolj, Olt, Mehedinti, Gorj District.

Land cover classes within the PA are distributed in the following groups: rivers, lakes (16 %), wetlands (11 %), farmland (14 %), pastures (15 %), other cultivated areas (2 %), deciduous forests (38 %), and forest habitat (4 %).

General characteristics

The territory located along the middle and the lower stream of the river Jiu, includes some of the most rare and relict representative samples of European-type lawn evolved to a lesser extent (coordinates: 23 ° 30 '02 "and 24 ° 14' 05" east longitude, 43 ° 42 '01 "and 44 ° 54' 55" north latitude, 128 km length, direction NNW-SSE). Field crosses 4 (27 %) of 15 green areas (Getti plateau and plain-Gavanu Burdea, Romanian forest steppe plane Danube valley) of the Continental bio-geographical region of Romania. The difference in altitude varies from 50 to 405 cm. The area encompasses many ecosystems and a total area of 147540 ha, most of which 33543 ha of natural (23 %), with significant local diversity and abundance times above the average, typical for the Romanian forest, which gives it exceptional geographic significance.

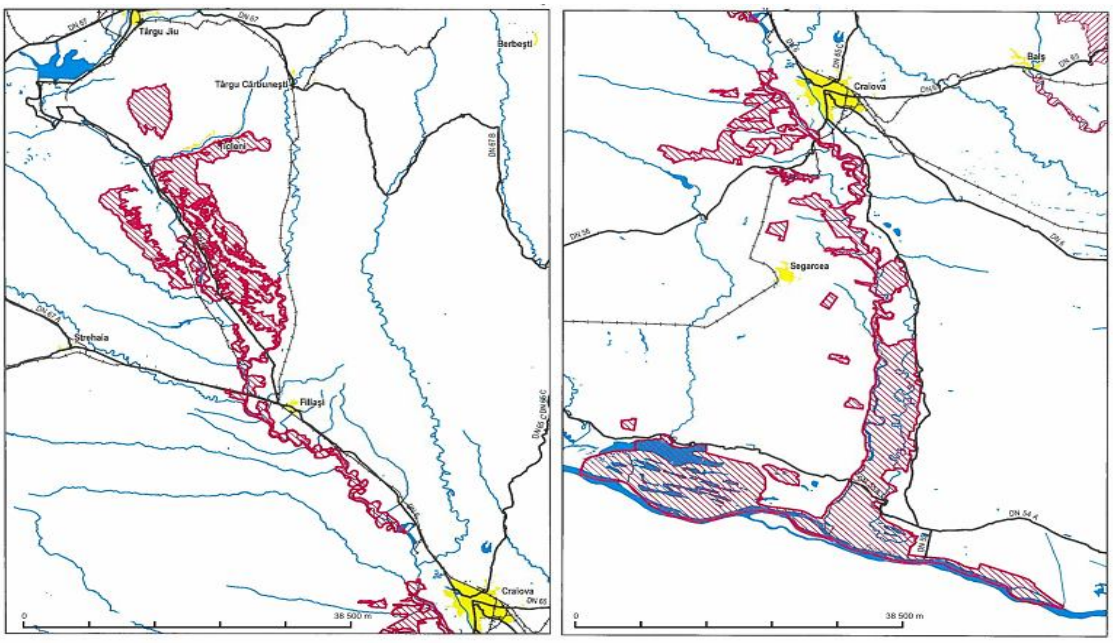


Fig. 5-2 Protected Area ROSCI0045 (source: Monitorul official al Romaniei, Porteal, Nr. 98 bis/7.II2008)

Protected area ROSPA0010

Indicative denomination of the site: ROSPA0010 Bistrets River (Bistreț) (1915.6 ha) – Dolj County

Land cover (type, percentage): Rivers, lakes (90 %); swamps (8 %); pastures (2 %)

The species listed in Annex I of the Birds Directive, which could be affected adversely during the Decommissioning of KNPP Units 1 to 4, are:

1. Dalmatian Pelican *(Pelecanus crispus)* – globally endangered species with 3-59 migrant birds and global assessment mention B. The species inhabits the wetlands of Bistreț where its hunting area is and where it stays for the night and rests next to the sand spits of the adjacent islands of Danube river. No significant adverse impact on the species is predicted.

2. Great White Pelican *(Pelecanus onocrotalus)* – migrant species with 50-150 migrant birds and global assessment mention B. During migrations the species inhabits the wetlands of Bistreț, where its trophic area is and where it stays for the night and rests next to the sand spits of the adjacent islands of Danube river. No significant adverse impact on the species is predicted.

3. Little Cormorant (*Phalacrocorax pygmeus)* – wintering and passerine species with 15 wintering and 1000 passing birds and global assessment mention A. No significant adverse impact on the species is predicted.

4. Eurasian Spoonbill (*Platalea leucorodia)* – nesting (34-41 couples) and passerine species (180-211 specimens.) with global assessment mention C. The species inhabits the wetlands of the Danube river valley. No significant adverse impact on the species is predicted.

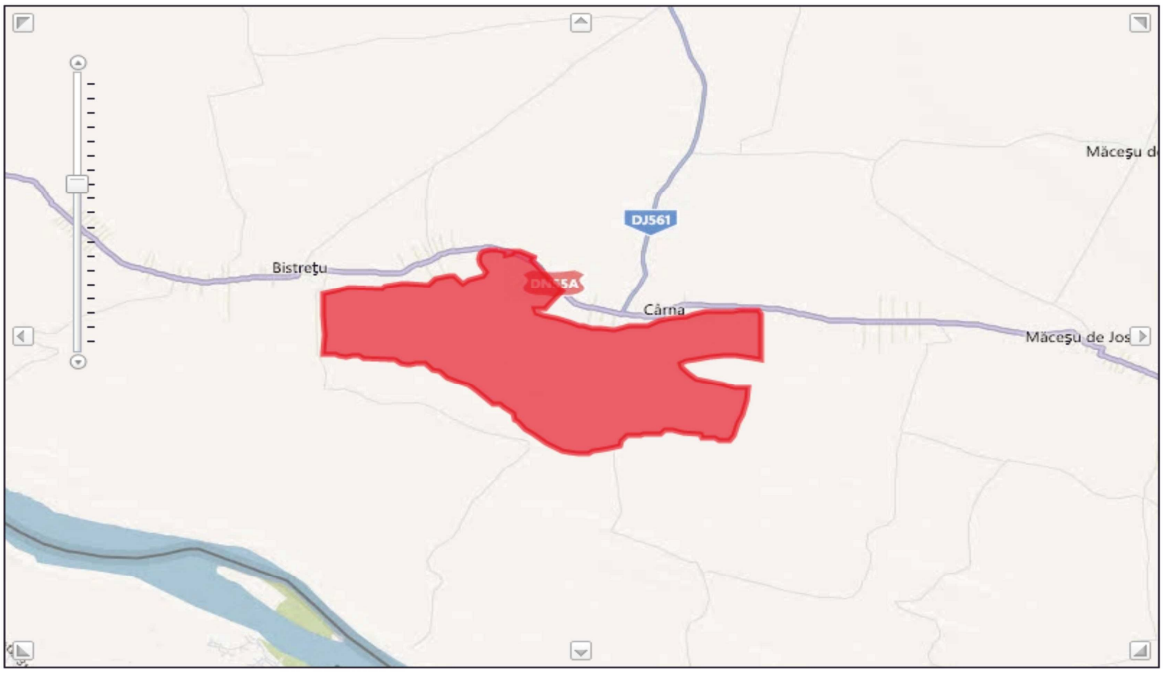


Fig. 5-3 Protected Area ROSPA0010 (*source:http://natura2000eea.europa.eu*)

Protected area ROSPA0023

Indicative denomination of the site: ROSPA0023 Jiu river –Danube river Confluences (Confluența Jiu – Dunăre) (21999.9ha) - Olt, Dolj Counties

Land coverage (type and percentage): rivers/lakes (17 %), crops/arable land (22 %), pastures (11 %), other arable fields (4 %), broadleaved forests (40 %), transition forests (6 %).

The species listed in Annex I of the Birds Directive, which could be affected adversely during the Decommissioning of KNPP Units 1 to 4, are:

1. Dalmatian Pelican *(Pelecanus crispus)* – globally endangered species with 3-59 migrant birds and global assessment mention B. The species inhabits the wetlands of Bistretsu where its hunting area is and where it stays for the night and rests next to the sand spits of the adjacent islands of Danube river. No significant adverse impact on the species is predicted.

2. Little Cormorant (*Phalacrocorax pygmeus)* – wintering and passerine species with 15 wintering and 1000 passing birds and global assessment mention A. No significant adverse impact on the species is predicted.

3. Eurasian Spoonbill (*Platalea leucorodia)* – nesting (34-41 couples) and passerine species (180-211 specimens.) with global assessment mention C. The species inhabits the wetlands of the Danube river valley. No significant adverse impact on the species is predicted.

4. White Stork (*Ciconia ciconia)* – nesting (20-30 couples) and passerine species with global assessment mention C. The species inhabits the wetlands of the Danube river valley. No significant adverse impact on the species is predicted.

In conclusion it can be summarized that the protected areas on both sides of Danube river are interconnected and form a complex ecological system which should be considered as a whole. The adverse impact on it due to the implementation of KNPP Units 1 to 4 decommissioning is assessed as insignificant.

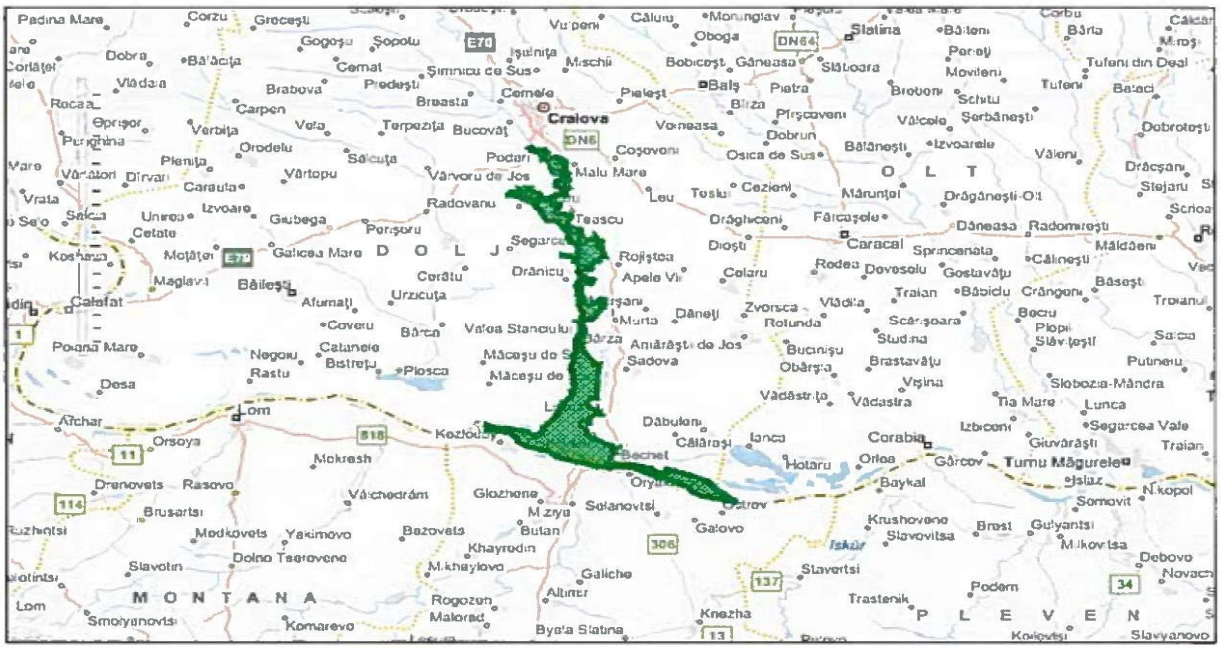


Fig. 5-4 Protected Area ROSPA0023 (*source: http://natura2000.eea.europa.eu*)

Detailed description of the protected territories and the protected areas in Romania is given in the IP Compatibility assessment report, presented as a separate document.

5.1 General description of the Romanian Protected Area ROSPA0010 (Bistret) under the Birds Directive

Type of Habitats	Coverage %
Inland water bodies (Standing water, Running water)	90.00
Bogs, Marshes, Water fringed vegetation, Fens	8.00
Improved grassland	2.00
Total	100 %

Other characteristics

Located in the south of the Oltenia region and of the Dolj County (at a distance of about 4 km from the Danube River), the protected area includes the fish-breeding complex Dunăreni-Bistreț having a surface of 2030 ha and the lagoon complex Bistreț-Cârna-Nasta-Nedela with a surface of 22,000 ha and very rich flora and fauna. The fish-breeding basins in Dunăreni-Bistreț are the result of the systematization works of the lagoon complex Bistreț-Cârna-Nasta-Nedela and are of special scientific interest from the ornithologic point of view, as they attract large avifaunistic diversity. Although they cannot fully replace the disappeared humid and aquatic natural ecosystems, these modified habitats still fulfill a number of favorable conditions especially for species of zoophagous aquatic birds in general and ichthyophagous birds in particular. The placement on an important migration route, the varied and considerable tropic offer as well as the decrease of natural aquatic ecosystems turn the fish-breeding basins in Dunăreni-Bistreț into important temporary or occasional resting places for the migratory and sedentary bird species dependent on the aquatic environment. The value of the fish-breeding basins as nesting places is moderate, so that they can only partially substitute the large marshes existing here before the changes due to fish-breeding activities. The scarceness of adequate nesting places is compensated by the richness of trophic resources leading to a maximal utilization of the existing green space (reed islands and willows on the lake, riverine vegetation) by means of storied nesting and nesting in mixed colonies.

Quality and importance

The site shelters a large number of bird species of the following categories:

a) Number of species in Annex 1 of the Bird Directive: 24

b) Number of other migratory species in the Annexes of the Convention on Migratory Species (Bonn convention): 72 species.

c) Number of globally threatened species: 7.

During the migration period, the site is important for all waterfowl species.

The place is important for wintering ducks and geese.

During the migration period, the place is inhabited by over 20,000 waterfowl; it is possible to apply for a place of international importance under the Ramsar Convention.

Vulnerability

Situated in the spill area of the Danube, the site is flooded whenever the flow rate of the Danube is very high. Fish-breeding and fishing activities carried out inside the site have a direct and indirect negative impact on the aquatic birds' populations of this area.

Conservation status

The site has not been designated as a protected area by national law.

Ownership

75 % private property and 25 % state property.

Site management

Site management organization:

There are no legally constituted site management structures.

Management plan:

There are no site management plans.

BIRDS listed on Annex I of Council directive 79/409/EEC – 23 species.

The bird species, subject to protection in PA Bistret, are presented in table 5.1-1.

Table 5.1-1 Bird species, subject to protection in PA Bistret

CODE	NAME	POPULATION				SITE ASSESSMENT			
		Resident	Migratory			Population	Conservation	Isolation	Global
			Breed	Winter	Stage				
A229	*Alcedo atthis*	12 p				D	C	C	C
A042	*Anser*			4 i	4 i	A	B	B	A
A209	*Ardea*		16 p			D	B	C	B
A024	*Ardeola*		50 p			D	B	C	B
A060	*Aythya*		25-34	75 i	15 i	C	B	C	B
A021	*Botaurus*		20 p			C	B	C	B
A396	*Branta*				20 i	D	B	C	B
A031	*Ciconia*		6 p		180	D	B	C	B
A030	*Ciconia*			1 i	48 i	D	B	C	B
A081	*Circus*		12-24	4 i		D	B	C	B
A082	*Circus*			1 i		D	B	C	B
A038	*Cygnus*				20 i	C	B	C	B
A027	*Egretta alba*		11 p	26 i		D	B	C	B
A072	*Egretta*		75 p			D	B	C	B
A131	*Him.*				78-	D	B	C	B
A022	*Ixobrychus*				20 i	D	B	C	B
A068	*Mergus*			3 i		C	B	C	B
A020	*Pelecanus*				31-	C	B	C	B
A019	*Pelecanus*				50-	C	B	C	B
A393	*Phal.*			15 i	100	C	A	C	A

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		POPULATION				SITE ASSESSMENT			
			Migratory			Population	Conservation	Isolation	Global
A034	*Platalea*		120-		400	D	B	C	B
A032	*Plegadis*		34-41		180	C	B	C	B
A132	*Recurvirostra*				44-	D	B	C	B

5.2 General Description of the Romanian Protected Area ROSPA0023 Confluența Jiu – Dunăre under the Birds Directive

General characteristics

Table 5.2-1 General Description of the Romanian Protected Area ROSPA0023 Confluența Jiu – Dunăre under the Birds Directive

Type of Habitats	Coverage %
Inland water bodies (Standing water, Running water)	17.00
Extensive cereal cultures (including Rotation cultures with regular fallowing)	22.00
Improved grassland	11.00
Other arable land	4.00
Broad-leaved deciduous woodland	40.00
Woodland habitats (general)	6.00
Total coverage	**100 %**

Other characteristics

The Jiu floodplain presents itself as a territory rich in habitats. Here there can be encountered riparian forests and copses, meadows, grasslands, agricultural areas, humid areas – marshes and canals and numerous anthropogenic habitats, all concentrated on this surface, in order that they mingle and may sometimes be difficult to delimit. Here, the presence of water bird species can be remarked, that found the appropriate living and reproduction conditions.

Quality and importance

This area hosts a significant number of protected bird species. According to the data we have the following categories:

a) Number of species in Annex 1 of the Bird Directive: 34.

b) Number of other migratory species in the Annexes of the Convention on Migratory Species (Bonn convention): 77.

c) Number of globally threatened species: 5.

During the migration period, the place is inhabited by over 20,000 waterfowl; it is possible to apply for a place of international importance under the Ramsar Convention.

Vulnerability

The extension of the anthropologically modified surfaces and the pollution of the watercourses have a negative impact on the bird species of this area.

Conservation status

The site has not been designated as a protected area by national law.

Ownership

Combined private and state properties.

Site management

Body responsible for the site management:

There are no legally constituted site management structures.

Site management and plans

There are no site management plans.

BIRDS listed on Annex I of Council directive 79/409/EEC – 32 species.

Bird species (32), subject to protection in PA ROSPA0023, are presented in table 5.2-2.

Table 5.2-2 Bird species in PA ROSPA0023

CODE	NAME	POPULATION				SITE ASSESSMENT			
		Resident	Migratory			Population	Conservation	Isolation	Global
			Breed	Winter	Stage				
A229	*Alcedo atthis*				6-8 i	D	C	C	C
A255	*Anthus*		10-			D	B	C	C
A089	*Aquila*		4-8 p			D	C	C	C
A209	*Ardea*				10-30	D	C	C	C
A021	*Botaurus*		2-4 p			D	B	C	B
A133	*Burhinus*		10-			D	C	C	C
A403	*Buteo rufinus*	2-4	2-4 p			C	B	C	B
A224	*Caprimulgus*		120-			D	C	C	C
A196	*Chlidonias*				200-	D	C	C	C
A197	*Chlidonias*				50-	D	C	C	C
A031	*Ciconia*		60-			D	C	C	C
A030	*Ciconia nigra*		20-			C	B	C	B
A081	*Circus*		6-10			D	C	C	C
A231	*Coracias*		46-			D	C	C	C
A122	*Crex crex*		100-			D	C	C	C
A238	*Dendrocopos*		100-			D	C	C	C
A429	*Dendrocopos*		90-			D	C	C	C
A027	*Egretta alba*				20-30	D	C	C	C
A072	*Egretta*				150-	D	C	C	C
A321	*Ficedula*		300-			D	C	C	C
A075	*Haliaeetus*		1-2 p			D	C	C	C
A131	*Himantopus*				20-30	D	C	C	C

		POPULATION				SITE ASSESSMENT			
			Migratory						
A022	*Ixobrychus*		12-			D	B	C	B
A177	*Larus minutus*				100-	D	C	C	C
A246	*Lullula*		RC			D	C	C	C
A073	*Milvus*		2-4 p			D	C	C	C
A020	*Pelecanus*				30-70	B	B	C	A
A393	*Phalacrocorax*			40-70		C	B	C	B
A034	*Platalea*				150-	D	C	C	C
A132	*Recurvirostra*				30-40	D	C	C	C
A193	*Sterna*				150-	D	C	C	C
A166	*Tringa*				1000-	D	C	C	C

5.3 General Description of the Romanian Protected Area with code ROPSCI0045 "Coridorul Jiului" under the Habitats Directive

General characteristics

PA ROSCI0045 "Coridorul Jiului" under Directive 92/43/EEC for the protection of natural habitats and of wild fauna and flora is type K. The Pa total area is 71394,0000 ha. It is located at an altitude between 6 and 332 m and is connected with two other PA under NATURA 2000 – ROSPA0010 and ROSPA0023 under the Birds Directive.

In terms of land cover classes, the territory of the protected area is sub-divided into the following groups:

Land cover classes Coverage	***%***
Water inland areas (not running and running waters)	12.0
Water inland areas (not running and running waters)	4.0
Swamps, marshlands, vegetation alongside the banks of water basins, bogs	11.0
Extensive grain crops (including rotation crops periodically let lie fallow)	14.00
Improved pastures (artificially created from grass mixtures)	15.00
Other lands	2.00
Broad-leaved deciduous forests	38.00
Forest habitats	4.00
Total coverage	***100***

The main purposes of the protected area are related to preserving the area of the natural habitats and the species habitats and their populations which are subject to protection within the boundaries of the protected area.

