Environmental Impact Assessment Report

for the Decommissioning of Units 1 to 4

at Kozloduy Nuclear Power Plant

CHAPTER 4

IDENTIFICATION, ANALYSIS AND ASSESSMENT OF THE FORESEEABLE IMPACT ON THE PEOPLE AND ENVIRONMENT AS A RESULT OF THE IMPLEMENTATION OF THE INVESTMENT PROPOSAL, THE USE OF NATURAL RESOURCES AND HARMFUL EMISSIONS DURING THE NORMAL OPERATION AND IN EMERGENCY SITUATIONS, GENERATION OF WASTE AND DISCOMFORT

CONTENTS

4. Identification, analysis and assessment of the foreseeable impact on the people and environment as a result of the implementation of the investment proposal, the use of natural resources and harmful emissions during the normal operation and in emergency situations, generation of waste and discomfort

The direct impacts on the people and environment caused by the decommissioning of Units 1-4 at Kozloduy NPP based on n the EWN experience [50] with the decommissioning of Greifswald NPP are described, assessed and presented in Appendices 11.4.1 and 11.4.2.

4.1 Atmosphere

During the implementation of the investment proposal for decommissioning of Units 1 to 4 of Kozloduy NPP it generally can be stated that the Pre-decommissioning Stage (PDS), Stage 1 and Stage 2 of the Decommissioning are separated.

A) Pre-decommissioning (PDS)

The activities, which will impact the atmosphere and respective fluctuations of the meteorological conditions during the Pre-decommissioning Stage of Units 1 to 4 of Kozloduy NPP are mostly conventional and caused by the new construction works, related to the construction of the necessary infrastructure for decommissioning A Size Reduction and Decontamination Workshop (SRDW), (3 744 m^2) will be constructed. Excavation and embankment works will be carried out, because the existing underground communications should be upgraded. Also, construction works will be executed for extension of the existing Repository for Conventional Municipal and Industrial Waste (RCMIW). After filling it, the works will go on with building of sites for safe storage and management of materials from decommissioning activities of Units 1-4 of Kozloduy NPP. About 10 decares, including road infrastructure and 300 m crane rails will be designed for the service of those sites. The impact on the ground air caused by the above construction works will be temporary and until their completion it will affect a comparatively small area that would not impact the atmosphere processes. In the regions of construction activities, and especially during the excavation works, the disposal of spoiled material and the reclamation of the ground as a result of the air dustiness will restrict the visibility. The quantity of the condensation cores will increase and their concentration will mostly depend on the season. During the cold part of the day it is possible to face some preconditions for temperature increase and fogs occurrence.

During the PDS it is not expected to have considerable non-radiation pollution of the atmosphere because during this stage no controlled emission sources are foreseen. The non-controlled emissions are related to the CO, NOx, SO_2, hydrocarbons, black smoke and dust discharged into the atmosphere by the internal combustion engines of the transport sources, which service the facility as well as dust, which will be emitted during the levelling of the Workshop site, excavation and other ground works, unloading and reloading of embankment materials. The pollution caused by the

internal combustion engines during the operation of the construction and transport machines will be negligible within the working day until completion of the construction stage.

At this stage solid radioactive wastes will be generated by dismantling of polluted construction materials, which will be subject to further treatment. If the accepted safety rules will be observed no such radiation impacts on the atmosphere might be expected.

During the stage of preparation of Units 1 to 4 of Kozloduy NPP for PDS no considerable negative impact on the atmosphere is expected. The impact will be local (on the territory of Kozloduy NPP), short-term, without any cumulative and transboundary effect.

B) Stage 1 of the decommissioning

At Stage 1 of the decommissioning the stages of Preparation for the safe enclosure and Control of the safe enclosure are included as well as dismantling of equipment beyond the Safe Enclosure Area.

Aiming to reduce the potential hazards from the facility prior the period of safe enclosure a number of activities is foreseen for removal of the inflammable and hazardous materials and conventional waste from the Units; elimination of a big part of the operational RAW, extraction, treatment and conditioning of the RAW, removal of the spent nuclear fuel from the SE area; removal of all operational waste from the SE area; construction of the infrastructure needed for preparation of the decommissioning activities; isolation of the unnecessary systems on the SE borders. Dismantling activities in the safe enclosure area include dismantling of the equipment in the controlled area and afterwards a transportation of that material to the Size Reduction and Decontamination Workshop (SRDW). The Activities on the border of the SE area will be carried out indoor and do not jeopardize the atmosphere processes around Kozloduy NPP site. The impact on the atmosphere caused by the activities at the SE border will be negligible.