5.3.1 Types of vegetation and natural habitats which are subject to protection in the protected area

The following habitats and species are included in the standard form as subject to protection in the area:

TYPES OF HABITATS from Appendix I of Directive 92/43/EEC

3130 Oligotrophic to mesotrophic standing waters with vegetation of Littorelletea uniflorae and/or Isoeto-Nanfjuncetea

3270 Rivers with muddy banks with Chenopodion and Bedintion p.p.

6260 Pannonian sand steppes

6440 Alluvial meadows of the alliance Cnidion dubii in river valleys

6510 Lowland hay meadows

1530 * Panonian salty steppes and salty marshlands /

9130 Beech forests of the type Asperulo-Fagetum

9170 Oak-hornbeam forests of the type Galio Carpinetum

91E0 Alluvial forests with Alnus glutinosa Fraxinus excelsior (Alno-Padion, Alnion incanae Salicion albae)

9110 Beech forests of the type Luzulo-Fagetum

91M0 Balkan-Pannonian Quercus dalechampii forests

91Y0 Dacian oak and elm forests

92A0 Riparian galleries of Salix alba and Populus alba

91F0 Riparian mixed forests of Quercus robur, Ulmus laevis, or Fraxinus angustifolia along the big Pivers.

Note: The * symbol denotes a habitat type which is of priority importance as far as its protection is concerned.

The following assessments are given according to the adopted indicators of the habitats in the Standard Form:

3130 Oligotrophic to mesotrophic standing waters with vegetation of Littorelletea uniflorae and/or Isoeto-Nanfjuncetea. Here lowland pioneer communities of annual plants, growing on drying wet sediments in shallow edges of ponds and along the major rivers are formed. The representativeness of the habitat is assessed as good, in terms of relative area it is class C 2 >= p >0; the equated extent is “good protection” and the total assessment of the site is “good value”

3270 Rivers with muddy banks with Chenopodion and Bedintion p.p. Pioneer and ruderal communities are formed on muddy banks along the rivers. The plants usually grow in favorable conditions during the summer. The representativeness of the habitat is assessed as good, in terms of relative area it is class C 2 >= p >0; the equated extent is “good protection” and the total assessment of the site is “good value”.

6260 Pannonian sand steppes. Habitat occupies moving, alluvial sands, which develop terophytic communities and tufted perennial grasses and subshrubs. The representativeness of the habitat is assessed as good, in terms of relative area it is

class B 15 >= p > 2 %; the equated extent is "good protection" and the total assessment of the site is "good value".

6440 Alluvial meadows of the alliance Cnidion dubii in river valleys. Floodplain habitat along the rivers, which after the withdrawal of water during the summer period develops hygromesophytic communities with rich species composition. The representativeness of the habitat is assessed as good, in terms of relative area it is class B 15 >= p > 2 %; the equated extent is "good protection" and the total assessment of the site is "good value".

6510 Lowland hay meadows. Habitat is most often formed on rich alluvial meadow soils and earth, which develop plant communities dominated by grasses and rich grass variety. The representativeness of the habitat is assessed as good, in terms of relative area it is class C 2 >= p >0; the equated extent is "good protection" and the total assessment of the site is "good value".

1530 *Panonian salty steppes and salty marshlands. Habitat is formed in the peripheral parts of the marshes and river valleys. Salinisation is most often associated with spring floods and summer drought. Vegetation consists of annual and perennial typical and atypical halophytes. The representativeness of the habitat is assessed as good, in terms of relative area it is class B 15 >= p > 2 %; the equated extent is "good protection" and the total assessment of the site is "good value".

9130 Beech forests of the type Asperulo-Fagetum. Mesophytic beech forests growing on neutral or near neutral soils, characterized by a rich species composition. The representativeness of the habitat is assessed as good, in terms of relative area it is class C 2 >= p >0; the equated extent is "good protection" and the total assessment of the site is "good value".

9170 Oak-hornbeam forests of the type Galio Carpinetum. Mixed mesophytic forests dominated by Quercus petraea agg. and Carpinus betulus. The representativeness of the habitat is assessed as good, in terms of relative area it is class C 2 >= p >0; the equated extent is "good protection" and the total assessment of the site is "good value".

91E0 Alluvial forests with Alnus glutinosa Fraxinus excelsior (Alno-Padion, Alnion incanae Salicion albae). Riparian forests growing of rich alluvial soils, periodic flooded. The representativeness of the habitat is assessed as excellent, in terms of relative area it is class B 15 >= p > 2 %; the equated extent is "good protection" and the total assessment of the site is "good value".

9110 Beech forests of the type Luzulo-Fagetum. Beech forests growing on poorer acidic, dry to fresh soils. Characterized by poorer species composition and significant participation of mosses. The representativeness of the habitat is assessed as excellent, in terms of relative area it is class B 15 >= p > 2 %; the equated extent is "good protection" and the total assessment of the site is "excellent value".

91M0 Balkan-Pannonian Quercus dalechampii forests. Xerothermic oak forests dominated by Quercus ceris, Quercus frainetto and Quercus petraea agg. The representativeness of the habitat is assessed as excellent, in terms of relative area it is

class B 15 >= p > 2 %; the equated extent is "good protection" and the total assessment of the site is "good value".

91Y0 Dacian oak and elm forests. The representativeness of the habitat is assessed as excellent, in terms of relative area it is class C 2 >= p >0; the equated extent is "good protection" and the total assessment of the site is "good value".

92A0 Riparian galleries of Salix alba and Populus alba. Waterlogged habitats of riparian forest communities dominated by willows and poplars. The representativeness of the habitat is assessed as excellent, in terms of relative area it is class B 15 >= p > 2 %; the equated extent is "good protection" and the total assessment of the site is "good value".

91F0 Riparian mixed forests of Quercus robur, Ulmus laevis, or Fraxinus angustifolia along the big rivers. Periodically flooded mixed deciduous forests. The representativeness of the habitat is assessed as excellent, in terms of relative area it is class B 15 >= p > 2 %; the equated extent is "good protection" and the total assessment of the site is "good value".
Plant species from Annex II of Directive 92/43/EEC are not included in the PA Standard Form as subject to protection. Plant species from the group "Other significant plant and animal species" related to the protection and management of the object, are not included either.

5.3.2 Animal species subject to conservation

Invertebrates (*Invertebrata*)

Arthropod (*Arthropoda*)

Insects (*Insecta*)

Dragonflys (*Odonata*)

1042 Large White-faced Darter –*Leucorrhinia pectoralis*
1045 Coenagrion ornatum –*Coenagrion ornatum*
1044 Coenagrion mercuriale
This species is wrongly classified for Bulgaria and is eliminated from the lists of protected species. Probably it is the same for the Romanian fauna species, taken into account the spreading area of the species.

Beetles (*Coleoptera*)

1013 Carabus hungaricus

Vertebrates (*Vertebrata*)

Damselfishes - Pisces/Osteichthyes

2491 Danube (*Alosa immaculate - A. pontica*)

This species is transitory and enters into its reproduction stage during the month of May, moves together in big schools in the upper water strata. In the past it was a species of economic value and was subject to massive fishing, because of which the current status of the species does not allow its use for economic purposes. The regulations for the fishing of this fish take into account its breeding period and the

quantities fished are relatively small and for satisfying household needs and in small quantities for the market in the towns on the Danube river. During the last 10 years this species demonstrates a trend towards stabilization of its stock, a conclusion drawn by us based on the relatively constant catches after the end of the fishing ban.

1130 Cyprinidae -*Aspius aspius*

According to the Standard form, this is rare species, of low density but in good conservation status. Based on our data obtained through studying the catch of 42fishermen, in the region of Kozloduy Islands, we found constant catches of specimens of various ages of the Cyprinidae species, which are evidence of the relatively stable conservation status of this species. This predator is easy to spot even by eyesight when observing the shoreline area of the river during sunset. Chasing its prey, this predator is shearing the water surface with its pectoral fin.

1124 Whitefin gudgeon – *Gobio albipinnatus*

In the Standard form, this species is said to be frequently encountered and in good populational and good conservation status.

2522 Ziege – *Pelecus cultratus*

This is an extremely rare species for the Danube river. From its status of an economically significant species, its density has fallen to the brink of survival. According to the Standard form, this species is frequently encountered but the source of the information is unclear.

1134 Fish linn – *Rhodeus sericeus amarus*

It is encountered on a massive scale in all the appropriate water basins. The species co-habitates with the fresh water shells, in which it lays its eggs.

1149 Spined loach – *Cobitis taenia*

It is not encountered in Bulgaria, It is found in the North. In Bulgaria and along the Danube river, the species C. elongatoides is encountered (Bacesku & Maier, 1969). The data is from Kottelat, M. & J. Freyhof (2007).

2555 Balon's ruffle – *Gymnocephalus baloni*

1157 Stripped ruffle – *Gymnocephalus scraetzer*

These two species are described in the Standard form as frequently occurring and in stable environmental conservation status. Both are deep-water species and inhabit the bottoms covered with coarse gravel.

1159 Zingel zingel – *Zingel zingel and* 1160 Zingel streber – *Zingel streber*

Both these species are reported in the Standard form to be rare but in excellent environmental conservation status. These cold-loving species are active during the winter months and in early spring, when they reproduce. During the rest of the year, they hide in the deep river pools and their identification is difficult and infrequent.

1146 Golden spinned loach - *Sabanejewia aurata balcanica*

1145 Eurasian Weather Loach –*Misgurnus fossilis*

Amphibians (*Amphibia*)

1188 Fire-bellied toad – *Bombina bombina*

The information from the Standard form about this species is that its density has not been determined. The species is frequently encountered in the shoreline area of the river, where the Fire-bellied toad can be scientifically proven from a distance by its melodious sound signals. The species is especially frequently occurring in the island's territories, where small and shallow swamps are formed and preserved over the entire year.

Reptiles (*Reptilia*)

1220 European pond turtle – *Emys orbicularis*
A typical species for the river and the island territories. Isolated specimens are caught in fishing nets during winters, where they die. Very frequently specimens of this species are killed for no obvious reason because of erroneous perceptions about the primary food of the species.

Mammals (*Mammalia*)

1355 European Otter –*Lutra lutra*
According to the Standard Form, the territory of the protected area is inhabited by undefined number of specimens. No specific methodology for identification has been described, but over such a big and rich in food area a higher density should be expected. The data on this species is scarce and incidental for this specific region but the studies in other regions of the country have shown an increase in the density of the species.

1335 European Ground Squirrel - *Spermophilus citellus*
This rodent living in colonies inhabits pastures or grassy embankments and avoids wetlands. The colonies are located on well shine on mainly hilly terrains with southern or eastern aspect. The species is currently relatively rare because of changes in the mode of cultivation of pasture cattle because of the intensive and chemical introducing agricultural. For the Romanian PA it is designated as common species.

Quality and importance
The PA territory belongs to the priority areas for conservation of the continental biodiversity and has great significance. Although it covers only 0.5 % of the national forest area in Romania and 0.6 % of natural areas, it includes: natural forest habitats protected by Romanian and European legislation (9 of 28 types); forest formations (22 of 50); forest types identified in the country (97 of 306). Jiu Valley is one of the Trans-Balkan corridors for migrating birds (Bulgarian Central-European path), followed by a significant number of birds. Together with the resident birds, 135 of 406 bird species in Romania are identified in the Jiu corridor, 114 of which are protected by the Romanian and European legislation.

Vulnerability

The location within three counties and near Craiova city provides a reasonable Plan for territory development (PTD), based on which the General development plan (GDP) of the near settlements can be updated every ten years. Once updated, the GDP allows the development of a Regional development plan (RDP) resulting in a Detailed development plan (DDT). DDT development aims to harmonize all current and future interests to this diverse territory, in which the proportion of forest fund (34 %) and forests (33 %) cannot be reduced, as well as other categories of land containing natural areas protected by EU and Romanian legislation. Thus, pollution, urbanization, agricultural activities and other destructive effects of human intervention in the environment can be reconciled with the essential requirements and activities for sustainable development and biodiversity conservation carried out by man.

6. Assessment of the possible impacts from the decommissioning of KNPP Units 1-4 on the Protected Areas

The assessment of the probability and extent of the impact of the investment proposal on the subject and objectives in the examined protected areas is based on comparative analysis, on the forecasted changes and on the expert assessment of their impact on the existing biological diversity in certain parts of their territory.

6.1 Description and analysis of the impact of the investment proposal on the Romanian Protected Area with code ROSPA0010 under the Birds directive

The description and analysis of the impact of the investment proposal on the types of natural habitats and species that are subject to protection has been performed sequentially and separately as follows:

On the habitats subject to protection

In the Standard Form for the protected area, there are no habitats types subject to protection included in it.

On the bird species subject to protection

The territories, in which an adverse impact from the implementation of the Investment Proposal on the bird species subject to protection in the protected area can be expected, can be divided into two regions:

A. Region of the Kozloduy NPP site and the areas between it and the protected area. On the very site of Units 1 to 4 of Kozloduy NPP no bird species are identified, which are subject to protection in the protected area. Exception is Long-legged Buzzard (*Buteo rufinus*) that does not nest on the Kozloduy NPP site but only passes in flight over it in search of food in the neighboring terrains.

Based on this information it can be concluded that there will be no considerable adverse impact on the bird species subject to protection in the protected area.

B. Protected area region, the Eastern part of which lies in the 12-km controlled area of Kozloduy NPP

The species subject to protection in PA Bistret are 23. The determination of the negative impact on them is performed in two steps. In the first step, the adverse impact is assessed qualitatively only (not expected-expected) - table 6.1-1.

Table 6.1-1 Expected adverse impact on the bird species subject to protection under Item 3 in the protected area ROSPA0010 as a result of the implementation of the Investment Proposal

No	Species	comprehensive assessment	Extent of the adverse impact	
			Not expected, because:	Expected:
1.	*Alcedo atthis*	C	**2**	
2.	*Anser erythropus*	A		+

No	Species	comprehensive assessment	Extent of the adverse impact	
			Not expected, because:	Expected:
3.	*Ardea purpurea*	B	**1**	
4.	*Ardeola ralloides*	B	**1**	
5.	*Aythya nyroca*	B	**2**	
6.	*Botaurus stellaris*	B	**2**	
7.	*Branta ruficollis*	B		+
8.	*Ciconia ciconia*	B		+
9.	*Ciconia nigra*	B	**2**	
10.	*Circus aeruginosus*	B	**2**	
11.	*Circus cyaneus*	B	**1**	
12.	*Cygnus cygnus*	B	**2**	
13.	*Egretta alba*	B	**2**	
14.	*Egretta garzetta*	B	**2**	
15.	*Him. himantopus*	B	**2**	
16.	*Ixobrychus minutus*	B	**2**	
17.	*Mergus albellus*	B	**2**	
18.	*Pelecanus crispus*	B		+
19.	*Pelecanus*	B		+
20.	*Phalacrocorax*	A		+
21.	*Platalea leucorodia*	B	**2**	
22.	*Plegadis falcinellus*	B	**2**	
23.	*Recurvirostra*	B	**2**	
Total			**30**	**6**

The designations in the “Not expected, because:” column:

1. The species **does not occur** in the habitats, which are part of the terrain of the Investment Proposal or in the immediate proximity, over the entire year or over a specific season.

2. The species may occur in the habitats, which are part of the terrain of the Investment Proposal or in the immediate proximity, but this happens irregularly, on an infrequent basis, accidentally and/or is denoted in the Standard Form for the protected area with a total assessment of “D”.

3. The species may occur regularly over the entire year or over a specific season in the habitats from the terrain of the Investment Proposal but does not use these habitats because of the proximity of an asphalt-paved road, a populated settlement or another reason.

4. The species only flies over the terrain of the Investment Proposal on a regular basis during feeding or migration.

5. The species is synanthropic or insensitive to anthropogenic impacts arising from the implementation of the Investment Proposal.

The quantitative assessment of the adverse impact from the implementation of the Investment Proposal on the six bird species indicated above is performed separately for each specific species as follows:

1. Little white-fronted goose (*Anser erythropus*) – this is a rare wintering species in Bulgaria. According to the standard form there is data about 4 wintering birds in the PA Bistrets with comprehensive assessment A. Although the Kozloduy NPP site is located 3 km to the east of the spending-the-night location (the marshlands at Bistretsu in Romania and the sand spits on the islands) and the feeding locations (Zlatiata), there is a rare possibility of small herds or single birds to fly over Kozloduy. No adverse impact is expected.

2. *Branta ruficollis* – regular wintering species in the protected area. According to the standard form there is data about 20 passing birds in the PA Bistrets during migration with comprehensive assessment B. The main direction of migration over PA "Zlatiata" is a northwest-southeast. There is a rare possibility of small herds or single birds to fly over Kozloduy. No adverse impact is expected.

3. White stork (*Ciconia ciconia*) – a common nesting species nesting in the villages around the PA. According to the standard form there is data about 6 nesting couples and 180 birds during migration with comprehensive assessment B. The main migratory direction is northwest-southeast. Small flocks or single birds may fly over the Kozloduy NPP site on infrequent basis only, because of which no adverse impact is expected.

4. *Pelecanus onocrotalus* – nesting, overflowing and passing species. According to the standard form there is data about 50-150 birds during migration with comprehensive assessment B. Small flocks or single birds may fly over the Kozloduy NPP site on infrequent basis only, because of which no adverse impact is expected.

5. Dalmatian Pelican *(Pelecanus crispus)* – constantly world endangered species. According to the standard form there is data about 31-59 birds during migration with comprehensive assessment B. During its migration it reaches considerable concentrations (between 150 and 252 specimens) in Protected Area “Island near Gorni Tsibur” Code: BG0002008. It hunts in the neighbouring Romanian marshlands and stays for the night and rests next to the sand spits of the adjacent islands. Representatives of this species may fly over the Kozloduy NPP site on infrequent basis only, because of which no adverse impact is expected.

6. *Phalacrocorax pygmeus* – constantly world endangered species. According to the standard form there is data about 153 passing and 1000 wintering birds with comprehensive assessment A. It reaches concentrations in Protected Area “Island near Gorni Tsibur” Code: BG0002008. It hunts in the neighbouring Romanian marshlands and stays for the night and rests next to the sand spits of the adjacent islands. Representatives of this species may fly over the Kozloduy NPP site on infrequent basis only, because of which no adverse impact is expected.

The Otis tarda species is also reviewed. Although it is not included in the standard form of PA Bistrets, it is included in the standard form of PA Zlatiata as a nesting species without constant nesting area. No adverse impact is expected, since this species is rarely expected to be seen at the KNPP site.

Because of all of the above, it can be said that the implementation of the Investment Proposal will not exert adverse impact on the bird species subject to protection in PA Bistrets under the Birds Directive.

Fragmentation

Since KNPP site is located 1 km north-east from the PA, no fragmentation of the territory of the protected area as a result of the implementation of the Investment Proposal is expected.

Disruption of the species composition

Not expected.

Chemical changes

Not expected.

Hydrological changes

Not expected.

Geological changes

Not expected.

Other changes

Not expected.

6.2 Description and analysis of the impact of the investment proposal on the Romanian Protected Area Confluența Jiu – Dunăre with code ROSPA00023 under the Birds directive

The description and analysis of the impact of the Investment Proposal on the types of natural habitats and species that are subject to protection has been performed sequentially and separately as follows:

On the habitats subject to protection

In the Standard Form for the protected area, there are no habitats types subject to protection included in it.

On the bird species subject to protection

The territories, in which an adverse impact from the implementation of the Investment Proposal on the bird species subject to protection in the protected area can be expected, can be divided into two regions:

A. Region of the Kozloduy NPP site and the areas between it and the protected area. On the very site of Units 1 to 4 of Kozloduy NPP no bird species are identified, which are subject to protection in the protected area. Exception is Long-legged Buzzard (Buteo rufinus), which does not nest on the Kozloduy NPP site but only passes in flight over it in search of food in the neighboring terrains.

Based on this information it can be concluded that there will be no considerable adverse impact on the bird species subject to protection in the protected area.

B. Protected area region, the southern part of which lies in the 12-km controlled area of Kozloduy NPP

The species subject to protection in the PA are 32. The determination of the negative impact on them is performed in two steps. In the first step, the adverse impact is assessed qualitatively only (not expected-expected) - table 6.2-1.

Table 6.2-1 Expected adverse impact on the bird species subject to protection under Item 3 in the Protected Area Confluența Jiu – Dunăre with code ROSPA00023 as a result of the implementation of the Investment Proposal

No	Species	Comprehensive assessment	Extent of the adverse impact	
			Not expected, because:	Expected:
1.	*Alcedo atthis*	C		+
2.	*Anthus campestris*	C	**2**	
3.	*Aquila pomarina*	C		+
4.	*Ardea purpurea*	C	**2**	
5.	*Botaurus stellaris*	B	**2**	
6.	*Burhinus*	C	**2**	
7.	*Buteo rufinus*	B		+
8.	*Caprimulgus*	C	**1**	
9.	*Chlidonias hybridus*	C	**2**	
10.	*Chlidonias niger*	C	**2**	
11.	*Ciconia ciconia*	C		+
12.	*Ciconia nigra*	B	**2**	
13.	*Circus aeruginosus*	C	**2**	
14.	*Coracias garrulus*	C	**2**	
15.	*Crex crex*	C	**1**	
16.	*Dendrocopos medius*	C	**1**	
17.	*Dendrocopos*	C	**1**	
18.	*Egretta alba*	C	**2**	
19.	*Egretta garzetta*	C	**2**	
20.	*Ficedula albicollis*	C	**1**	
21.	*Haliaeetus albicilla*	C		+
22.	*Himantopus*	C	**2**	
23.	*Ixobrychus minutus*	B	**2**	
24.	*Larus minutus*	C	**2**	
25.	*Lullula arborea*	C	**1**	
26.	*Milvus migrans*	C	**2**	
27.	*Pelecanus crispus*	A		+
28.	*Phalacrocorax*	B		+
29.	*Platalea leucorodia*	C	**2**	
30.	*Recurvirostra*	C	**2**	
31.	*Sterna hirundo*	C	**2**	
32.	*Tringa glareola*	C	**2**	
Total			**27**	**7**

The designations in the "Not expected, because:" column:

1. The species **does not occur** in the habitats, which are part of the terrain of the Investment Proposal or in the immediate proximity, over the entire year or over a specific season.

2. The species may occur in the habitats, which are part of the terrain of the Investment Proposal or in the immediate proximity, but this happens irregularly, on an infrequent basis, accidentally and/or is denoted in the Standard Form for the protected area with a total assessment of "D".

3. The species may occur regularly over the entire year or over a specific season in the habitats from the terrain of the Investment Proposal but does not use these habitats because of the proximity of an asphalt-paved road, a populated settlement or another reason.

4. The species only flies over the terrain of the Investment Proposal on a regular basis during feeding or migration.

5. The species is synanthropic or insensitive to anthropogenic impacts arising from the implementation of the Investment Proposal.

The quantitative assessment of the adverse impact from the implementation of the Investment Proposal on the seven bird species showed above is performed separately for each specific species as follows:

1. *Alcedo atthis* – permanent species. According to the standard form there is data about 6-8 birds during migration with comprehensive assessment C. Single birds may visit the KNPP area and mainly the discharge channel, but negative impact is not expected.

2. *Aquila pomarina* – nesting, overflowing and passing species. According to the standard form there is data about 4-8 nesting couples with comprehensive assessment C. The main migratory direction is northwest-southeast. Small flocks or single birds may fly over the Kozloduy NPP site on infrequent basis only, because of which no adverse impact is expected.

3. Long-legged Buzzard (*Buteo rufinus*) – nesting, overflowing and passing species. According to the standard form there is data about 2-4 nesting couples with comprehensive assessment B. Single birds may fly over the Kozloduy NPP site on infrequent basis only, because of which no adverse impact is expected.

4. White stork (*Ciconia ciconia*) – a common nesting species nesting in the villages around the PA. According to the standard form there is data about 60-80 nesting couples comprehensive assessment C. The main migratory direction is northwest-southeast. Small flocks or single birds may fly over the Kozloduy NPP site on infrequent basis only, because of which no adverse impact is expected.

5. *Haliaeetus albicilla* – nesting, overflowing and passing species. According to the standard form there is data about 1-2 nesting couples comprehensive assessment C. single birds may fly over the Kozloduy NPP site on infrequent basis only, because of which no adverse impact is expected.

6. Dalmatian Pelican (*Pelecanus crispus*) – constantly world endangered species. According to the standard form there is data about 30-70 birds during migration with comprehensive assessment A. During its migration it reaches considerable concentrations (between 150 and 252 specimens) in Protected Area "Island near Gorni Tsibur" Code: BG0002008. It hunts in the neighbouring Romanian marshlands and stays for the night and rests next to the sand spits of the adjacent islands. Representatives of this species may fly over the Kozloduy NPP site on infrequent basis only, because of which no adverse impact is expected.

7. *Phalacrocorax pygmeus*- constantly world endangered species. According to the standard form there is data about 40-70 wintering birds with comprehensive assessment B. It reaches concentrations in Protected Area "Island near Gorni Tsibur" Code: BG0002008. It hunts in the neighbouring Romanian marshlands and stays for the night and rests next to the sand spits of the adjacent islands. Representatives of this species may fly over the Kozloduy NPP site on infrequent basis only, because of which no adverse impact is expected.

The Otis tarda species is also reviewed. Although it is not included in the standard form of PA Bistrets, it is included in the standard form of PA Zlatiata as a nesting species without constant nesting area. No adverse impact is expected, since this species is rarely expected to be seen at the KNPP site.

Because of all of the above, it can be said that the implementation of the Investment Proposal will not exert adverse impact on the bird species subject to protection in PA Confluența Jiu – Dunăre with code ROSPA00023 under the Birds Directive.

Fragmentation

Since KNPP site is located 1 km north-east from the PA, no fragmentation of the territory of the protected area as a result of the implementation of the Investment Proposal is expected.

Disruption of the species composition

Not expected.

Chemical changes

Not expected.

Hydrological changes

Not expected.

Geological changes

Not expected.

Other changes

Not expected.

6.3 Description and analysis of the impact of the investment proposal on the Romanian Protected Area Coridorul Jiului with code ROSCI0045 under the Habitats directive

The assessment of the extent of trans-border impact of the investment proposal for decommissioning of of KNPP Units 1-4 and in cases of accidents and incidents during the IP implementation is based on an assessment of the impact on each of the criteria for Favorable Environmental Protection Status – population in the area, area of the habitats in the area (where there are specific habitats of smaller areas but important in significance, they are taken into account separately), quality of the habitats (structural and functional parameters), future perspectives (other important parameters). Account is taken separately of other structural and functional parameters, such as the overall functional role of the area for the connectedness of the network – bio-corridor function, geographical connectedness.

A 10-grade assessment scale is used for determining the extent of the impact, and this scale makes it possible to take into account the various parameters of the significance of a given impact in respect of the standard indicators for assessment of the extent of the impact.

Impacts on vegetation and habitat types in PA Coridorul Jiului with code ROSCI0045

There is no information of specific observations conducted on the radioecological status of vegetation and habitats in PA Coridorul Jiului with code ROSCI0045 in relation with the KNPP impact assessment.

The EIAR results from the performed monitoring of the environmental components in the KNPP 30-km area on the territory of Romania lead to the conclusion that significant change in the radioecological status in Romania as result of the plant has not been found.

The assessment of the degree of impact of the investment proposal on the protected area is formed based on indicators: direct destruction of parts of habitats; impact on the boundary zones of the habitats; fragmentation (segmentation of habitats) upon PMF construction, operation and decommissioning combined with pollution with harmful substances from decommissioning of Units 1-4 of Kozloduy NPP, and in cases of accidents and incidents during the implementation of the investment proposal.

The assessments are presented in a table format, where, for the sake of simplicity, we have not included the parameters for Favorable Conservation Status (FCS), about which it is assumed that they have no bearing on the expected impacts. The assessment from the table serves for identification of the extent of impact.

Table 6.3-1 Impacts on habitats 3130, 3270, 6260, 6440, 6510, 1530, 9130, 9170, 91E0, 9110, 91M0, 91Y0, 92A0, 91F0

Parameters Impacts	Total area	Species composition	Invasive species
Direct destruction of the habitat	The implementation of the investment proposal is not	There is no likely impact	There is no likely impact

Parameters Impacts	Total area	Species composition	Invasive species
	expected to cause any direct destruction of habitats		
Boundaries (ecoton) of the habitat	There is no likely impact on territories adjacent to the habitat	There is no likely impact	There is no likely impact
Fragmentation	There is no likely impact	There is no likely impact	There is no likely impact
Fire hazard	There is no likely impact from the construction and operation of the facilities.	There is no likely impact	There is no likely impact
Hazard of accidental pollutions from accidents	There is very little likely impact.	There is very little likely impact.	There is very little likely impact.

Based on estimated impacts upon the habitats subject to protection in the PA, the impact of the investment proposal is assessed as low in degrees (1-3), and it can be avoided without any special measures, other than the best practices for decommissioning of Units 1-4 of Kozloduy NPP, and in cases of accidents and incidents during the implementation of the investment proposal.

The complex analysis of the potential impact of the Investment Proposal allows to conclude that the implementation of the IP will not have a negative impact on the vegetation and habitats in PA Coridorul Jiului with code ROSCI0045.

Loss of habitats and individuals

Destruction of parts of natural habitats 3130, 3270, 6260, 6440, 6510, 1530, 9130, 9170, 91E0, 9110, 91M0, 91Y0, 92A0, 91F0 is not expected.

Fragmentation

Not expected.

Disruption of the species composition

Not expected.

Chemical changes

Not expected.

Hydrological changes

Not expected.

Geological changes

Not expected.

Other changes

Not expected, unless in cases of accidents and incidents.

On animal species

The possible negative impacts can be grouped in two main areas according to the different animal habitats. Subject to protection are typical hydrobionts – fish, larvae of dragonflies, amphibians species – red-bottom toad, common pond turtle, otter, as well as typical terrestrial species such as the Hungarian level runner and Souslik.

The separate elements subject to treatment by the IP vary in nature, course of action and duration. The possible radioactive contamination resulting from accidents or errors in the mechanisms of decontamination and conservation of radioactive materials (RAM) have the greatest possible impact on the animal species. Regardless of the programs developed for the precise and safe decommissioning of the Units, safety alternatives in cases of emergency situations must be developed as well. The consequences of such pollution are unpredictable for the fauna as a whole. Given the characteristics of the river ecosystems damage can be carried and transmitted over long distances. Genetic modifications due to the increased radioactive background can have disastrous consequences. This impact is paramount in importance and duration. Other impacts that may arise during the implementation of IP are associated with contamination of the environment with various organic hazardous substances. Especially dangerous are the soluble chemicals when entering water. In these cases there may be impacts over large distances along the rivers and entering of these substances in closed basins or low flow basins.

Indirect impacts of the possible implementation of the IP will be of secondary importance and in some cases may be neglected, given their insignificance.

The increased motor traffic can be estimated as negligible. Noise, light pollution and exhaust fumes from fuels are impacts accompanying the implementation of any IP, and they can be neglected in this case.

It can be concluded that in case of possible IP implementation **great attention should be paid to the protection of the animal species and habitats from radioactive contamination and the discharge of fuels and other hazardous substances**. Especially dangerous are the soluble chemicals when entering water, since they can affect many animal species and habitats.

In case of force majeure a program for taking immediate measures regarding the protection of animal species must be pre-developed. Natural disasters - earthquakes, high water wave as well as a possible terrorist act are included in this category. The last possible impacts are subject to a separate action plan in case of emergency and for each type of impact there must be concrete actions leading to a reduction or complete prevention of possible damage to the species subject to conservation in PA. This document will not consider force majeure situations, which are subject to settlement by other regulations.

The above possible actions are valid for normal proceeding of the IP.

Loss of habitats and individuals

Destruction of habitats for species subject to conservation in the PA is not expected. The mouth of the River Jiu is situated above the NPP, and there are two islands that

are a major barrier for most potential impacts that may arise in connection with any course of the Danube.

Fragmentation

Not expected.

Disruption of the species composition

Not expected.

Chemical changes

Not expected.

Hydrological changes

Not expected.

Geological changes

Not expected.

Other changes

Not expected, unless in cases of accidents and incidents.

General conclusion for the protected areas on the Romanian coast of the Danube River in the KNPP area

The following areas from NATURA2000, protected under the EU Directive on the conservation of natural habitats and of wild fauna and flora, are situated on the Romanian coast of the Danube river in the KNPP area:

- ROSPA0010 Bistreț (Birds Directive)
- ROSPA0023 Confluența Jiu – Dunăre (Birds Directive)
- ROSCI0045 Coridorul Jiului (Habitats Directive).

On the basis of all present of the above, a conclusion can be drawn that subject to strict adherence to the adopted technology for decommissioning of KNPP Units 1-4 and subject to strict compliance with the already existing mitigating measures envisaged for prevention, reduction or termination of the harmful impact on the environment, the implementation of the Investment Proposal will not have significant adverse impact on Romanian Protected Area ROSPA0010 Bistret River under the Birds Directive, as well as on Protected Areas ROSPA0023 Jiu River-Danube River Confluence under the Birds Directive and Protected Areas ROSCI0045 Corridor of Jiu River under the Habitats Directive.

These PA are described in Chapter 3 (detailed description and analysis of elements of the environment) from EIAR for the Investment Proposal.

These PA are also described in section 4 of the Integrated compatibility assessment of the Investment Proposal with protected areas NATURA 2000 network. In section 5 from the same document the extent of the negative impact on the subjects and objects of protection in them has been assessed.

It is not known whether the use of the Bulgarian Ordinance on assessment of compliance is applicable in assessment of Romanian protected areas. In the EC document on Article 6 regarding the protected areas from NATURA 2000 it is stated that "... In some cases the assessment according to Directive 85/337/EEC (according to the changes with 97/11/EC) can reconcile the assessment under Article 6 (3)...".

The official approach based on the "Multilateral Agreement of the countries of Southeastern Europe for the implementation of the Convention on EIA in a Trans-boundary Context", Article 6, § 1, has not been implemented to this moment. No joint working group has been formed between the country of origin and the affected country for determining the detailed rules for communication and consultation. Therefore, the only possible way for assessment was to include it in the EIAR and CAR.

7. Assessment of health status of the population in 30-km zone around Kozloduy NPP on the territory of Romania

The assessment is performed based on the presented data from Romania.

A. Population in the 30-km zone of the Kozloduy NPP living on the territory of Romania

According to the data provided by experts from Romania 75150 people live in 19 settlements within the Romanian part of the 30-km area. For 4 settlements within this area no data was submitted for their population. However, considering the average population of villages in this part of the country, probably the total number of population is about 80 thousand people (table 7-1).

Table 7-1 Number of the population in the 30-km zone of the Kozloduy NPP living on the territory of Romania

Settlement	Population (number of people)
v. Ostroveni	5255
v. Gighera	3208
v. Valea Stanciului	5736
v. Călăraşi	6282
t. Bechet	3917
t. Dăbuleni	12819
v. Piscu Vechi	2713
v. Sadova	8489
V .Gângiova	2630
t. Măceşu de Jos	1433
t. Măceşu de Sus	1427
t. Bistreț	4336
v.Goicea	2774
v. Bârca	4024
v. Vela	2033
v. Nedeia	1380
v. Sarata	2139
v. Listeava	1612
v. Horezu Poenari	2943

B. Health status of the population within 30-km zone of Kozloduy NPP in Romania

The 30-km zone from the Romanian coast of the Danube includes 19 locations.

Currently, the occupied population is around 110000 people and is distributed mainly in the following economic activities:

- 38 % are employed in industrial production;
- 15 % are employed in trade and services;
- 10 % are employed in the transport system;

- 8 % in education;
- 5.7 % work in the healthcare system.

In this distribution no evidence of involvement in an environment of ionizing radiation can be found.

The Ministry of Health, through the Radiation Laboratory of Hygiene and the regional health center in Bucharest in cooperation with local institutions, carried out systematic monitoring of the health status for the period 1999 – 2010.

Data on the monitoring carried out on 78323 people residing within the 30-km zone of observation shows:

1. The distribution of population by age shows that the percentage of population over 60 years is much higher than the average data for the country.

2. In all the years of the observation period, mortality of the population in the surveillance zone is lower than the mortality data for the entire Romanian population.

3. Data related to illnesses from ionizing radiation shows:

- Throughout the period the solid cancer mortality in the surveillance zone is lower than the average data for the country.
- The occurrence of illnesses of solid cancers in the surveillance zone is also lower compared with the data for the whole country.
- Mortality from leukemia and lymphoma in the surveillance zone is rising after 2008. However, there are no available data on the dynamics of this indicator in relation to the entire population of the country.
- The frequency of illnesses of all types of leukemias and lymphomas, throughout the entire 12-year observation period, in terms of population in the area show a gradual increase. Since 2007, this increase is significant. When comparing this frequency with the frequency in four regions around nuclear plants, the highest frequency of solid cancer and lymphomas are found in the area near Kozloduy. However, these values do not exceed those established in respect of the entire population of Romania.

The results of the dynamics of total mortality rate and the mortality rate and the frequency of solid cancers in the surveillance zone are lower than the average data for the country. The increase in mortality and incidence of leukemias and lymphomas in recent years among the observed population can be associated with the large percentage of people over 60 years. This is confirmed by data from the ten-year radiological monitoring of atmospheric and deposited on the surface water aerosols of the gamma background (performed in SSMR four points - Turnu Severin, Beckett, and Craiova Zimnitsa), which show values much lower than the norms. Fig. 7-1 shows the total mortality rate for Beckett County and for the country.

The population in the monitored area includes 78323 people living in settlements within the 30-km KNPP area, and these settlements fall within the Dolj County.

The age distribution of the population shows aging, and the percentage of the people older than 60 years of age is much bigger than that for the main Romanian population. The systematic review of the health status of the population begins in 1999. The

results from the 12-year monitoring of the health status of the population are presented in the table below.

Table 7-2 Population health status in Romania

Year	Population	General mortality ‰	Solid cancer mortality o/oooo	Leukemia mortality o/oooo	Solid cancer frequency o/oooo	Distribution
1999	88884	979	90.2		102.3	3.37 *
2000	87355	938	110.5		102.2	3.43 *
2001	89039	797.7	90.5		103.2	6.69
2002	81875	951.4	125.3	5.4	106.3	3.77
2003	80138	1066.6	130.9	0	177.3	5.60
2004	83950	1110.5	116.6		167.4	1.90
2005	84203			1.3	137	8.09
2006	82539	1031.1	149.4	0.76	235.7	7.13
2007	82277	955.9	115.4	0.74	208	13.41
2008	80129			3.3		
2009	79917	1141.9	104.2	5.12	224	17.1
2010	78323	1142	132.3	6.97	177.1	17.1

General mortality

Lower than the overall mortality of Romania throughout the survey interval. Trend is consistent with the national trend.

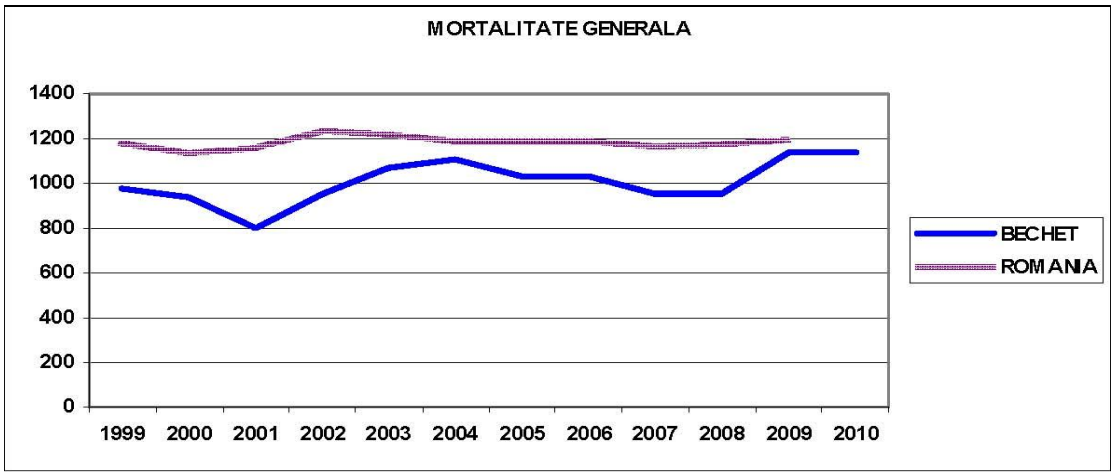

Fig. 7-1 General mortality in Bechet area for 1999- 2010

Solid cancer mortality

Lower than the value for the general population of Romania throughout the survey.

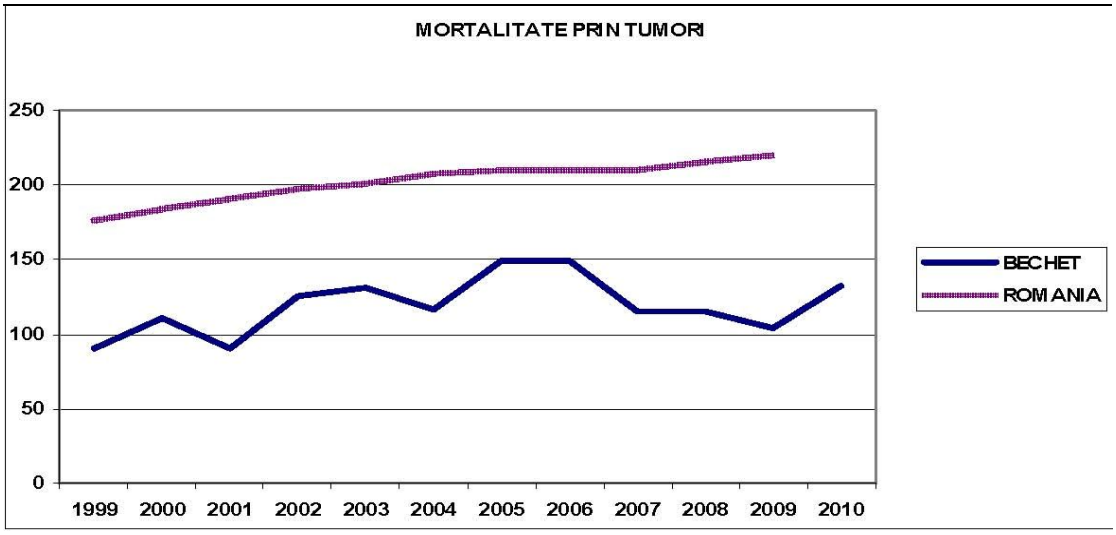

Fig. 7-2 Solid cancer mortality in Bechet area for 1999- 2010

Leukemia mortality

The mortality from all types of leukemia/lymphoma has continuously increased during the interval 1999-2010. No national data available for comparison.

Solid cancer frequency

While the values for Bechet area are slightly higher than the other monitored areas, they do not exceed the values recorded for the general population of Romania. The highest value was recorded for the year 2006 equal to that for the general population of Romania. There is a tendency for increase of this value parallel to that of the national general population.

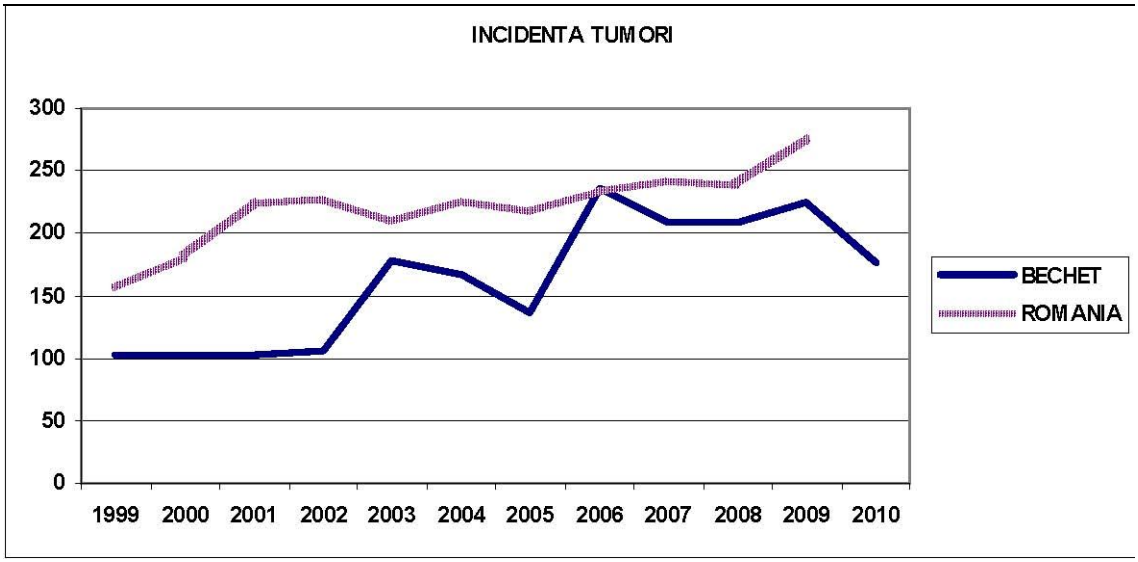

Fig. 7-3 Solid cancer frequency

Leukemia and lymphoma frequency

The frequency rates for all types of leukemia and lymphoma have continuously increased over the survey interval. Beginning with the year 2007 the Bechet area shows the highest value in comparison with the values with other monitoring areas.