It is planned to equip all decontamination systems with filtrating ventilation system. For elimination of the environmental impact the design requirements to the SRDW should include control over the gaseous emissions into the environment. There will be some uncontrolled dust emissions during the construction of the workshop on an independent site beyond the turbine hall caused by the excavation and embankment works as well as by gases discharged by the internal combustion engines of the construction machines. These emissions are restricted in view of time and scope and they will not impact the values of the main meteorological elements in the region. Such impact is restricted within a radius of about 50 m from the construction site.

On the Kozloduy NPP site solid municipal waste, construction, production and hazardous waste will be generated. Most parts of this waste could not cause considerable air pollution and they will not impact the atmosphere.

C) Stage 2 of the decommissioning

Stage 2 of the decommissioning process includes dismantling of the safe Storage Area and then the release of the building from regulatory control. The application of the safety measures elaborated in the project will guarantee the protection of the lower

atmosphere layer over the site of the power plant and the adjacent territories so no ***cumulative impacts*** are expected.

In the stages of decommissioning some bulk materials such as sand and zeolite will be used. When transporting, filling and storage of these materials is necessary to take into account some of the measures set in Art. 70 of Ordinance № 1 in 2005, to limit emissions from stationary sources, such as:

1. Appropriate choice of locations (sites) for loading and unloading during the development.

2. When the sand is stored - use of wind-barriers or embankments, covering the surface, reducing the height of the stored material.

3. Restricting activities at high speeds and wind direction;

4. Construction of covered warehouses for storing zeolite.

5. Optimizing the conditions of loading and unloading, by reducing the height of the landing, using trays.

6. Automatic height adjustment of landing with the height of the bulk material;

7. When transporting these materials to meet the following requirements:

- Use of closed or covered with tarpaulin vehicles, including in-factory transport;
- Transport links to be regularly cleaned and tarmac depending on the degree of contamination.

Application of the developed project safety precautions will ensure the protection of the ground layer of the atmosphere at the plant site and surrounding areas, so that cumulative impacts are not expected.
From the most probable ***accidents*** (fire, interruption of processes, failures of installation, spills, flooding, explosions, load dropping, road accidents, etc), the ones, which are significant for the soils are the accidents that may occur outdoor.

In view of the atmospheric air the most significant impact on it is expected in case of explosions and fires, failures of installations and ventilation and filtrating systems in particular. As a result of these accidents it is possible that some gas emissions and aerosols will be generated, including radioactive emissions, which will depend on the type and scales of the accident. The impact shall be only temporary and local, until the liquidation of the accidents. The analysis of the climatic conditions in the region shows that the probability of transboundary transmission is limited, because the prevailing winds in the Kozloduy region are with northern component.

The analysis of the Investment Proposal and of the possibilities for contamination of the ambient air in the 30-km area around Kozloduy NPP, which is within the Romanian territory shows that during the construction and operation of the Size Reduction and Decontamination Workshop (SRDW), the Decay Storage Site for RAW (DSS), category 1 and the Site for Conventional Waste less waste products will be generated than during the normal operation period of Kozloduy NPP Units. In this regard no negative impacts on the values of the meteorological elements and the atmosphere condition as well as transboundary impact are expected.

Taking into account that the predominant winds in the region are mainly from NW, W and N, the probability of aerosols transfer towards Romanian territory is strongly limited.

D) Close down and reclamation Stage

The stage after decommissioning of Units 1-4 of Kozloduy NPP includes activities related to the dismantling and decontrol of buildings and facilities. These activities will impact positively the microclimatic properties of the power plant territory and its adjacent areas.

The following conclusion could be drawn about the impact during and after the decommissioning of Units 1-4 of Kozloduy NPP.

Probability of occurrence:	During the decommissioning and construction
Territorial scope of impact (geographic region, affected population:	Local
Reversibility of the impact (reversible, irreversible):	Not expected
Duration of the impact (short term, medium term and long term):	Until reclamation
Frequency of impact occurrence (permanent/temporary):	Not expected
Type of the impact (positive/negative; direct/non-direct; secondary; cumulative and synergy);	Negative

4.2 Atmospheric air

During the decommissioning of Units 1 to 4 of Kozloduy NPP the Stage of Pre-decommissioning (PDS), Stage 1 and Stage 2 of the Decommissioning are separated.

A) Pre-decommissioning (PDS)

The activities, which will impact the atmosphere air during the Pre-decommissioning stage of Units 1-4 of Kozloduy NPP are mostly construction ones. The impact on the air will be mostly non-radiological.