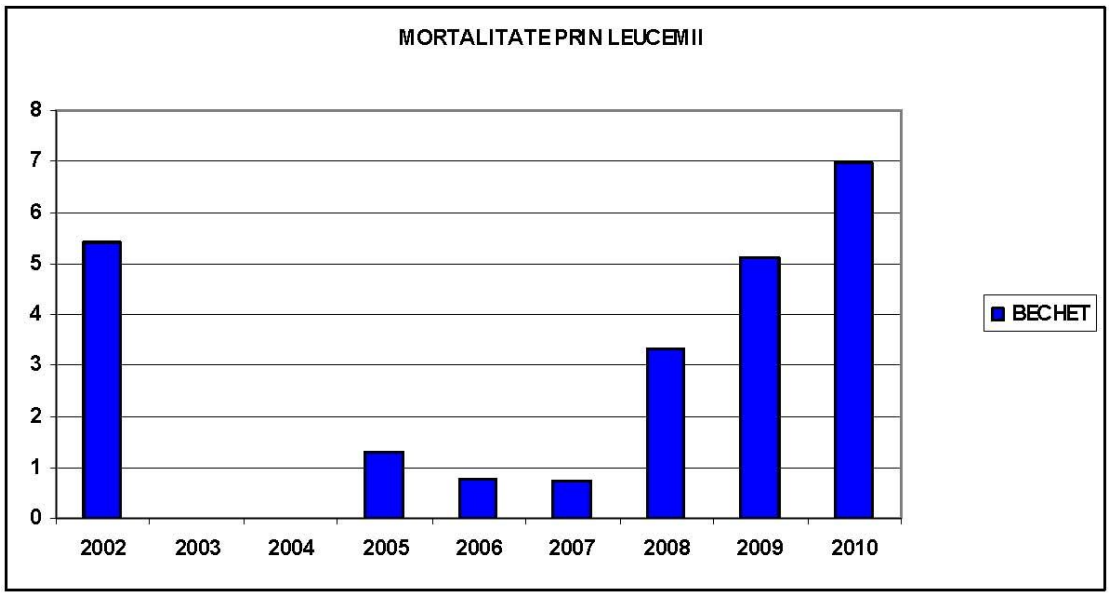

Fig. 7-4 Mortality of leukemia in Bechet area, 2002 – 2010

Conclusions

The health status of the population in 30-km zone around Kozloduy NPP in Romania is not different from that of the entire population.

8. Assessment of the expected impacts to the environment and the people as a result from KNPP Units 1-4 decommissioning

Chapter 4 of the EIAR summarizes the assessments of all expected impacts on the components and factors of the environment in transboundary aspect. Based on the results from these assessments it can be concluded that transboundary impacts as a result of the IP implementation are not expected.

The experience of EWN during the Greifswald NPP (KGR) decommissioning project, which is currently 88 % complete, as well as the experience of the team of licensed experts making the assessment, forms the basis for the EIA of the decommissioning of the KNPP Units 1 to 4. The experience of EWN is summarized in the EWN Environmental Impact Register. The considered values of the direct impacts are based on preliminary estimates, which should be made more specific and detailed in the framework of the planned implementation of the activities, for example in the project for radiological survey of the Units 1 to 4. This greater level of detail and specificity is important for the detailed planning of the dismantling activities.

The comparison of the Greifswald NPP (KGR) and the Kozloduy NPP (KNPP) is made in terms of different indicators and data regarding the anticipated impacts is presented as follows:

- Estimation of the different types of waste;
- Estimation of the discharges of radioactive nuclides into the atmosphere and into the water as a result of the decommissioning of the KNPP Units 1 to 4;
- Estimation of the Collective Effective Dose from dismantling of the KNPP Units 1 -4;
- Estimation of the non-radiation impacts during the decommissioning period (emissions into air, emissions into water, thermal discharges, noise, vibrations and water, electricity and thermal energy consumption).

Some output data by indicators is presented below:

Technological materials (without building structures): approx. 75 000 t

Of them:

- Conventional waste (material category 1 and material category 2 and 3 after free release): 65 000 t;
- RAW: 10 000 t (solid RAW from dismantling).

Based on the comparison of the emissions during the operational period and the post-operational period and on the 14-year EWN experience from the Greifswald NPP (KGR) decommissioning, the gas-aerosol emissions from the stacks of Unit 1+2, Unit 3+4 and AB-1 and AB-2 are estimated as follows:

Emissions into the atmosphere:

20 MBq LLA is the average annual value over the entire decommissioning period. This value includes the emissions from the planned projects: SRDW and DSS.

Emissions into the water (water discharge points of the Units 1–4):

Nuclides (without ^{3}H): 120 MBq average annual values over the decommissioning period; ^{3}H: 50 GBq average annual values over the decommissioning period.

Based on the comparison of the CED from the EWN experience during the decommissioning, the CED can be estimated for the period of decommissioning of the KNPP Units 1 – 4, including the activities in the SRDW and the Decay Storage Facility: CED: 200 mSv average annual value over the decommissioning period for 350 exposed persons.

In comparison to the operational period, the thermal discharges are negligible, because after the shutdown of the reactors there will be no thermal emissions from these Units into the Danube river. Small residual thermal discharges shall be caused mainly by cooling of spent fuel and the operation of the evaporation plants for the water purification systems.

The activities associated with the highest noise levels are the demolition of building structures (not envisaged at present), the reconstruction of existing buildings by using hydraulic chisels and the construction of new facilities by using excavators (e.g. for the projects SRDW and Heat Generation Plant).

According to the EWN experience, there are no indications of high vibration levels from the demolition of old buildings and the construction of new ones.

As for the impacts from water, electricity and thermal power consumption during the decommissioning activities, based on the EWN experience can be stated that no changes compared to the post-operational phase are expected. The main share of the water consumption is the consumption for sanitary purposes for the personnel. The main consumers of electrical and thermal power are the systems which shall remain operational in the post-operational period (e.g. the ventilation systems of the reactor buildings).

8.1 Dose exposure of the population during normal execution of the decommissioning activities of Units 1-4

On the ground of the results set forth in the Annual report on the environmental radiological monitoring at Kozloduy NPP for the period 2009-2011 [190] the summarized data on the population exposure are given by years.

According to the data of the National Statistical Institute from 31.12.2012, the population in the 40-km area around Kozloduy NPP on Bulgarian territory is 108149.

The methods and organization of the radioecological monitoring are presented in section 1.2.2 of this chapter.

Based on the Annual Report of Kozloduy NPP, 2008 “Results from the environmental radiological monitoring at Kozloduy NPP, 2008” [85], the results related to dose intake of the population in the 30-km and 40-km areas around the NPP, due to exposure to gaseous and liquid releases from NPP, are presented below.

The assessments of the individual and collective dose rates for the population in the 30-km area around KNPP are for the period 2009-2011 and in the 40-km area are for

the period 2009-2011. The calculation of the individual and collective dose rates for the population is based on verified and validated models following the CREAM methodology, approved by EC.

Public exposure dose estimates are based on the calculation taking into account the meteorological data related to the year and the climatic data within the period 2009-2011.

Tables from 8.1-1 to 8.1-5 provide data on the public exposure in the 30-km area around KNPP related to different gas-aerosol releases within the period 2009-2011.

Table 8.1-1 Dose rate of the population within the 30-km area from gaseous releases (except ^{3}H and ^{14}C) for the period 2009-2011

Year	Gaseous releases					
	Collective effective dose, man Sv	**Normalized effective dose, man Sv/GW.a**	**Individual effective dose, Sv**	**Comparisons with the maximum individual dose**		
				BNRS 2004 [16], 1 mSv	**Regulation on NPP safety [11], 0.25 mSv**	**Background radiation, 2.4 mSv**
2009 (40 km)	$2,83.10^{-4}$	$1,74.10^{-4}$	$3,47.10^{-10}$- $1,17.10^{-8}$	0,0012 %	0,0047 %	0,0005 %
2009* (40 km)	$2,93.10^{-4}$	$1,80.10^{-4}$	$5,05.10^{-10}$- $8,02.10^{-9}$	0,0008 %	0,0032 %	0,0003 %
2010 (40 km)	$1,47.10^{-2}$	$8,44.10^{-3}$	$7,18.10^{-9}$ – $8,02.10^{-7}$	0,080 %	0,32 %	0,033 %
2010* (40 km)	$2,06.10^{-2}$	$1,18.10^{-2}$	$1,40.10^{-8}$ - $4,85.10^{-7}$	0,049 %	0,19 %	0,020 %
2011 (40 km)	$1,47.10^{-3}$	$8,44.10^{-4}$	$6,18.10^{-9}$ – $7,02.10^{-7}$	0,008 %	0,032 %	0,0033 %
2011* (40 km)	$2,06.10^{-3}$	$1,18.10^{-3}$	$1,40.10^{-8}$ – $2,85.10^{-7}$	0,0049 %	0,019 %	0,002 %

* Dose estimated with microclimatic data.

Table 8.1-2 Dose rate of the population within the 30-km area from RNG for the period 2009-2011

Year	**RNG**			
	Collective effective dose, man Sv	**Normalized effective dose, man Sv/GW.a**	**Compared to UNSCEAR-2000 [154], %**	**Individual effective dose, External exposure to RNG, Sv**
2009 (40 km)	$1.51.10^{-5}$	$9.31.10^{-6}$	0.31 %	$1.93.10^{-11}$ – $4.67.10^{10}$
2009* (40 km)	$1.55.10^{-5}$	$9.53.10^{-6}$	0.32 %	$2.78.10^{-11}$- $3.16.10^{10}$
2010 (40 km)	$6.82.10^{-5}$	$3.92.10^{-5}$	1.31 %	$9.19.10^{-11}$ – $3.34.10^{-9}$
2010*	$9.54.10^{-5}$	$5.48.10^{-5}$	1.83 %	$1.80.10^{-10}$-

Year	RNG			
	Collective effective dose, man Sv	**Normalized effective dose, man Sv/GW.a**	**Compared to UNSCEAR-2000 [154], %**	**Individual effective dose, External exposure to RNG, Sv**
(40°km)				$2.02.10^{-9}$
2011 (40 km)	$4.82.10^{-5}$	$1.92.10^{-5}$	0.92 %	$3.19.10^{-11}$ – $1.34.10^{-9}$
2011* (40°km)	$7.54.10^{-5}$	$3.48.10^{-5}$	1.53 %	$1.80.10^{-11}$- $2.02.10^{-10}$
UNSCEAR-2000	-	$3.0.10^{-3}$	-	-

* Dose estimated with microclimatic data.

Table 8.1-3 Dose rate of the population within the 30-km area from LLA within the 30-km area for the period 2009-2011

Year	LLA			
	Collective effective dose, manSv	**Normalized effective dose, manSv/GW.a.**	**Compared to UNSCEAR-2000 [154], %**	**Individual effective dose, LLA at ground surface level, Sv**
2009 (40 km)	$2.65.10^{-4}$	$1.63.10^{-4}$	41 %	$1.23.10^{-10}$ – $2.99.10^{-9}$
2009* (40°km)	$2.74.10^{-4}$	$1.69.10^{-4}$	42 %	$1.81.10^{-10}$ – $4.45.10^{-9}$
2010 (40 km)	$6.71.10^{-5}$	$3.85.10^{-5}$	10 %	$3.36.10^{-11}$ – $1.23.10^{-9}$
2010* (40°km)	$9.50.10^{-5}$	$5.45.10^{-5}$	14 %	$6.69.10^{-11}$ – $1.80.10^{-9}$
2011 (40 km)	$4.51.10^{-5}$	$2.14.10^{-5}$	7.6 %	$2.43.10^{-11}$ – $1.26.10^{-9}$
2011* (40°km)	$7.53.10^{-5}$	$3.15.10^{-5}$	12 %	$5.19.10^{-11}$ – $1.78.10^{-9}$
UNSCEAR-2000		$4.0.10^{-4}$		

* Dose estimated with microclimatic data.

Table 8.1-4 Dose rate of the population within the 30-km area from ^{131}I within the 30-km area for the period 2009-2011

Year	^{131}I			
	Collective effective dose, man Sv	**Normalized effective dose, man Sv/GW.a.**	**Compared to UNSCEAR-2000 [154] %**	**Individual effective dose, Inhaling -^{131}I,** Thyroid 0-1 year (max.), Sv
2009 (40 km)	$2.66.10^{-6}$	$1.64.10v^{6}$	1.6 %	$2.38.10^{-11}$ – $6.04.10^{-11}$

Year	^{131}I			
	Collective effective dose, man Sv	**Normalized effective dose, man Sv/GW.a.**	**Compared to UNSCEAR-2000 [154] %**	**Individual effective dose, Inhaling -^{131}I,** Thyroid 0-1 year (max.), Sv
2009* (40°km)	$2.73.10^{-6}$	$1.68.10^{-6}$	1.7 %	$1.19.10^{-11} – 4.09.10^{-11}$
2010 (40 km)	$2.21.10^{-5}$	$1.27.10^{-5}$	13 %	$1.21.10^{-11} – 7.95.10^{-10}$
2010* (40°km)	$3.10.10^{-5}$	$1.78.10^{-5}$	18 %	$2.37.10^{-11} – 4.81.10^{-10}$
2011 (40 km)	$1.21.10^{-5}$	$1.27.10^{-6}$	7 %	$1.31.10^{-11} – 6.95.10^{-10}$
2011* (40°km)	$2.10.10^{-5}$	$1.78.10^{-6}$	15 %	$2.37.10^{-11} – 2.81.10^{-10}$
UNSCEAR-2000	-	$1.0.10^{-4}$	-	-

* Dose estimated with microclimatic data.

Table 8.1-5 Maximum individual dose (Sv) from exposure to gas-aerosol releases discharged from Kozloduy NPP, taking into account the contribution of ^{3}H and ^{14}C, per Unit of electric power production

Year	Maximum dose, RNG+LLA +^{131}I	Maximum dose from ^{3}H, Sv	Maximum dose from ^{14}C, Sv	Maximum dose, total Sv
2009	$1.43.10^{-8}$	$4.36.10^{-8}$	$4.05.10^{-7}$	$4.54.10^{-7}$
2010	$3.09.10^{-9}$	$5.39.10^{-8}$	$5.01.10^{-7}$	$5.52.10^{-7}$
2011*	$2.28.10^{-9}$	$3.94.10^{-8}$	$3.66.10^{-7}$	$4.03.10^{-7}$

* Dose estimated with microclimatic data.

Public exposure to liquid releases into the Danube River

The low values of the releases with the unbalanced waters from KNPP during 2011 and during the previous years determine the low level of public exposure in the region. The tritium activity released in 2011 amounts to 11.77 TBq and represents respectively 7 % of the permissible level and 42 % of the control level for the period. Stabilization of this parameter is observed within the last three years (2009-2011), varying from 7 % to 12 % of the permissible level. The summary activity of the liquid releases (except tritium) is 186 MBq, which is only 0.13 % of the control level of the limit permitted by BNRA for the period.

Table 8.1-6 below gives data related to the dose rate for the population in the 30-km area around Kozloduy NPP from liquid releases within the period 2009-2011.

The collective dose for the population in the 30-km area resulting from liquid releases during 2011 is estimated at $4.23.10^{-3}$ manSv/year. The normalized collective dose per unit of electricity production amounts $2.85.10^{-3}$ manSv/GWyear. This exposure is below 21 % from the average value valid for the PWR reactors in the world.

The maximum individual effective dose in the 30-km area is estimated at $2.34.10^{-7}$ Sv/year, and for a representative of the critical group from the population living along the Danube riverside (Oriahovo town, Liaskovets village, Ostrov village and Gorni Vadin village) it is respectively $3.48.10^{-6}$ Sv/year. This exposure is negligibly low and represents 0.4 % of the annual effective dose limit of 1 mSv, according to BNRP-2012 [16]. Compared to the limit of 0.25 mSv/year for the exposure from radioactive releases from NPP, according to the Regulation on ensuring the safety of nuclear power plants [11], the maximum dose represents only 1.4 % of the limit value, and for the liquid releases quota of 0.05 mSv/year it represents 7.0 %.

The obtained results for the dose burden from KNPP releases are completely comparable with the international practice according to the official UN data from 1997.

Table 8.1-6 Public exposure to liquid releases within the 30-km area for the period 2009-2011

Year	Liquid effluents				
	Collective dose, manSv	Normalized collective dose, man.Sv/GW.a		Individual effective dose	
		including ^{3}H	excluding ^{3}H	Maximum in the 30-km area, Sv	Critical group, Sv/year
2009	**$4.62.10^{-3}$**	**$2,84.10^{-3}$**	**$6.53.10^{-6}$**	**$6.27.10^{-7}$**	**$4.41.10^{-6}$**
2010	**$4.43.10^{-3}$**	**$2.54.10^{-3}$**	**$4.62.10^{-6}$**	**$6.00.10^{-7}$**	**$4.23.10^{-6}$**
2011	**$4.23.10^{-3}$**	**$2.34.10^{-3}$**	**$4.12.10^{-6}$**	**$5.73.10^{-7}$**	**$4.13.10^{-6}$**
UNSCEAR-2000		$1.4.10^{-2}$	$6.0.10^{-3}$	Kozloduy NPP, 2009, 20 % ^{3}H, 0.1 % others.	

Summarized results

The performed assessments show that the additional exposure of the population in the 30-km area as a result of the gas-aerosol and liquid releases due to KNPP operation is negligibly low.

The calculated maximum individual effective dose for the population, representing the sum of the gas-aerosol (with ^{14}C and ^{3}H) and the liquid releases from KNPP in the environment is 4.96 μSv/year. This represents only 0.18 % of the public exposure corresponding to the natural background radiation for the country (2.4 mSv), 0.5 % of the population allowable limit (1 mSv), according to BNRP-2012 [16] and about 60 times under the permissible limit of 0.25 mSv/year for the exposure to radioactive releases from KNPP. The maximum estimated dose is under the free release level, according to BNRP-2012 [16] – 10 μSv/year.

The Annual reports on the environmental radiological monitoring at Kozloduy NPP do not contain separate assessment of the radiation exposure of the population on the Romanian territory. But it can be stated that this exposure is of the same magnitude and the same level as for the Bulgarian population.

The influence of liquid releases into the Danube river on the public exposure is almost the same for the Bulgarian and the Romanian territory.

The influence of gas-aerosols released on the Romanian territory on the public exposure is comparable with that on the Bulgarian territory. The main influencing parameters are the meteorological conditions, particularly wind direction and wind strength.

The meteorological conditions (see Chapter 3, section 3.1.1 of this report) are comparable for both the Romanian and the Bulgarian territory.

Conclusion

Based on the results for the exposure of the population living in the region surrounding Kozloduy NPP related to the gaseous and liquid emissions in the environment, the following conclusions can be formulated:

1. The low levels of the emissions released by KNPP determine the negligibly low dose rate for the population in the territory of Bulgaria, and also in the territory of Romania, hundred times below the dose rate corresponding to the exposure to the natural radiation background, especially after the final shut down of Units 1 to 4.

2. The maximum individual effective dose for the population, which is 4.03 μSv/year, resulting from KNPP emissions in the atmosphere and in the hydrosphere in 2011, similar to the previous periods, is many times below the permissible limits, according to [11 and 16] and is the established free release level – 10 μSv/year, according to BNRP -2012 [16].

3. The comparison of the normalized collective effective dose rates for the population generated by the gas-aerosols and liquid releases from NPP into the environment with the UNSCEAR-2000 [154] indicative values valid for many other NPP with PWR reactors (pressurized water reactor), has shown compliance with the worldwide recognized practice.

4. The additional exposure of the population from the radioactive emissions in the environment in the 30-km KNPP area is around 500 times lower than that from the natural radiation background - 2.4 mSv. During the past 10 years the maximum effective dose for the population ranges from **2.5 to 5 μSv/a.**

5. The low levels of the radioactive releases from KNPP determine exposure values with negligible radiation risk for the population in the NPP area.

9. Assessment of the expected impacts to the environment and the people in case of accidents during decommissioning Units 1-4 Kozloduy NPP

In the existing Kozloduy NPP Emergency plan the Units 1-4 decommissioning activities are also taken into account [132]. The Emergency Plan provides technical and human resources as well as instructions and procedures for action in case of emergencies occurring both during operation and decommissioning according to [12] and [27].

The Emergency Plan determines the organization of the KNPP emergency structures activation; the implementation of the urgent measures for protection of the personnel, the population and the environment, as well as measures for protection of the KNPP facilities in case of emergency or other critical events; and the interaction with the executive authorities.

It is necessary to improve the manner of notification and communication as well as the cooperation with the Romanian authorities regarding the necessary measures.

Results from the analyses of limiting initiating events during decommissioning of KNPP Units 1-2

The results from the analyses of different initiating events during decommissioning of KNPP Units 1-2 are presented in the Safety Analysis Report (SAR) [58]. HEPA filter rupture is considered as the limiting accident and the results from the analysis are presented in table 9-1, 9-2 and 9-3.

Table 9-1 Inhalation effective dose for an individual from the critical group of the population as a result of HEPA filter rupture

Nuclide i	H_{eff},i (mSv)
^{137}Cs	5.2 10-6
^{90}Sr	4.3 10-7
^{238}Pu	2.6 10-6
^{239}Pu	4.0 10-6
^{240}Pu	2.6 10-6
^{241}Pu	1.2 10-6
^{241}Am	9.2 10-6
^{244}Cm	3.8 10-7
H_{eff} (mSv)	2.56 10-5

The results show that the effective dose for an individual from the critical group of the population (adult) amounts to 2.56 10^{-5} mSv and is much lower than the acceptance limits according to BNRP-2012 [16]. According to BNRP-2012 [16] the annual individual effective dose from external and internal exposure of the population during accidents is ≤ 5 mSv during the first year of a design accident (at the border of the area for preventive protection measures and beyond).

Table 9-2 Individual effective dose [Sv] for the first 24 hours after the release, with rain during the release of nuclides in the atmosphere

Distance, km	Stability category A	Stability category B	Stability category C	Stability category D	Stability category E	Stability category F
0.1	2.48E-11	1.17E-11	0	0	0	
0.2	1.38E-11	8.28E-12	5.18E-12	0	0	
0.3	9.36E-12	5.62E-12	3.54E-12	2.15E-12	2.15E-12	
0.4	6.95E-12	4.2-E-12	2.64E-12	1.61E-12	1.61.E-12	
0.5	5.46E-12	3.36E-12	2.10E-12	1.28E-12	1.26E-12	
0.6	4.44E-12	2.78E-12	1.75E-12	1.06E-12	1.06E-12	
0.7	3.70E-12	2.36E-12	1.50E-12	9.07E-13	9.07E-13	
0.8	3.14E-12	2.04E-12	1.31E-12	7.93E-13	7.93E-13	
1.0	2.35E-12	1.58E-12	1.04E-12	6.34E-13	6.34E-13	

The maximal individual effective dose for the first 24 hours after the radioactive release is at 100 m from the point of release and amounts to **2.84E-8 mSv.** This value is valid for rainy weather; in dry conditions the value is lower.

Table 9-3 Individual effective dose [Sv] for the first 24 hours after the release, with rain during the release of nuclides in the atmosphere

Distance, km	Stability category A	Stability category B	Stability category C	Stability category D	Stability category E	Stability category F
0.1	**7.73E-09**	3.18E-09	0	0	0	0
0.2	3.70E-09	2.25E-09	1.41E-09	0	0	0
0.3	2.48E-09	1.52E-09	9.60E-10	5.84E-10	5.84E-10	0
0.4	1.81E-09	1.12-E-09	7.13E-10	4.36E-10	4.36.E-10	0
0.5	1.41E-09	8.85E-10	5.65E-10	3.46E-10	3.46E-10	1.00E-09
0.6	1.14E-09	7.26E-10	4.67E-10	2.87E-10	2.87E-10	8.42E-10
0.7	9.49E-10	6.13E-10	3.97E-10	2.45E-10	2.45E-10	7.05.E-10
0.8	8.04E-10	5.27E-10	3.44E-10	2.13E-10	2.13E-10	6.03E-10
1.0	6.03E-10	4.07E-10	3.70E-10	1.68E-10	1.68E-10	4.61E-10

The results show that the individual effective dose under the most conservative development of the accident (considering the wind rose for the area of Kozloduy and relevant meteorological data, respectively) amounts to 7.73.10-6 mSv at 100 m from the source and is much lower than the acceptance limits according to BNRP-2012 [16]. According to BNRP-2012 [16] the annual individual effective dose from external and internal exposure of the population during accidents is ≤ 5 mSv during the first year of a design accident (at the border of the area for preventive protection measures and beyond).

Results from the analyses of limiting initiating events during decommissioning of KNPP Units 3-4

The results from the analyses of different initiating events during decommissioning of KNPP Units 3-4, presented in the Safety Analysis Report (SAR) [58], are summarized and presented in table 9-4.

Table 9-4 Results from the analyses of limiting initiating events during decommissioning of KNPP Units 3-4

Initiating event	Process/System	Main results
Spills of liquid from a container with spent filters during its transportation outside the SFSP	SFSP decontamination	The maximal value for the calculated dose rate for the personnel is equal to 5.634 mSv/h. Radiological consequences outside the Reactor Hall are not expected. There are no consequences for the population.
Falling of a load during replacement of the filters from the SFSP due to loss of power supply of the crane	SFSP decontamination	The expected maximal dose rate at the surface of the rack is 3 mSv/h. The time of staying close to the rack can be limited to several minutes. Radiological consequences outside the Reactor Hall are not expected. There are no consequences for the population.
Rupture of aerosol filter along with release of radioactivity into the environment	Operation of B 2 ventilation system	This event is related to release of activity outside the units. The collective effective dose for a member of the population 7.73E-9 Sv/year at 100 m from the source and 6.03E-10 Sv at 1 km from the source.
Error during the replacement of an aerosol filter, resulting in a drop of a filter cartridge and spilling of some of its contents	Operation of B 2 ventilation system	The dose rate for the personnel is 0.705 mSv/h. The time for cleaning should not

Initiating event	Process/System	Main results
		exceed 1 hour. The radiological consequences are localized at the place of the incident. There are no consequences for the population.

The results show that the individual effective dose under the most conservative development of the accident (considering the wind rose for the area of Kozloduy and relevant meteorological data, respectively [53]) amounts to 7.73.10-6 mSv at 100°m from the source and is much lower than the acceptance limits according to BNRP-2012 [16].

Conclusion

The impacts of KNPP Units 1-4 decommissioning on the population health are negligible, because the dangerous and radioactive materials will remain at KNPP site (as during planned shutdown of the Units in the period of their normal operation). During the normal operation of KNPP Units the main impact to the personnel and population is caused by the nuclear fuel. Risk assessment for the population during normal operation of the Units is given in Chapter 1 and Chapter 3 of this document. The spent nuclear fuel is removed from Units 1-4 and transported to the spent nuclear fuel storage facilities before the start of the decommissioning activities. Therefore, in this case measures for reducing the impact on human health are not necessary.

Nevertheless, based on the analyses of the limiting initiating events, made upon conservative assumptions and presented in the Safety Analysis Report (SAR) during KNPP Units 1-4 decommissioning, the results show that the effective dose to an individual of the critical population (adult) amounts to 2.56E-5 mSv and is far below the acceptance limit for this critical group of 1mSv for one year or less than 5 mSv for five consecutive years after the accident.

Therefore, the impact on the population during implementation of the decommissioning activities for KNPP Units 1-4 will be negligible. Even in case of the possible limiting accidents the effective dose for the critical group of the population will be many times lower than the permissible values. Transboundary impact on the Romanian population in the KNPP 30-km area is not expected.

It can be concluded that the exposure of the population in the KNPP 30-km area, including Romania, in cases of limiting accidents during the IP implementation will be many times lower than the International documents ICPR 103 and the requirements of BNRP 2012.

10. Expert conclusions

Based on the detailed description and analysis of the environmental components and factors and the key interactions among them at the IP site, the following expert conclusions were formulated:

Quality of the atmospheric air

Releases of radioactive noble gases (RNG) - Kr, Xe isotopes, and of short-lived iodine isotopes (^{131}I, ^{133}I, ^{135}I) after removal of the nuclear fuel from the Units are not expected.

The radiological impact on the critical individuals resulting from exposure to RNG or inhaling of ^{131}I will be absolutely negligible compared to that from the releases during normal operation.

The emissions of long-lived aerosols from the activities which will be performed during the SE preparation can be compared to some extent to those during the long stay period, with decreasing of the maintenance/inspection activities and increasing of the cleaning/decontamination activities and RAW conditioning activities.

Subject to compliance with the technology and control of the decontamination and dismantling processes, decommissioning can be performed safely for the environment and the population. The radioactive gas aerosol emissions are expected to be within the admissible limits and the contamination of the air in the KNPP area to be lower than that in the period of normal operation.

The following facilities are expected to be organized sources of harmful emissions in the air during decommissioning: The facility for processing of solid RAW with high volume reduction factor (Plasma melting facility) and the Size Reduction and Decontamination Workshop. These facilities, however, are equipped with their own filtrating systems. Therefore, the impacts are expected to be negligible.

Unorganized emissions of dust from the excavation activities and gases from the ICE of the construction transport machinery are expected during construction of the storage sites for RAM and non-radioactive waste. These emissions are limited in duration and scope. Such impacts are usually limited within a 50-m radius around the construction site.

Other emissions from non-radioactive sources may be generated during metal cutting and waste transportation (CO2, NOx and PM10). Based on the assessments of the planned decommissioning activities and the EWN experience [8], it can be concluded that the emissions of non-radioactive substances in the air during decommissioning processes of KNPP Units 1-4 will be lower than the permitted levels.

The analysis of the Investment Proposal and of the possibilities for contamination of the ambient air in the 30-km area around Kozloduy NPP, falling within the Romanian territory, shows that during the decommissioning of KNPP Units 1 to 4 the planned activities will generate fewer waste products than during the normal operation period.

The analysis of the current state and the considerably limited emissions expected during the decommissioning in comparison with the normal operation shows that

transboundary impact is not expected. Transboundary transfer of pollutants is not expected either.

Harmful physical factors

During the entire decommissioning period there will be redistribution of the existing residual activity, which will change the location, amount and extent of radiation within KNPP site, and under certain conditions in the environment.

Based on the analysis of the radiation state of the environment and the provided information, the impact of the ionizing radiation from the activities during the DECO period on the radiation γ-background can be estimated as insignificant under the following conditions:

Keeping of the areas with their control limits and admissible values of the gamma radiation, as well as their control values and admissible limits on the outside walls of compartments containing radioactivity;

- Keeping of the limitations on gamma radiation in and around the newly formed buffer areas and areas for temporary storage and of the capacity limitations of the RAW storing facilities;
- Provision of adequate biological protection of the activated equipment carried out of the SE area and of RAW treatment and transportation;
- Keeping of the admissible limit values for emissions of radioactive substances in the waste water and in the ground atmospheric layer outside of the site and in the radiation monitoring areas.

It can be concluded that during the decommissioning activities, including the dismantling works, no impact of the radiation gamma-background is expected, subject to keeping of the above conditions. The gaseous RAW emissions during decontamination are within the permitted aerosol levels and their impact is negligible.

Additional impacts on the ***environment from non-ionizing radiation*** are not expected during implementation of the DECO activities, according to the DECO Plan and to the EWN experience.

Noise will be temporary and resulting mainly from the preparation and construction of new buildings or reconstruction of existing ones. The impact will be local.

Vibrations are possible as result from the preparation and construction of new buildings or reconstruction of existing ones, and from RAW processing during scrap cutting. The impact is temporary and local.

After completion of the decommissioning activities a sharp reduction of all impacts on the environment by ionizing and non-ionizing radiation, noise and vibrations is expected.

Transboundary impact from harmful physical factors is not expected.

Soils

The soils in KNPP territory and in the 30-km area around it are black soils, alluvial, deluvial and gray forest soils. The most widely distributed are the black soils. Their resilience to anthropogenic impacts is dependent on the nature of the activities carried

out. The resilience of the black soils to mechanical impacts, such as construction and digging activities, is very low, while in regard to pollution with inorganic and organic contaminants the black soils are highly resilient. Their buffer qualities are determined by the favorable reaction of the soil solution, the high content of carbonates and the heavy mechanical composition. The beneficial potassium regime is also important for the resilience to radioactive contamination. The grey forest soils are also resilient.

The potential sources of impacts on the soils during KNPP Units 1-4 decommissioning will be radiological and non-radiological.

The activities at the border of the SE area will be performed in closed spaces and present no danger to the soils at KNPP site or the adjacent lands. A considerable part of the activities in the SE area are not related to generation of sources of impact on the soils. Decontamination will be performed in a closed room. Subject to effective performance of the planned decontamination activities, impact on the soils at KNPP site and the adjacent lands is not expected. After decontamination, the possible sources of soil contamination are various waste types, sludge and water used for technology needs.

During KNPP Units 1-4 decommissioning liquid and solid radioactive waste is expected to be generated. The limits for liquid waste releases are assumed to be considerably lower than the limits during Units 1-4 normal operation, and are determined in the "E" mode license of the Units. This means that the expected impact on the soils during decommissioning will be much smaller than that during normal KNPP operation.

Sources of non-radiological impacts on soils are mainly the activities related to construction of new buildings and earthworks, transportation of landmass.

The impacts on soils from the construction of the Decay storage site for transitional RAW, the Size reduction and decontamination workshop and the Storage site for conventional (non-radioactive) waste from decommissioning will depend on a number of factors. Their parameters should be determined in the working design. The impact on soils during construction will not differ from that regarding other construction projects. The impacts will be mainly mechanical - from earthworks, compaction, sealing, insulating. The construction machinery will be a source of dust and gas emissions from the ICE. Formation of surface runoff at the construction site is also expected, as well as generation of domestic and construction waste. The impact on soils will be temporary - within the working day and until completion of the construction works. Significant impacts on soils and the lands adjacent to the project are not expected during this stage. The impacts from these activities are assessed as negative, direct, long-term, and after completion of the construction works they will be positive, direct, and long-term, because of the recycling and reclamation.

Various types of conventional (non-radioactive) waste will be a source of non-radiological impact on soils within the EIAR scope. Their collection, transport, and storage should be carried out in accordance with a program developed to ensure the protection of soils.

The period after the final shutdown of Units 1-4 is related to the presence of gaseous and liquid emissions. Increase in the levels of the gaseous emissions is not expected,

and they do not present danger for the soils. The residual dissolved activity from the decontamination of rooms, equipment and others is planned to be purified in the special water cleaning system. Therefore, the technological water will not be a source of contamination of the soils.

The analysis of the expected sources of impacts on soils, related to the Units 1-4 decommissioning and the post-decommissioning period, shows that the planned activities are not a source of contamination of the soils.

After completion of the decommissioning, reduction of the radiological and non-radiological emissions in the environment (air and water) is expected; respectively, consequences for the lands and soils are not expected.

Based on the official information provided by Romania on the radionuclide content in the uncultivated and cultivated soils, it can be concluded that the soils in the 30-km KNPP area contain radionuclides within the limits of the natural background, which shows that soils in Romanian territory in the above-mentioned area are not affected by the NPP operation.

Transboundary transfer of pollutants is not expected.

Liquid effluents

The liquid releases into the environment consist of purified technological water from decontamination before and after dismantling, and water from the bathrooms and laundries, from cleaning the floors and corridors, and from the laboratories. Part of this water fulfills the requirements for free release directly into the environment after measuring its activity.

In the period of final termination of the reactors` operation the activities of removing of the liquid and solid RAW from their initial storage location will contribute significantly to the minimization of the impacts during work with radioactive materials. The subsequent activities - transportation, temporary storage in converted storage areas and compartments, and RAW transfer to the facilities for treatment and final conditioning will be performed with equipment that will be pre-tested for RAW leakage resistance.

Provided that no damage at the storage site occurs, caused by the mechanisms of RAW transportation from their original storage sites, the impact on surface and groundwater from working with radioactive materials can be regarded as negligible. In case of damage occurring at the storage site, measures for localization and restoration of the damaged site are planned.

The provision of mobile equipment for treatment and final conditioning of radioactive solid waste and liquid waste treatment with guaranteed RAW leakage resistance, which is delivered to the decontamination location, reduces the probability of leakages during transportation of waste and further helps to reduce the impact on the hydrosphere.

Solutions from decontamination and washing water used in the decontamination of equipment and buildings are considered liquid waste to be concentrated and processed by cementing.

During the processing and conditioning of RAW to solidified form, suitable for their conditioning, the condensate of the vapors that are released during the concentration of the liquid waste and waste water from the various technological processes may be used in another technological process (for example, cementing and decontamination) or to be discharged after purification and chemical and radiation control by a waste water discharge system into the Danube, which is their receiver. Subject to all the technological and regulatory requirements, the impact of treatment and conditioning of radioactive waste on surface and ground water will not endanger the ecosystems and the health of the population from the affected area.

To protect surface and groundwater, technological wastewater discharged in the hydrosphere must comply with standards of purity for the content of non-radioactive and radioactive contaminants. After completion of the DECO activities improvement of the purity of surface and groundwater in the affected area will be observed.

The overall liquid discharges into the environment as a result of the decommissioning of KNPP Units 1-4 will be low. The annual radioactivity caused by them will be within the limits with enough reserve. The reduced impact on surface and ground water can be considered as a positive effect of the decommissioning of the units compared to their operational period.

Among the positive impacts associated with decommissioning, special attention should be paid to the elimination of thermal pollution of the Danube due to the cooling water during operation.

Upon completion of decommissioning improvement of the purity of surface and groundwater in the affected area will be observed. The monitoring data of surface and groundwater in 30-km KNPP area on Romanian territory do not show deviations which may be associated with the activities of KNPP.

The decommissioning technologies selected on the basis of the international experience and the distribution of the decommissioning activities in time give reason to limit the expected direct impact from the activities on the site on the water quality, within the accepted norms.

The environmental impact is insignificant and cannot cause any transboundary impact.

Flora

Subject to the adopted technology for the decommissioning of KNPP Units 1-4 and adoption of Alternative 2, and application of the proposed measures for preventing, reducing or terminating of the harmful impact on the environment from the IP implementation, negative impact on the flora and fauna in the adjacent territories is not expected. In this regard, the requirements and instructions in the updated and approved revision of the KNPP Emergency plan must be strictly observed, including the activities and the possible emergencies during Units 1-4 decommissioning. Transboundary impact on the flora during KNPP Units 1-4 decommissioning is not expected.

Fauna

Based on the estimated impacts on the fauna as result from the IP implementation, they are assessed as weak, mainly indirect, or occurring in emergency or force majeure situations. They can be avoided without application of any special measures, besides observing of the best practices during KNPP Units 1-4 decommissioning and the currently performed precautionary and monitoring activities, as well as the updated KNPP Emergency plan, including the activities and the possible emergencies during Units 1-4 decommissioning. Transboundary impact on the fauna during KNPP Units 1-4 decommissioning is not expected.

Landscape

KNPP territory has a complex landscape structure. There are several distinct types of landscapes - "anthropogenic", "forest" and "aquatic". The resilience of these landscapes is low. Their existence is determined by human activity. The "forest" landscape is characterized by a higher resilience and has a capacity for self-regulation and restoration. The landscape diversity in the 30-km KNPP area is represented by the following landscape types - "forest", "meadow", "agricultural", "aquatic" and "anthropogenic". The "aquatic" landscape (formed by the natural water flows in the watersheds of the rivers Danube, Skat, Ogosta and Tsibritsa) and the "forest" landscape are characterized by high resilience.

Essential role in the circulation of substances in landscape is performed by loess soil forming materials and soils, which thanks to their carbonate content create migration barriers to various contaminants, including radionuclides.

The decommissioning processes are related to implementation of construction activities at KNPP site, which will not change the "anthropogenic" landscape. Construction activities will not be implemented in the 30-km KNPP area.

KNPP Units 1-4 decommissioning processes are also related to implementation of a number of activities, and, provided that the decommissioning activities of these Units are properly performed, there is no danger of contamination of the landscape components. Provided that the Program for conventional waste management at KNPP and SE RAW is properly applied, negative impacts on landscape are not expected.

Transboundary impacts on landscape during KNPP Units 1-4 decommissioning are not expected.

Protected territories and protected areas (Natura 2000)

According the formally submitted data from the Rumanian side for the purposes of the decommissioning EIAR, three protected areas occur on the Rumanian territory from the 30-km area surrounding KNPP. The Protected Area ROSCI 0045 is under the Habitat Directive and Protected Areas ROSPA 0010 and ROSPA 0023 are under the Bird Directive.

It can be concluded that the PA along both banks of the Danube river are interconnected and form a complicated ecological complex which should be considered as a whole. The negative impact on it resulting from the decommissioning of KNPP Units 1-4 will not be significant.

Land use

The lands in the 30-km KNPP area are mainly agricultural. The decommissioning of KNPP Units 1-4 requires use of the existing site of the Units only, therefore the territory necessary for the decommissioning is currently used by KNPP. The planned decommissioning activities are similar to those currently performed at KNPP Units 1-4 site. After completion of all decommissioning measures and activities the buildings subject to free release will be used for industrial purposes. Free release of territories for agricultural or forest purposes is not expected.

Therefore, impact of the radiation and non-radiation factors on land use is not expected during implementation of the decommissioning activities. These factors will not affect land use in the region, since expropriation of agricultural land for the implementation of projects related to decommissioning of the Units is not planned.

Cultural heritage

Impact on the archaeological monuments in the KNPP 30-km is not expected, as these activities will be performed within KNPP site.

Transboundary impacts on cultural monuments or archaeological findings in the 30-km KNPP area on Romanian territory are not expected.

Health Risk

All activities which will be carried out during decommissioning are consistent with the requirements for occupational health and safety and the protection of public health. Annual prophylactic examinations of personnel by the "Occupational Medicine" department of KNPP are performed according to a certain schedule.
The radiological impact on the critical individuals resulting from exposure to RNG or inhaling of ^{131}I during pre-decommissioning activities will be absolutely negligible compared to that from the releases during normal operation. The radioactive aerosols are a tangible risk for internal radiation in the process of the dismantling activities, which requires strict individual dosimetric control and compliance with the regulatory requirements. The decommissioning activities shall be preliminarily planned and this shall include elaboration of dismantling activities time-schedule, taking into account that for each decommissioning activity or group of activities, in reference of its complexity, a separate working package/procedure containing detailed activity

description is provided. It is opportune to mention also the high level of safety culture in Kozloduy NPP and systematic application of the ALARA principle, minimizing the specific risk of occupational radiation exposure.

During the installation and assembly works some working groups will be exposed to general and local vibrations, metal aerosols, infrared and ultraviolet radiation (welding). There are effective devices for collective and personal protection against the exposure of these conventional factors and their use will minimize the unfavorable health effect, which will be short-term and local.

Concerning the health risk for the population in consequence of the KNPP Units 1 to 4 decommissioning it should be stated that the public health impact is almost zero, taking into account that the hazardous/radioactive materials, as well as the construction works, source of adverse impact, will not cross the fence of the NPP site, thus in this case no measures for mitigation of the impact on the public health in relation with the IP implementation are needed.

Based on the above and subject to application of all planned measures it can be concluded that the IP implementation will not have a negative impact on the environment and the health of KNPP personnel and the population in the 30-km area and in Romanian territory.

Social and socio-economic aspects

According to the adopted strategy of "Deferred dismantling" [4] during both decommissioning stages of the Units the highly qualified and experienced professionals serving the shutdown reactors will be redirected to employment in the new decommissioning activities.

In this connection, an agreement was signed between KNPP and SE RAW for specification of the terms for transferring of employment of part of the personnel from KNPP EP-1 to SE RAW. Under this agreement, the employment relationship with the employee is transferred to the new employer and retains its type at the old employer at the time of the change. The new employer (SE RAW) respects the service before and after the change, preserves the additional remuneration for service and experience received under the old employer, and provides social benefits similar to those at KNPP (increased amount of paid annual leave, extra pay, compensation, etc.). This measure is an example of a significant reduction of the socio-economic consequences of the termination of the operation of the Units and the start of decommissioning activities. Thus, a number of positive effects are achieved – retaining of employment for the specialists released from the Units` operation, retention of the social benefits, utilization of the rich experience and knowledge of these specialists, as well as achieving of higher efficiency in the new activities, providing continuity, and last but not least – the negative crisis effect will have a smaller impact on the unemployment. Retention of qualified staff and its inclusion in the new decommissioning activities would have yet another positive effect - providing qualified personnel for potential construction and operation of a new unit at KNPP.

In terms of population and economy, the Romanian part of the 30-km KNPP area of impact does not have industrial and service activities related with the recent operation of the four shutdown reactors or with their decommissioning. Therefore, we are convinced that the KNPP Units 1-4 decommissioning activities cannot have economic and social impacts on the economy and population in the Romanian part of the 30-km KNPP area of impact.

11. Cumulative effects in respect of the other projects implemented at KNPP site

During decommissioning of Units 1-4 it is extremely important to assess the cumulative effect from the radionuclide emissions in the air and in the water. The possible cumulative effects which have to be considered regarding the decommissioning are emissions of the following other projects on KNPP site:

- Operation of Units 5 + 6;
- Decommissioning of Units 1- 4;
- PMF operation;
- Dry Spent Fuel Storage Facility (DSFSF) operation;
- Size Reduction and Decontamination Active Workshop (SRDW);
- and National Disposal Facility for Low and Intermediate Radioactive Waste (NDF).

These sources have been assessed assuming that the projects are under way and the Wet Spent Fuel Storage Facility is empty and is not in operation. DSFSF and NDF are not sources of radioactive emissions in the air, according to [51], [52]. According to the EWN experience (EWN Environmental impacts register, Appendix 11.4.2: Impacts on the environment by SRDW operation), the SRDW emissions are very low and are considered as emission values from decommissioning activities.

When calculating the cumulative effect the releases in the air and water from the following facilities have been considered: operation of KNPP Units 5 and 6, Units 1-4 decommissioning and the emissions from the PMF operation.

Input data

In table 11-1 and below the input data for the calculations are given.

Table 11-1 Annual emissions of radionuclides in air

Emission source	Noble gases, Bq	^{131}I, Bq	Aerosols, Bq	Reference
Unit 5	5.5E+11	3.7E+06	4.5E+06	[52]
Unit 6	3.6E+10	7.7E+03	2.7E+05	[52]
Units 1-4			20E+06	[53]
PMF			6E+06	[2]

During normal operation of KNPP Units 5-6, 2010, the actual emissions in the unbalanced water from EP-1 and EP-2, as per activity and nuclide distribution are:

- Nuclides (exept ^{3}H): 289 MBq.
- Tritium (^{3}H): 22,7 TBq.

Average annual values over the entire period of Units 1-4 decommissioning:

- Nuclides (exept H^{3}): 120 MBq.
- Tritium (^{3}H): 50 GBq.

The modeling of distribution of gaseous and liquid emissions released into the environment by KNPP are presented in the report “Analysis of the dose originating

from gas aerosol and liquid releases to the environment from the operation of KNPP Units 5-6, Units 1-4 decommissioning process and the emissions from the plasma melting facility (PMF) operation, incurred by the public within the 30-km supervised area surrounding Kozloduy NPP" [223]. The following computer codes and models are used for the calculation of the cumulative effect:

- Modeling program code, based on the EU approved methodology CREAM (Consequences of Releases to the Environment Assessment Methodology) Radiation Protection 72 –Methodology for Assessing the Radiological Consequences of Routine Releases of Radionuclides to the Environment.
- To assess the public dose due to liquid discharges - program code DARR-CM, as adapted to the hydrology of the KNPP area and used for conservative evaluation of the dose exposure of a critical group of the public.
- To assess the public dose within the monitored area due to gas-aerosol discharges - program code LEDA-CM, Normal Operation Shield, as adapted to the geographical and meteorological characteristics of the KNPP area. The methodology considers both the external and the internal impact of the radioactive releases and estimates the annual individual effective dose, the annual individual dose equivalent, and the critical group dose, as well as the collective dose for the population, per age groups.

The modeling program codes used to estimate the individual and the collective effective doses for the population from radioactive discharges to the environment have been verified and validated.

The results of the population dose calculation are presented in the tables below.

Table 11-2 Individual effective doses from liquid and gaseous releases

Description of the source	Max dose from gas-aerosol emissions, Sv/a	Max dose from liquid emissions, Sv/a	Max dose, Total, Sv/a
Operation of Units 5&6 KNPP	$7.18.10^{-9}$ – $8.02.10^{-7}$	$3.22.10^{-7}$ – $6.00.10^{-7}$	*** $5.03.10^{-6}$
	$8.02.10^{-7}$	*** $4{,}23.10^{-6}$	
Operation Units 5&6 + Decommissioning Units 1-4	$7.33.10^{-9}$ - $8{,}04.10^{-7}$	$3.23.10^{-7}$ – $6.01.10^{-7}$	*** $5.04.10^{-6}$
	$8.04.10^{-7}$	*** $4.24.10^{-6}$	
Operation Units 5&6 + Decommissioning Units 1-4 +PMF	$7.36.10^{-9}$ – $8.05.10^{-7}$	$3.23.10^{-7}$ – $6.01.10^{-7}$	*** $5.05.10^{-6}$
	$8.05.10^{-7}$	*** $4.24.10^{-6}$	

****The dose assessments apply to a critical group of the population within the 40-km area around KNPP.*

Table 11-3 Collective effective doses for the population in the 40-km area around KNPP

Description of the source	Collective dose from gas-aerosol emissions, manSv/a	Collective dose from liquid emissions, manSv/a	Collective dose, Total, manSv/a
Operation Units 5&6 KNPP	$1.47.10^{-2}$	$4.43.10^{-3}$	$1.91.10^{-2}$
Operation Units 5&6 + Decommissioning Units 1-4	$1.48.10^{-2}$	$4.44.10^{-3}$	$1.92.10^{-2}$
Operation Units 5&6 + Decommissioning Units 1-4 +PMF	$1.49.10^{-2}$	$4.44.10^{-3}$	$1.93.10^{-2}$

The dose estimates obtained refer to the population of the Bulgarian side (72416 people, year 2007). Taking into account the population in the respective part of Romania – another 75 150 people, the collective effective dose for the entire area can be approximately doubled. These are data fully comparable with the practice adopted for PWRs worldwide.

The dose distribution map for the population within the 40-km area and a function of the distance to the emission source are presented on fig. 11-1 and fig. 11-2.

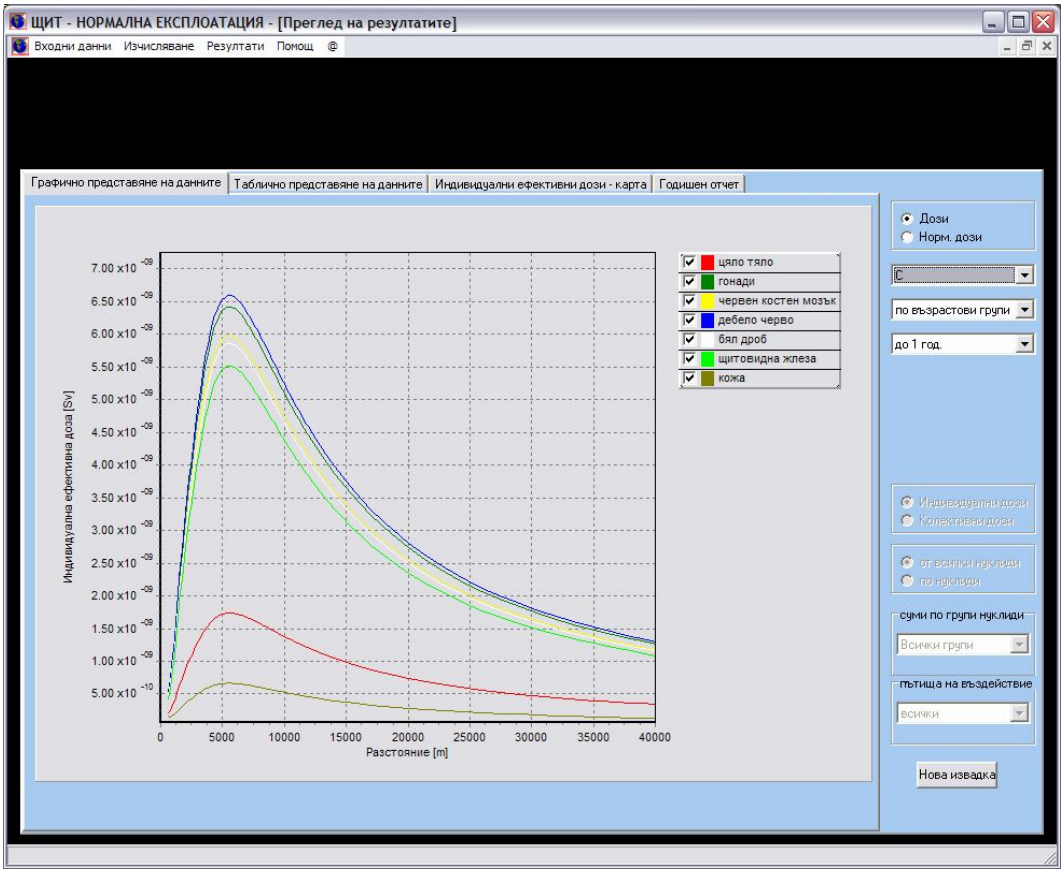

Fig. 11-1 Individual effective dose as function of the distance to the source

The maximum values of the individual effective dose were calculated within the 40-km area around Kozloduy NPP.

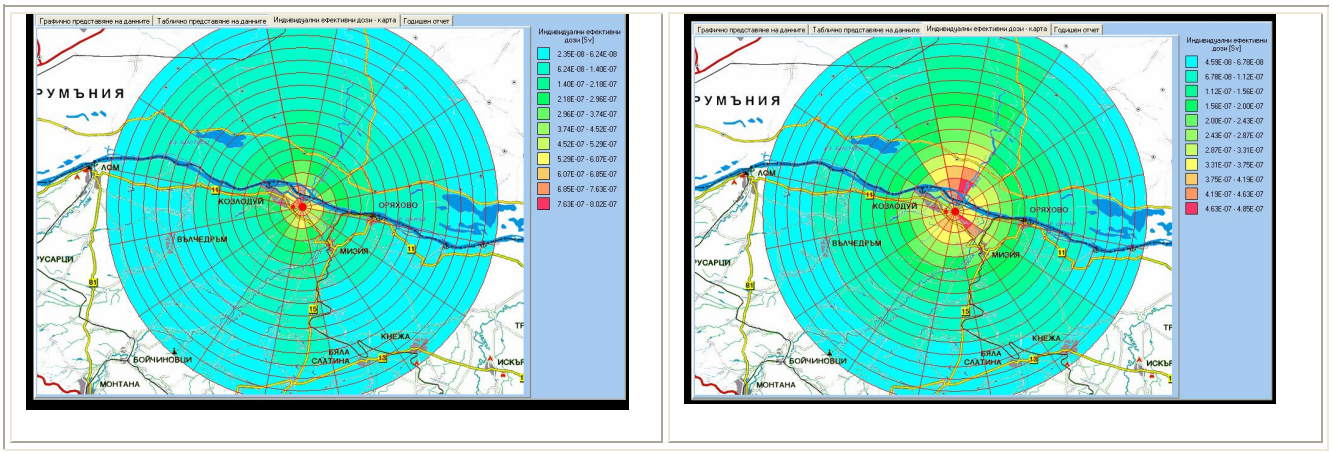

Fig. 11-2 Distribution of the individual effective dose from external exposure to RNGs, LLAs, ^{131}I + (^{3}H, ^{14}C) within the area of Kozloduy NPP, 2011.

a) with meteorological data for 2011 b) with micro climate data for 2001–2011.

Conclusions

Based on the performed analysis for the population exposure to normal operation of KNPP Units 5-6, the decommissioning of KNPP Units 1-4 and the normal operation of the Plasma Melting Facility (Project 5c) the following conclusions can be made:

- The maximum annual effective dose per individual of the critical group of the population living within the 40-km area around KNPP, resulting from the liquid and gas-aerosol releases to the environment, was conservatively calculated at 5.05μSv/a, which is a much lower value than the quota of 250 μSv/a for exposure from radioactive emissions from NPP (Ordinance on the Assuring of Safety of NPPs) and the norms determined for the population of 1 mSv/a (BNRP-2012, Basic Norms for Radiation Protection)
- The additional exposure is about 500 times lower than natural radiation background (2.33 mSv).
- The calculation of the cumulative effect added to the effect of KNPP Units 5-6 normal operation, and due to emissions from the decommissioning of KNPP Units 1-4, and the normal operation of the plasma melting facility (PMF, Project 5c) results in a negligible increase of the maximum individual and collective effective doses by 0.5 to 1 %.
- The maximum annual effective dose of the population within the 40-km area around KNPP, and due to aerosol emissions only, 6 MBq under normal operation of the plasma melting facility (PMF), was estimated at $5.47.10^{-10}$ Sv/a, which is barely 0.01 % from the total exposure resulting from all activities on the KNPP site.
- The comparisons of the collective effective dose values for the population around KNPP with the respective data for many other nuclear power plants with PWRs (WWERs) reactor type proved comparable with the practice worldwide.

12. Measures for minimization and mitigation of the adverse impact on the environment

Based on the analyses and assessments made during EIAR development specific measures have been proposed for reducing, preventing, or termination of significant adverse effects on human health and the environment from implementation of the IP "KNPP Units 1-4 decommissioning". Firstly, the measures concerning the radiological impacts on the environment and human health have been reviewed, and secondly - those related to the non-radiological impacts on the environment and human health.

Minimization of ionizing radiation exposure of personnel and population – by consistently applying the developed Program for Radiation Protection in Kozloduy NPP, applicable also for the decommissioning, strict implementation of efficient programs and action plans stemming from the applicable legislation on health protection from ionizing radiation and on work in environments with ionizing radiation, as well as by using remotely-controlled equipment, manipulators, etc. The ALARA (As Low As Reasonably Achievable) principle is to be applied by taking into consideration the whole history of the occupational radiation exposure.

Minimization of contaminant emissions into the atmosphere – by using highly efficient filtration systems capturing emissions and dust by local dust-capturing and dust-arresting systems (e.g. by sprinkling) and by rigorous planning of the activities with high dust emissions, as well as by adequate selection corresponding to the best available techniques for of the location of the new decommissioning facilities, parameters related to the construction method, technology used, capacity, quantitative data regarding the waste and the radioactive gas emissions.

Minimization of water pollution – by minimizing the water consumption, the generation of waste water by recycling and by using the treated waste water in further processes of radioactive waste treatment and conditioning, efficient filtration systems, use of mobile decontamination equipment for liquid and solid RAW and by organizing an extended measurement and sampling program based on the conservative principle with updating of the sampling points network reflecting the newly-designed decommissioning facilities etc.

Noise reduction – by using adequate routes and a time schedule of the transportation activities in compliance with the national legislation and regulatory provisions.

Minimization of soil pollution and land occupation (at the Kozloduy NPP site) – by minimization of land occupation needed for buffer unloading/storage sites for decommissioning waste and when applicable maximum use of the existing civil structures and built-up areas for implementation of the new decommissioning facilities; by use of technologies minimizing the formation of secondary waste and preventing the contamination of the surroundings lands.

Mitigation of the impact on the flora – by using the vegetation sampling within the ongoing radiation monitoring analysis for determination of some non-radiological parameters such as heavy metal contents in plant samples from the 3-km area.

Mitigation of the impact on the fauna - by survey of fauna species present onsite whose habitats would be potentially disturbed (or destroyed) by construction works and provision of a plan for their relocation, if necessary.

Mitigation of the impact on the biodiversity components – by traceability of the impact on the physiological state, behavior reaction and reproductivity of the species as well as assessment of the risks for the protected resources from potential impacts resulting of the NPP vicinity by inclusion in the Site Emergency Decommissioning Plan.

Mitigation of the occupational and public health risk – by implementation of effective individual and collective protective devices for mitigation of the adverse impact on human health: by preliminary planning of decommissioning activities, including time-schedules of the dismantling operations and provision for each dismantling activity or group of dismantling activities specific work procedure, which will contain detailed description of the activity; by strict individual dosimetric control and respect of the regulatory provisions; by systematic application of the ALARA principle, which leads to the minimization of the specific risk of personnel radiation exposure risk.

Mitigation of the socio-economic impact – by utilization of operating personnel preferentially from Kozloduy NPP and recruitment of work force preferentially among the inhabitants of the affected municipalities and relocation of the exempted operational personnel to the decommissioning activities; be opportune update of the developed Program for Management of the Social Consequences from the Decommissioning of Units 1 to 4 at Kozloduy NPP [15], adopted by Kozloduy NPP in 2006 and by adequate training and re-training of the personnel at all levels and work places of the organization.

Measures for minimization and mitigation of harmful impacts to environment and population during the realization of this IP for different environmental factors are presented below in tables.

12.1 Measures for reducing, preventing, or termination of harmful impacts by radiation exposure of the personnel (ALARA principle)

No	Description of the measure	Period/Phase	Result
	Planned measures		
1.	Elaboration of detailed instructions for each dismantling activity.	Decommissioning preparation	Personnel health protection and providing safe working conditions
2.	Maximal removal of all components/equipment of Category 3 and further treatment, after decay storage (KNPP Units 1 to 4 Updated Decommissioning Strategy)	During Decommissioning	Personnel health protection and providing safe working conditions

No	Description of the measure	Period/Phase	Result
3.	Pre-dismantling decontamination of systems and equipment (e.g. Projects 4a and 4b)	Decommissioning preparation	Personnel health protection and providing safe working conditions
	Proposed measures		
1.	Implementation of Units dismantling program and establishment of a data base for traceability of each component of the Decommissioning activities	Decommissioning preparation and during Decommissioning	Personnel health protection and providing safe working conditions
2.	Introduction of additional measures for radiation protection optimization during decommissioning (data base on occupational dose related to activities)	During Decommissioning	Personnel health protection and providing safe working conditions
3.	Implementation of the results from the Quantitative assessment of the materials and the radiological inventory of Units 1-4 of KNPP ([1]Project 11c).	Decommissioning preparation	Personnel health protection and providing safe working conditions
4.	Observing the statutory limits and the adopted administrative limits for the occupational and public dose rate by conducting continuous radiation monitoring. Optimization of the control thresholds for γ-radiation equivalent dose rate corresponding to the respective zones at KNPP site and within the restricted (controlled) zone of the Units	Decommissioning preparation and during Decommissioning	Personnel health protection and providing safe working conditions

[1] Supporting projects of the Decommissioning of Units 1-4 of Kozloduy NPP, financed by KIDSF

12.2 Measures for reducing, preventing, or termination of the harmful impact by radioactive releases to the atmosphere

No	Description of the measure	Period/Phase	Result
	Planned measures		
1.	Provide the gaseous releases control into environment from SRDW based on the appropriate methodology and programs, according to the KNPP radiation monitoring program	Decommissioning preparation	Protection of the atmosphere against radiological impact
2.	The activities related to the preliminary waste conditioning by application of modern technological solutions of decontamination and size reduction in closed cabins with separate filtering systems when applicable (planned for the SRDW project).	Decommissioning preparation	Protection of the atmosphere against radiological impact
3.	SRDW to ensure an effective protection against release of radioactive substances into the environment, including emission of radioactive aerosols into the atmosphere, installed upstream the ventilation stack output.	Decommissioning preparation	Air pollution prevention
4.	The SRDW design to be referenced to the following additional radiation limits: • Equivalent dose rate at a distance of 1.0 m to the external wall of the SRDW up to 1 μSv/h; • Equivalent dose rate for the population up to 0.10 mSv/y.	Decommissioning preparation and During Decommissioning	Environmental and public health protection
5.	Design and implementation of a radiation monitoring system based on the type, quantity and level of contamination of the incoming materials in SRDW.	Decommissioning preparation and During Decommissioning	Environmental and public health protection
	Proposed measures		
1.	Use of mobile systems for capturing and filtering for all activities with potential of aerosols formation.	During Decommissioning	Protection of the atmosphere against radiological

No	Description of the measure	Period/Phase	Result
			impact
2.	Installation of a plant-wide ventilation system for the SRDW (supply and extract) with HEPA filtration having at least 99,97 % efficiency for the gas discharges purification from aerosols	During Decommissioning	Protection of the atmosphere against radiological impact
3.	Provide qualitative and quantitative assessment program for the quantification of the respective emitted radioactive substances on the basis of the type, quantity and level of contamination of the materials to be handled in the SRDW (depending also of the fragmentation level, fragmentation and decontamination methods etc.)	Decommissioning preparation and During Decommissioning	Protection of the atmosphere against radiological impact
4.	Elaboration of the Site Monitoring Program, derived on the basis of the principle of conservatism during sampling of aerosols with periodic update of the sampling points and, if necessary, inclusion of new ones, consistent with the location of the decommissioning activities like the SRDW.	Decommissioning preparation and during Decommissioning	Protection of the atmosphere against radiological impact

12.3 Measures for reducing, preventing, or termination of soils radioactive contamination

No	Description of the measure	Period/Phase	Result
	Planned measures		
1.	Pre-operational radiation monitoring of soil	Decommissioning preparation	Prevention of soil contamination and environmental protection

No	Description of the measure	Period/Phase	Result
	Proposed measures		
1.	Up-date of the sampling points locations for the purposes of soils radiation monitoring, in consideration of the decommissioning activities	Decommissioning preparation	Prevention of soil contamination and environmental protection
2.	To provide the necessary measures for continuous radiation control and environmental protection within the design of the Project for Organization of Sites for Management of Materials generated by the decommissioning of Units 1-4 (Decay Storage Sites for Transitional RAW (DSS) and Site for Conventional Site (SCD)	Decommissioning preparation	Prevention of soil contamination and environmental protection
3.	Update of the scope of the radiation monitoring of the sludge from drain channels dredging in consideration of the decommissioning activities.	Decommissioning preparation and during decommissioning	Prevention of soil contamination and environmental protection

12.4 Measures for reducing, preventing, or termination of the harmful impact by radioactive releases into surface and groundwater

No	Description of the measure	Period/Phase	Result
	Planned measures		
1.	Effective management of the liquid RAW management	Decommissioning preparation	Prevention of radiological contamination of surface and underground water
	Proposed measures		
1.	Implementation of a continuous monitoring program including regular control measures and appropriate maintenance procedures of the Active Drainage Pipework in order to avoid and prevent potential leakages and radioactive contamination	During Decommissioning	Protection of the surface and groundwater against radiological impact

No	Description of the measure	Period/Phase	Result
2.	Elaboration of operational instructions for implementation of process radiation control of the main sources of liquid radioactive discharge related to the dismantling and decontamination of the equipment	Decommissioning preparation	Prevention of radiological impact on surface and groundwater
3.	Elaboration of radiation monitoring program based on the conservative principle of the sampling points selection for the liquid releases with periodic up-date of the sampling points and when applicable incorporation of new ones in reference of the decommissioning activities	Decommissioning preparation and during Decommissioning	Prevention of radiological impact on surface and groundwater

12.5 Measures for reducing, preventing, or termination of the harmful physical factors impact

The program for safety assessment during the period of decommissioning is necessary for assessment and management in order to reduce the risk of impact and ionizing radiation for the personnel of the plant, the population and the environment from the planned activities. It is prepared in accordance with the Updated strategy for decommissioning of KNPP Units 1-4 [7] and is in accordance with the contemporary standards, criteria and the international experience of decommissioning of nuclear facilities, in reference of some specific characteristics. The Concept for radiation protection, presented in the Decommissioning plan [36], provides opportunity to meet the requirements and rules for radiation protection during execution of all planned activities. Also, monitoring programs, instructions, rules, etc. have been developed in accordance with this concept aimed at reducing the radiation impact, including ionizing impact on the environment.

Provided that the measures in the program for radiation protection are implemented, protection measures during execution of the decommissioning activities are not planned.

Provided that the planned decommissioning activities and technologies are performed and the specified machines, equipment and units are used, which according to the documents are not significant sources of migrating EMF, additional impacts on the environment are not expected. This is also confirmed by the EWN experience [50], and no additional measures are proposed.

Additional measures to mitigate the impacts from noise and vibrations during the implementation of the IP are not planned, provided that the planned measures in the projects are applied.

12.6 Measures for reducing, preventing, or termination of the harmful impact related to RAW management

A Complex Program for RAW Management at Kozloduy NPP, ID No:DOD.ED.PM.387/03 [162] was established in order to guarantee safe RAW management.

The program covers all the activities, related to the removal of the RAW back-log from Units 1- 4, AB-1 and AB-2, including their retrieval from the specialized temporary RAW storage facilities as well as the activities for management of decommissioning generated RAW.

In order to mitigate the adverse impact for the environment and human health due to RAW generation during the decommissioning of the units, the basic requirements and main provisions of the developed Complex Program for RAW Management at Kozloduy NPP [162] shall be observed. A review of internationally used RAW management techniques and methods is currently being developed and the result shall be applied for the specific case.

No	Description of the measure	Period/Phase	Result
	Planned measures		
1.	Construction of Size Reduction and Decontamination Workshop (SRDW) (Project 12) in application of the relevant safety and environmental protection measures	Decommissioning preparation	Environmentally friendly and safe RAW management; human health protection
2.	Construction of Sites for Management of Materials generated by the decommissioning of Units 1-4 (Project 19) in application of the relevant safety and environmental protection measures	Decommissioning preparation	Environmentally friendly and safe RAW management; human health protection
3.	Construction of Facility for Treatment and Conditioning of Solid RAW with High Volume Reduction Factor (RWT) (Project 5b) in application of the relevant safety and environmental protection measures	Decommissioning preparation	Environmentally friendly and safe RAW management; human health protection
4.	Supply of Facility for Treatment of Low Level Liquid RAW (Danube system) in application of the relevant safety and environmental protection measures	Decommissioning preparation	Environmentally friendly and safe RAW management; human health protection

No	Description of the measure	Period/Phase	Result
5.	Facility for Retrieval and Stabilization of Spent Ion Exchange Resins (RES) (Project 5a) in application of the relevant safety and environmental protection measures	Decommissioning preparation	Environmentally friendly and safe RAW management; human health protection
6.	Facility for Free Release Measurement (FRM) (Project 6a) in application of the relevant safety and environmental protection measures	Decommissioning preparation	Environmentally friendly and safe RAW management; human health protection
7.	Supply of Equipment for Retrieval and Processing of the Liquid Phase from Evaporator Concentrate Tanks (LPR) in AB-1 (Project 9a) in application of the relevant safety and environmental protection measures	Decommissioning preparation	Environmentally friendly and safe RAW management; human health protection
8.	Supply of Equipment for Retrieval and Processing of the Solidified Phase from Evaporator Concentrate Tanks (SPR) (Project 9b) in application of the relevant safety and environmental protection measures	Decommissioning preparation	Environmentally friendly and safe RAW management; human health protection
9.	Supply of different type of containers for transport and storage of materials resulting from dismantling works (WCP) (Project 11b) in application of the relevant safety and environmental protection measures	Decommissioning preparation	Environmentally friendly and safe RAW management; human health protection
10.	Supply of mobile equipment for decontamination and purification of water (DTE) (Project 4a) in application of the appropriate safety and environmental protection measures.	Decommissioning preparation	Environmentally friendly and safe RAW management; human health protection
Proposed measures			
1.	Inventory of the quantities and the processes of treatment of the liquid and solid radioactive waste resulting from the dismantling activities as well as monitoring of the sites for temporary storage of	Decommissioning preparation and during Decommissioning	Environmentally friendly and safe RAW management; Human health protection

No	Description of the measure	Period/Phase	Result
	the containers with waste, and tracking of all these data by using of adapted database system for Complete Waste Tracking similar to this used by the EWN decommissioning project		

12.7 Measures for reducing, preventing, or termination of the harmful impact by non-radioactive emissions to the atmosphere

No	Description of the measure	Period/Phase	Result
	Planned measures		
1.	With regard to the intensive traffic on the site territory during the decommissioning to provide control for the use of transport vehicle in good shape.	Decommissioning preparation and during Decommissioning	Air quality protection
	Proposed measures		
1.	Use of mobile systems for capturing and filtering for all activities with potential of aerosols formation.	During Decommissioning	Air quality protection against radiation contamination
2.	During transportation and storage of bulk material the following measures have to be applied: 1. The sand shall be stored by using windproof enclosures or tips; protection covers of the surface; reduction of the bulk tips height; avoiding of these activities at high wind speed 2. Construction of closed type storage sites for zeolite 3. Optimization of the handling activities by reduction of the uploading height, etc.; automatic modification of the	During Decommissioning	Air quality protection Prevention of unorganized dust emissions dispersion

No	Description of the measure	Period/Phase	Result
	uploading height in reference of the tips height modification; 4. The transportation of these materials shall meet the following requirements: use of closed or covered transport vehicles including the internal site transport; the transport routes to be regularly cleaned up and covered with asphalt layer in reference of the level of pollution		

12.8 Measures for reducing, preventing, or termination of the harmful impact by soil pollution

No	Description of the measure	Period/Phase	Result
	Proposed measures		
1.	Update and realization of the second stage of the Repository for conventional waste	Decommissioning preparation	Soil and environment protection
2.	The existing radiation monitoring network to be used for determination of non-radiation characteristics of soils as soils acidity, general heavy metal content during sampling analyses etc.	Decommissioning preparation	Soil and environment protection
3.	The fertile humus layer from the lands where new construction is planned should be removed and stored separately for conservation according the provisions of Regulation N 26 of 2 October 1996.	Decommissioning preparation	Soil and environment protection
4.	Provide non-radiation monitoring of the drain channels sludge dredging.	Decommissioning preparation and during decommissioning	Soil and environment protection

12.9 Measures for reducing, preventing, or termination of the harmful impact by non-radioactive releases into surface and ground water

No	Description of the measure	Period/Phase	Result
	Proposed measures		
1.	With regard to the intensive traffic on the site territory during the decommissioning to provide control for the use of transport vehicle in good shape.	Decommissioning preparation and during Decommissioning	Protection of surface and groundwater quality
2.	Water supply pipelines and fittings should be maintained in good operating condition in order to prevent leakages and losses.	During Decommissioning	Water resources protection Protection of groundwater from contamination
3.	With regard to the sensitivity of this region to pollution by nutrients continuous control of Units 1-4 sewage waters shall be followed for nutrient pollution. In case of systematic pollution a module for sewage water biological treatment incorporating denitrification stage sell be implemented.	During Decommissioning	Protection of surface and groundwater quality
4.	Continuous control for organized and permits compliant waste water discharge in the existing and newly built (e.g. Size reduction and decontamination workshop) KNPP sewage system.	During preparation for Decommissioning	Protection of surface and groundwater from contamination
5.	Measures to prevent (isolate) potential interaction of the sewage system with the ground water.	During preparation for Decommissioning and during Decommissioning	Protection of surface and groundwater from contamination

12.10 Measures for reducing, preventing, or termination of the harmful impact by conventional waste management

The best way according to EWN experience [50] is the elaboration of a manual for conventional waste management with detailed instructions for all waste management activities. This instruction must be elaborated under consideration of the relevant requirements of the BREF. Another important stipulation in the manual for conventional waste management must be the control/auditing of waste treatment facilities which receive waste from KNPP and SE RAW.

No	Description of the measure	Period/Phase	Result
	Planned measures		
1.	Supply of complex weight platform for transport vehicle station (Project 6e)	During Decommissioning	Environmentally friendly waste management
	Proposed measures		
1.	The management of the construction waste generated by the decommissioning of Units 1 to 4 shall be in compliance with the requirements of the Regulation on construction waste management and use of recycled construction waste (promulgated SG89/13.11.2012)	Decommissioning preparation	Environmentally friendly waste management
2.	Organize separate collection and transportation of the demolition wastes and avoid their mixture by establishing Operating Instructions and Execution Procedures	Decommissioning preparation and during Stages 1 and 2 of the Decommissioning	Environmentally friendly waste management
3.	The waste generated by the site activities to be handed over based on written contracts to operators holders of the respective authorization under art.35 of the Waste Management Act (WMA)	Decommissioning preparation and during Stages 1 and 2 of the Decommissioning , Closure and reclamation	Environmentally friendly waste management
4.	The Problem with	Decommissioning preparation	Environmentally

No	Description of the measure	Period/Phase	Result
	the obsolete chemicals should be solved stage by stage and this waste should be treated as hazardous waste	and during Stages 1 and 2 of the Decommissioning	friendly waste management
5.	Establish and maintain a database on waste generation sources, quantities, and the companies, to which it was handed over for further treatment, facilitating the waste inventory management in compliance with the WMA provisions.	Decommissioning preparation and during Stages 1 and 2 of the Decommissioning	Environmentally friendly waste management
6.	The handing over and reception of the operational, construction and harmful waste to be performed on the base of written contract with operators holding a permit or registration document under art.35 for the respective activity with the respective code of the waste storage site, according the regulation under art. 3 of waste classification and in compliance with art.8 of the WMA.	Decommissioning preparation and during Stages 1 and 2 of the Decommissioning	Environmentally friendly waste management
7.	It is recommended to require from the Supplier to submit	Decommissioning preparation and during Stages 1 and 2 of the Decommissioning	Minimizing the negative impact from the hazardous

No	Description of the measure	Period/Phase	Result
	safety data sheets in compliance with the Act on the Protection from the Negative Effect of the Chemical Substances and Mixtures (or the European Regulation (EC) No 1272/2008 on Classification, Labeling and Packaging of Substances and Mixtures (CLP Regulation)		substances and mixtures

12.11 Measures for reducing, preventing, or termination of the harmful impact to earth bowels

No	Description of the measure	Period/phase	Result
	Planned measures		
1.	Observation of the established instructions, procedures, methods and programs for the implementation of technological radiation control of the main sources of liquid releases and radioactive contamination, related to the dismantling and decontamination of the facilities.	Decommissioning preparation	Protection of the geological environment and the associated groundwater bodies from radiological impacts.
2.	When construction works are performed, the sites should be approved by a geological engineer.	During Decommissioning	Prevention of the occurrence of local technogenic engineering geological processes
3.	Monitoring of the geological environment in terms of its stability should be performed.	During Decommissioning	Prevention of technogenic engineering geological processes and phenomena

No	Description of the measure	Period/phase	Result
4.	Control of the protection of the surface and ground waters from chemical pollution as a preventive measure for preservation of the geological environment.	Permanently	Protection of the geological environment

12.12 Measures for reducing, preventing, or termination of the harmful impact on the landscape

Harmful effects on the landscape are not expected due to the fact that the decommissioning activities in all stages and the implementation of the supporting projects (such as: Size Reduction and Decontamination Workshop, Decay Storage Site for Transitional RAW and Site for Conventional Waste from Decommissioning) will take place within Kozloduy NPP site.

12.13 Measures for reducing, preventing, or termination of the harmful impact on the natural objects

Due to the expected little impact on the natural objects located outside of KNPP site, special measures for mitigating the harmful impacts on them are not planned, except for compliance with the best practices during Decommissioning preparation, Decommissioning process and closure and restoration of KNPP Units 1-4. In order to avoid a cumulative effect from the decommissioning activities for KNPP Units 1-4, the operation of KNPP Units 5-6 and the National storage for radioactive waste, the main objective during operation of all specified objects is keeping the levels of all releases in compliance with the permitted ones in the license and application of specific technical solutions ensuring the safety of the environment.

12.14 Measures for reducing, preventing, or termination of the harmful impact on the biodiversity - flora

No	Description of the measure	Period/Phase	Result
	Proposed measures		
1.	To avoid additional impact on the flora in the adjacent territories during the construction activities on building, equipment and commissioning of the Sites for management of the material from decommissioning of Units 1-4, the associated transport infrastructure and 300 m of railroad.	Decommissioning preparation	Biodiversity protection
2.	It is recommended to use plant samples from the radiation monitoring for determination of some conventional parameters such as heavy metals content	During Decommissioning	Biodiversity protection

No	Description of the measure	Period/Phase	Result
	in plants in the 3-km area.		

12.15 Measures for reducing, preventing, or termination of the harmful impact on the biodiversity - fauna

No	Description of the measure	Period/Phase	Result
	Proposed measures		
1.	Monitoring of fauna species present onsite including the ex-marsh land of Kozloduy, whose habitats would be potentially disturbed (or destroyed) by construction works is recommended. A plan must be developed to relocate habitats elsewhere.	During Decommissioning	Biodiversity protection
2.	It is recommendable to investigate if there is impact on the physiological, behavioral and reproduction status of the animal species, subject of conservation in the protected areas Zlatiata SPA and Kozloduy Islands SAC (SCI) as well as the risks of likely impact related to their proximity to the KNPP site.	During Decommissioning and in Post decommissioning phase	Biodiversity protection

12.16 Measures for reducing, preventing, or termination of the harmful impact on the human health

The impact on the occupational health from the processes and activities of KNPP Units 1-4 decommissioning will consist in exposure to general dust and noise for the construction workers. During the installation and assembly works some working groups will be exposed to general and local vibrations, metal aerosols, infrared and ultraviolet radiation (welding). There are effective devices for collective and personal protection against the exposure of these conventional factors and their use will minimize the unfavorable health effect.

Concerning the impact on the occupational health due to ionizing radiation, all activities planned to be implemented will be conformed to the health and safety protection of the working staff and the population. The decommissioning activities shall be preliminarily planned and this shall include elaboration of dismantling activities time-schedule, taking into account that for each decommissioning activity or group of activities, in reference of its complexity, a separate working package/procedure containing detailed activity description is provided. It is opportune to mention also the high level of safety culture in Kozloduy NPP and systematic

application of the ALARA principle, minimizing the specific risk of occupational radiation exposure.

Concerning the health risk for the population in consequence of the KNPP Units 1 to 4 decommissioning it should be stated that the public health impact is almost zero, taking into account that the hazardous/radioactive materials, as well as the construction works, source of adverse impact, will not cross the fence of the NPP site, thus in this case no measures for mitigation of the impact on the public health in relation with the IP implementation are needed.

12.17 Measures for reducing, preventing, or termination of the harmful impact on the cultural and historical heritage

Harmful effects on the sites of cultural and historical heritage are not expected due to the fact that the decommissioning activities in all stages and the implementation of the supporting projects (such as: Size Reduction and Decontamination Workshop, Decay Storage Site for Transitional RAW and Site for Conventional Waste from Decommissioning) will take place within Kozloduy NPP site, where no cultural relics or archaeological findings were identified.

12.18 Measures for reducing, preventing, or termination of the negative socio-economic effects

No	Description of the measure	Period/Phase	Result
	Planned measures		
1.	Periodical update of the Program for management of the social consequences from decommissioning of Units 1-4 of Kozloduy NPP, approved in 2006 by the KNPP [157]	Decommissioning preparation and during Decommissioning	Reduction of the negative socio-economic impact
2.	Based on the Agreement between KNPP and State Enterprise RAW (SE RAW), part of EP-1 personnel to be relocated (reemployed) by	Decommissioning preparation and during Decommissioning	Reduction of the negative socio-economic impact

No	Description of the measure	Period/Phase	Result
	State Enterprise RAW		
	Proposed measures		
1.	SE RAW Management to provide funding for application of measures aiming to preserve the highly qualified personnel, employed so far in the operation of the four shutdown Units	Decommissioning preparation and during Decommissioning	Reduction of the negative socio-economic impact
2.	To provide conditions and mechanisms for vocational retraining of former operational personnel of the shutdown Units in order to integrate them in the decommissioning process	Decommissioning preparation and during Decommissioning	Reduction of the negative socio-economic impact
3.	Suggestion to organize meetings-interviews with each one of the staff of the suspended Units in order to clarify the options, preferences and opportunities for redirection, prequalification, additional training to acquire new	Decommissioning preparation and during Decommissioning	Reduction of the negative socio-economic impact

No	Description of the measure	Period/Phase	Result
	knowledge and skills or preferences for early retirement		
4.	The Management of SE RAW in cooperation with the Administration of the affected municipalities should seek opportunities to develop joint projects for development of SE RAW production and servicing activities, through which to provide employment and income to part of the population of the region, and to consider the opportune policy to offer jobs with priority to people from the affected municipalities.	Decommissioning preparation and during Decommissioning	Reduction of the negative socio-economic impact

12.19 Measures for minimization of fire risks and fire consequences

No	Description of the measure	Period/Phase	Result
	Planned measures		
1.	In order to mitigate the adverse impact and risk of fire for the environment and the population during the decommissioning of the Units, the requirements of the respective decommissioning procedures shall be observed, aiming	Decommissioning preparation and during Decommissioning	Human health protection and environmental protection

No	Description of the measure	Period/Phase	Result
	to avoid occurrence of fire and to observe the fire protection rules.		
	Proposed measures		
1.	In the framework of the elaboration of Decommissioning Safety Analysis Report to assess the fire risk and to propose appropriate measures for fire occurrence prevention and limitation of fire consequences	Decommissioning preparation and during Decommissioning	Human health protection and environmental protection

12.20 Emergency planning with regard to the modifications related to risk of accidents in decommissioning conditions

No	Description of the measure	Period/Phase	Result
	Planned measures		
1.	To observe strictly the requirements and instructions stated in the approved Updated Emergency Plan of Kozloduy NPP [132], including activities during decommissioning of Units 1-4.	Decommissioning preparation (design of the planned facilities) and during Decommissioning	Human health protection and environmental protection
2.	The internal emergency plans of the Units to be maintained in full compliance with the up-dated Emergency Plan of KNPP and to be strictly applied for all accident scenarios including the limiting events regarding the occupational, public and environmental risks.	During Decommissioning	Human health protection and environmental protection

13. Environmental monitoring

The EIAR provides a detailed description of the existing environmental KNPP and Se RAW in-house monitoring, as well as the proposed on-going monitoring of the environmental components and factors during the implementation of the decommissioning activities on Units 1 to 4 of Kozloduy NPP and after their completion according to the In-house Environmental Non-Radiological Monitoring Program and Environmental Radiological Monitoring Program.

The current non-radiological KNPP and SE RAW in-house monitoring will be in use during the implementation of the decommissioning activities on Units 1 to 4 of Kozloduy NPP. Independently of this, additional measures for some of the environmental components are recommended for implementation during the decommissioning. For the soils, for instance, it is suggested that the results from the radiation monitoring will be used for determining additional non-radiation parameters of the soils (e.g. soil acidity – pH, humus and clay content (single sample) from which the migration of the soils elements including this of the radioactive isotopes depends. The following additional activities for water monitoring are recommended: to update the in-house non-radiation water monitoring programs by adapting them to the decommissioning activities including adding new monitoring points to the monitoring network in connection with the new decommissioning activities; monitoring for possible leaks from the locations where waste from the dismantling is accumulated.

Additional activities in connection with the Waste Monitoring according to the Conventional Waste Monitoring Program during the KNPP operation are also proposed.

The existing radiation and environmental radiological monitoring at Kozloduy NPP will continue to be applied during the KNPP Units 1 to 4 decommissioning activities implementation. The radiation monitoring of the environment will be organized and will follow the current in-house radiation monitoring of the radioactive gaseous aerosol and liquid radioactive discharges from the decommissioning, as well as of the content of anthropogenic nuclides into the environmental components and the nutrients in the Kozloduy NPP region. Fig. 13-1 shows the layout of the environmental radiological monitoring stations in the areas around Kozloduy NPP and fig. 13-2 shows the layout of the radiation monitoring stations and the Thermo Luminescent Dosimeters (TLDs) at the Kozloduy NPP site.

Independently of this, additional radiation monitoring for some of the environmental components is proposed to be performed during decommissioning. For instance: based on the conservatism principle for the soil sampling programs, regular updating of the sampling points and (if necessary) inclusion of new sampling points reflecting the location of the decommissioning activities shall be necessary. Additional soil radiation monitoring may become necessary in the case of occurrence of radioactive leakages. The existing radiation monitoring of waste and the related facilities and sites during implementation of the decommissioning shall continue, and the following main additional activities related to waste monitoring are also recommended:

– Radiation monitoring of the sites for temporary storage of the containers containing RAM from dismantling of the facilities;

The radioactive aerosols are a tangible risk for internal radiation in the process of the dismantling activities, which requires that the rigorous individual dosimetric control should continue and the regulatory requirements should be complied with. As for the exposure to conventional harmful physical factors, effective devices for collective and personal protection should be used, which will minimize the adverse impact on human health.

In the area of influence of Kozloduy NPP on the Romanian territory the National Environmental Radioactivity Surveillance Network (NERSN) in Romania performs two programs of environmental radioactivity surveillance, which operate in parallel:

– Standard Surveillance Environmental Radioactivity Program – simultaneously performed by all SSRM. In the Standard Program all SSRM has the same sampling and analysis schedule.
– Special Surveillance Environmental Radioactivity Program – individually performed by every SSRM, under NEPA's coordination. The Special Program assumes that every laboratory has its own monitoring program within its competence area.

In Romania, the National Environmental Radioactivity Surveillance Network (NERSN) ensures the radiological monitoring in the influence area of Kozloduy NPP– Bulgaria at 4 laboratories, called Surveillance Stations for Radioactivity Monitoring (SSRM): SSRM Bechet, SSRM Craiova, SSRM Drobeta Turnu Severin and SSRM Zimnicea, and 13 automatic monitoring stations for determination of the gamma background in Dolj county, in Mehedinti county and in Teleorman county.

Fig. 13-1 Environmental Radiological Monitoring Stations in the Kozloduy NPP region.

Type "A" Monitoring Station: aerosols, atmospheric particulates, soils, vegetation, γ-background(TLD) – 11 pcs.
Type "B" Monitoring Station: atmospheric particulates, soils, vegetation, radiation γ-background (TLD) – 15 pcs.
Type "C" Monitoring Station: water, sediments, algae, radiation γ-background – 7 pcs.

Food stuff *Potable water* *milk;* *fish* *Cereals*

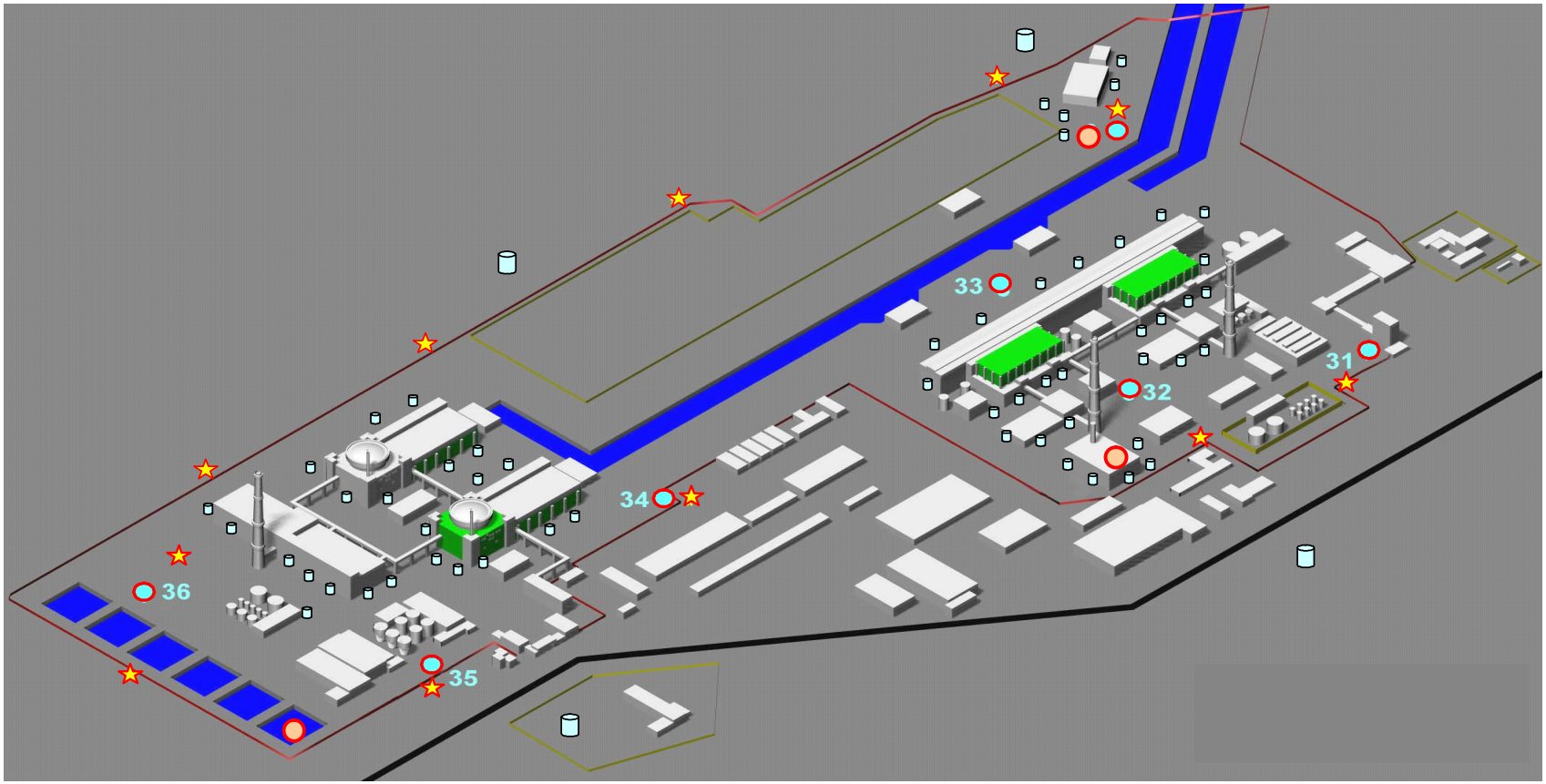

Fig. 13-2 Layout of the Radiation Monitoring Stations and the Thermo Luminescent Dosimeters (TLDs) at Kozloduy NPP Site.

- Type "B" Monitoring Station: atmospheric particulates, soils, vegetation, radiation γ-background – 7 pcs.
- TLD (type: TLE-4), located at KNPP site fence – 10 pcs.
- More than 180 test-pits for groundwater monitoring on the KNPP site + 4 reference drill holes outside the KNPP site
- Aerosol monitoring station – 3 pcs.

14. General conclusions

Based on the results from the EIAR and the experts' conclusions, in summary it can be stated that the assessed impacts on the environment and on people as a result of the Decommissioning of Units 1 to 4 of Kozloduy NPP during Stage 1 and Stage 2, and as a result of the new projects in the Pre-decommissioning phase (such as: Size Reduction and Decontamination Workshop, Decay storage sites for transitional RAW and for conventional waste from decommissioning) and the Closure and land restoration stage, can be assessed as very low, taking into account that:

- The radiological impacts will be limited to significantly lower levels than those immediately after the KNPP Units 1 to 4 final shutdown and will be considerably reduced compared to the Units' operational phase. The radiological impacts can be reduced to even lower levels through consistent application of the ALARA principle, which is successfully applied to all previous activities performed on the Kozloduy NPP site. Transboundary radiological impacts are not expected.
- The non-radiological impacts of the decommissioning activities such as generation of conventional waste and harmful emission have been assessed as very low, local in terms of impact and short-term in terms of duration. Transboundary non-radiological impacts are not expected.

In conclusion it can be summarized that the impacts on the environment and the people in the process of implementation of the decommissioning activities for Units 1 to 4 of Kozloduy NPP are expected to be very low and will be reduced further by application of the proposed measures reducing, preventing, or termination, and the performed environmental monitoring.

15. Requirements of the Romanian Ministry of Environment and Forest

In the tables below the Romanian Ministry of environment and forest requirements, their fulfillment in the respective EIA Report chapter and comments are listed.

General Romanian requirements

No.	Romanian requirements	Proposal for addressing the comment (references to the corresponding chapter in the relevant document -EIAR chapter, NTS, CAR or else)	Comments
1.	Presentation of possible alternatives referring to decommissioning of nuclear reactors and description of the methods and the techniques of treatment, neutralization and final disposal of waste resulting from decommissioning activities	The alternatives are considered in EIAR Chapter 2; techniques and treatment of waste are considered.	According to the updated Strategy, the final disposal of the RAW is foreseen in a National repository and is thus subject of another EIA procedure. For Bulgarian National Disposal Facility, Romania should be informed in detail about the procedure according Espoo.
2.	Description of measures to prevent and limit the effects and potential impact caused by radioactive pollution.	Considered in EIAR chapter 6.	
3.	The manner of guarantee and assurance of financial resources necessary for ensuring the means of preventive treatment and subsequent treatment of situations of radioactive contamination that may occur in the environment in Romania (the potential impact of radioactive contamination on animal and vegetable bodies from the Project range of action) and also the radioactive decontamination costs, incurred, damage compensation and remediation brought to the environment and consequently to the population.	Considered in EIAR Chapter 4 and in the Compatibility assessment report (CAR).	This question is more important for the operating Units. The stated issue is broader than the Decommissioning Project Range and the subject of EIAR. The clarification on a high level (governments) is necessary. The contamination of Romanian territories is not expected.
4.	Presentation of the monitoring and management programs of decommissioning activities and also, elaboration of a program to monitor the degree of radioactivity contamination in the situation of producing such phenomena.	Considered in EIAR Chapters 1, 6 and Attachment 11.6.	

5.	Presentation of possible sources and causes of radioactive pollution, radiation monitoring and characterization of .possible radioactive effluents, methods, means and measures or actions needed for decontamination in order to comply with the permitted limit values (in terms of radioactive contamination) when they are discharged into natural receivers.	Considered in EIAR Chapters 1, 3 and 4.	
6.	Compliance with the Community regulations in force relating to nuclear security measures imposed by the International Atomic Energy Agency standards and norms in force on this issue.	Radiation protection is considered in EIAR chapter 1. The compliance with all EU and IAEA requirements is stated in Chapter 2 and NTS. The information about the SNF management is a separate part under the operating license and is described in Chapter 1.	
7.	Description of the way of assuring the means to inform, educate and aware the affected public or likely to be affected by this project.	This matter is the responsibility of the relevant authorities in both countries.	
8.	It is also necessary that during the decommissioning works, the Bulgarian side should inform the Romanian side upon the schedule of that works, so that the population from the affected area or likely to be affected to be informed, educated and aware in time.	This matter is the responsibility of the relevant authorities in both countries.	
9.	It is also necessary that the Bulgarian party to inform Romanian party on any technical incident/accident produced during the decommissioning works and because of which radio-nuclides or radiations are issued in environment, giving rise to -radiation level or raise .the level of radioactive contamination of the animal and vegetal organisms. In this respect, correct and concrete measures and actions must be taken in time for preventing contamination.	This question is more important for the operating Units. This matter is the responsibility of the relevant authorities in both countries.	
10.	A special chapter on the impact of	Transboundary impact	Presented in EIAR Chapter 4,

<table>
<tr><td></td><td>environmental factors on the Romanian territory.</td><td>is included as separate document of the EIAR.</td><td>in the document transboundary aspect of IP and in the CAR.</td></tr>
<tr><td>11.</td><td>On both banks of the Danube sector comprised around Kozloduy city (Bulgaria) there are Nature 2000 sites and natural protected areas. On the Romanian bank there are the following Natura 2000 sites protected under the Habitats and Birds Directives, respectively:
<table>
<tr><td>RQSPA001Q</td><td>Bistret River</td></tr>
<tr><td>RO.SPA0023</td><td>Jiu river-Danube River Confluences</td></tr>
<tr><td>ROSCI0045</td><td>Corridor of Jiu river</td></tr>
</table></td><td>Considered in EIAR chapter 4, document “Transboundary impact” and CAR.</td><td></td></tr>
<tr><td>12.</td><td>The proposed decommissioning project may have a negative impact on protected natural areas located on both banks, both nearby and also in the closest vicinity that is why an appropriate assessment must be carried on according to the Habitats Directive.</td><td>Considered in chapters 3,4 and CAR and presented in the document “Transboundary aspect” of IP</td><td></td></tr>
</table>

Specific Romanian requirements

No.	Specific requirements	Proposal for addressing the comment (references to the corresponding chapter in the relevant document -EIAR Chapter, NTS, CAR or else)	Comments
1.	A comparison between the analyzed decommissioning strategies taking into, account criteria of impact on the population and the environment, -with reference to the transboundary effects.	Considered in EIAR Chapters 1 and 2.	
2.	The justification of the selected period for the implementation of decommissioning activities (2012-2035) through immediate dismantling and the identification of the risk factors which can affect the deployment of the decommissioning in this period or even-to stop the activity.	Considered in EIAR Chapters 1 and 2.	
3.	The identification of the decommissioning stage (stages) which would raise a maximum risk for the radiological safety if the decommissioning activity would be suspended and if, in this case, a transboundary risk for the population and environment could occur.	Considered in EIAR Chapters 1 and 2.	
4.	A summary of the financing arrangements after 2013, when the UE financial support will cease, taking into account that the decommissioning is planned to be completed by 2035. It should be analyzed: the consequences of the lack of money after 2013, the-effects of the costs increasing on the nuclear safety and on the management of radioactive waste removed from the NPP area and the proposed measures-1 in this case.	General information in Introduction and Chapter 1.	Decommissioning funding is organized after 2013 by a Bulgarian Decommissioning Fund and RAW management Fund.
5.	The project management, including the measures taken in order to use the proper decommissioning technologies and to ensure the most competent staff, to get a maximum efficiency in the decommissioning activities and to reduce as much as possible the potentially consequences on the environment. It should be identified those operations which, during the decommissioning, could lead to the release of toxically effluents with environmental impact and to present the measures to minimize their occurrence and	The requirements are considered in the EIAR Chapters 1, 2 and 4.	

	consequences.		
6.	A presentation of the facilities, including their location, and of the radioactive waste management steps (decontamination, pre-treatment, treatment, conditioning, storage, and disposal) for all ILW and HLW. Which is the up-dated commissioning schedule for radioactive waste management facilities, how is it correlated with the decommissioning activities and which are the proposed measures for the management of radioactive waste in the case of delay or even impossibility to put into operation the necessary facilities (for instance, treatment and conditioning plant – "Plasma Melting Facility" – or the National Repository for Low and Intermediate Level Waste).	The RAW from decommissioning is considered in the EIAR Chapter 1, 2, 3, 4 without High Level RAW.	
7.	A presentation of the purification systems for the radioactive gases and other chemicals which can be harmful for population and environment. How these systems behave in normal and abnormal conditions (high concentrations of effluents with possible transboundary effects can occur).	Considered in EIAR Chapters 1, 2 and 3.	
8.	Information about the release and control of radioactive liquid or harmful effluents from the decommissioning area and from the radioactive waste management facilities, in normal and abnormal conditions, and if such liquid effluents can reach the Danube river in certain circumstances;	Considered in EIAR Chapters 1, 3 and 4.	
9.	Taking into consideration that there is the possibility that the aquatic environment may be contaminated on long or temporary term, what is the effect of harmful effluents on aquatic biological components.	Considered in EIAR Chapters 1, 3 4 and CAR.	
10.	What is the impact of contamination with radioactive and non-radioactive substances of the aquatic ecosystem.	Considered in EIAR Chapters 4, 6 and CAR.	
11.	What measures should be taken not to affect in the short/long term the biological components and the water quality.	Considered in EIAR Chapters 4, 6 and CAR.	
12.	Assessments to prove that in normal operating conditions, the release of the gaseous and liquid effluents will not cause an exposure which can affect the human health from another member state.	Considered in EIAR Chapters 3 and 4 and presented in the document "Transboundary aspect" of IP	
13.	Which are the internal; risk factors (human errors, technical disturbances) or external	The risks are described in Chapter 4 and in the	

	that can initiate undesirable events in decommissioning activity and in the operation of .radioactive waste management facilities, leading to the release of-gaseous arid liquid effluents with transboundary effects and which are the proposed' measures to minimize their negative effects. In this respect, it should be noted if a safety assessment of the decommissioning activity has been performed, by considering the individual elements that can affect the safety of decommissioning, by analyzing the radiological risks which can occur and the measures to prevent and diminish their effects and also the transboundary effect at, short, medium and long distance.	document "Transboundary aspect" of IP.	
14.	The assessment and analyze of some scenarios for the situation in which emissions of radioactive effluents will occur following an incident (e.g. equipments failure, electricity switch-off, fires caused by electrical faults, etc),or a severe accident (major fire, floods, earthquake, strong storm, lightening, explosion). The dozes which can affect the Romanian population health should be mentioned. The probability of a severe accident should be established and a simulation of such severe accident and its consequences should be performed, using a validate computer code (COSYMA, -RODOS, etc). An example of severe accident which should be assessed is that of an airplane crash on the decommissioning area or on the. Radioactive waste management area, leading to the physical destruction of the structures followed by the initiation of a major fire, resulting in radionuclide spreading and their deposition on the Romanian territory. The nature of spread radionuclide and the doze caused by radiological exposure should be determined and the radiological hazard should be established.	The risks are described in Chapter 1 and in the document "Transboundary aspect" of IP.	
15.	Information regarding the levels for releasing from the license conditions of the field, buildings, materials and equipments considered as conventional waste, to be recycled or reused according the criteria required by the fundamental safety norms (Directive 96/29./Euratom).	References to the regulation (Radiation Protection Ordinance) in the Chapters 1, 5 and 9	
16.	Information regarding radioactive waste management released from the regulatory	References to the regulation (Radiation Protection	

	control, if this is the case.	Ordinance) in the Chapters 1, 5 and 9	
17.	The manner of treatment, conditioning and storage of highly radioactive wastes (less of burned fuel), during decommissioning and especially after its closing.	The treatment of activated components is described in Chapter 1.	Out of scope of this EIAR.
18.	Non-radioactive and radioactive liquid waste treatment and their impact on water, especially on the Danube River.	Considered in EIAR, Chapters 1, 3 and 4.	
19.	Management of hazardous substances used during decommissioning activities.	Considered in EIAR Chapters 1, 3 and 4.	
20.	Information, regarding the spent fuel storage and the time when a geological repository (Landfill) will be available.	Out of scope of this EIAR.	
21.	Which are the discharge derived limits of the radioactive effluents under normal conditions and which are the corresponding doses of these limits for the Romanian population?	Considered in EIAR Chapters 1, 3 and 4 and in the document "Transboundary aspect" of IP.	
22.	We must stress further upon the requirements of the Romanian Ministry of Health, as follows: A. Establishment of a Romanian-Bulgarian monitoring program for the radioactive component in the air, water and soil in the areas possible affected. Such a program must include both the environmental authorities and the health authorities on the both sides o f the Danube (Romanian and Bulgarian). The program must be targeted to: - a quick announcement of the exceeded permitted dose, and - an increase in the frequency determinations as compared to the number of determinations done usually. B. Romanian side should be informed of the proposed emergency actions for the Romanian affected population, foreseen in case-of an accident/incident Also, Romanian authorities require receiving the emergency plan-issued for radiological accidents/incidents situations, with proposed actions for both sides. C. To make available as soon as possible, a - more detailed schedule of decontamination activities at Kozloduy.	A separate monitoring program for decommissioning is not necessary because the existing monitoring program is also used during the decommissioning.	A.) A common radiological monitoring program Bulgaria-Romania has to be negotiated on a high level (between Romanian and Bulgarian governments). B.) This question is more important for the operating units. This matter is the responsibility of the relevant authorities in both countries.. C.) Out of scope of this EIAR.
23.	The transboundary impact chapter of the EIA	Considered in EIAR	

	report must comprise the radiological impact study on human health. This study must estimate the individual and population risk in excess using estimated levels of exposure and data on excess risk according to ICRP 103, for diseases associated with exposure to ionizing radiation (incidence and mortality from malignant disease, birth defects, and developmental defects). This appraisal must cover both the situation of normal development of activities and the „worst case scenario". Given the significant levels of non-radiological contamination of the environmental factors (air, groundwater, surface water) it is necessary that the EIA report to be completed by the synergic effects of their action on the population within the area of influence of the NPP.	Chapter 1, section 1.14, Chapter 3 and in the TI document.	
24.	Description of the treatment, conditioning and storage of highly radioactive waste from decommissioning. It is necessary to explicitly include the impact analysis of liquid waste on the Danube.		This is out of scope of this EIAR.
25.	EIA report must contain a description of the mitigation measures to reduce as much as possible the environmental impact, including measures for protection of terrestrial and aquatic fauna and flora and biodiversity. The document must specify the place and the transport mode for high active waste as well as preventive measures in case of accident during dismantling and transport.	Considered in Chapter 6.	
26.	Taken into account the Romanian communities existing within the 30-km area we consider of great importance the effects of the project to be well addressed in the EIA report.	Considered in EIA R Chapters 1, 3 and TI document.	