A Size Reduction and Decontamination Workshop (SRDW) (3744 m^2) will be constructed. Excavation and embankment works will be carried out, because the existing underground communications should be re-routed. The site is located south of the existing Turbine hall of Units 1 to 4 and it is located within the range of the fence of Kozloduy NPP Site. No construction of roads is foreseen, because the existing ones will be used.

Also, construction works will be executed for extension of the existing facility for Repository for Conventional Municipal and Industrial Waste (RCMIW), after its filling in.

The construction activities at this stage include construction, equipment and commissioning of 4 sites, approximately 10 decares, including road infrastructure and 300 m railway.

During this stage mostly uncontrolled harmful emissions are expected. The air pollution will be caused by:

- Spent gases from the internal combustion engines (ECE) of the machines executing construction and transportation activities. Main pollutants, which will be emitted into air, are CO, NO_x, SO_2, CH and dust. These emissions will depend on the number and type of the equipment used during the construction and mode of operation.
- Dust particles - during the execution of the civil and installation works some dust will be emitted mostly during the excavation works, disposal of the excavated earth and then during the reclamation of the ground. Its concentration will depend mostly on the season of execution of the construction activities, meteorological conditions and measures undertaken for reduction of the dust load.

For the construction period building machines and motor transport vehicles such as excavators, bulldozers, loaders and motor trucks will be used. Pursuant to the fast inventory methodology (Methodology for determination of harmful emissions under the balance methods per 1 ton of diesel fuel the following quantities of harmful emissions will be released: (MEW, EEA. 2007. http://eea.government.bg/bg/legislation/air/mpg-07/Metodika_2007.html):

Substance/emission (kg/t)		Substance/emission (µg/t)	
NMVOC	7.3	Cd	0.01
NO_x	30.2	Cu	1.7
CO	12.6	Zn	1.0

Substance/emission (kg/t)		Substance/emission (µg/t)	
CO_2	3188	Ni	0.7
N_2O	0.12	Cr	0.05
CH_4	0.3	Se	0.01
NH_3	0.01	PAH	0.23
PM	2.4	DIOX	0.042

In general, these emissions are typical for construction and they could not be avoided. The pollution will be local at small distances - approximately 50 m from the different machines and will not impact considerably the pollution in the region. In spite of this it will be required for the emission minimization to use fuel in compliance with the standard requirements and good maintenance of the building and transport equipment. Washing out of the tyres of the transport vehicles when they leave the construction site.

During the stage of preparation of Units 1 to 4 of Kozloduy NPP for PDS no considerable negative impact on the atmosphere is expected. The impact will be local (on the territory of Kozloduy NPP), short-term, without any cumulative effects.

B) Stage 1 of the decommissioning

The process for decommissioning of Units1 to 4 includes 2 stages - Stage 1 and Stage 2. At Stage 1 of the decommissioning the stages of Preparation for the safe enclosure and Control of the safe enclosure are included as well as dismantling of equipment beyond the Safe Enclosure Area.

Dismantling of the equipment beyond the Safe Enclosure Area commences with the equipment in the non-contaminated buildings and Turbine Hall of the Units and includes:

- Dismantling of the non-contaminated equipment;
- Dismantling of the turbines;
- Dismantling of the secondary circuit.

Before the Safe Enclosure period a series of activities is foreseen aiming to reduce the potential hazards caused by the equipment. These activities include the elimination of inflammable and hazardous material and conventional waste from the Units; elimination of a big part of the operational RAW and provision of conditions and capacities for extraction, treatment and conditioning of the radioactive waste, for which there are no respective technologies implemented before the commencement of the real decommissioning activities; removal of the spent nuclear fuel from the SE area; construction of the infrastructure needed for preparation of the decommissioning activities; isolation of the unnecessary systems on the SE borders.

The activities on the border of the SE area are described in detail in Chapter 1 of this report. During these activities the impact on the air will be negligible. The only radiation risk is related to the dismantling of the equipment.

The activities in the SE area are described in details in Chapter 1 of this report and during these activities the impact on the air will be negligible.

Decontamination activities according to the Decommissioning plan of Units 1and 4 [36] are described in details in Chapter 1 of this report. During these activities the impact on the air will be negligible.

Dismantling activities in the Safe Enclosure Area are described in details in Chapter 1 of this report and include equipment dismantling in controlled area and afterwards the transport of that material to the Size Reduction and Decontamination Workshop (SRDW). During these activities the impact on the air will be negligible.

Size Reduction and Decontamination Workshop (SRDW)

For the decommissioning of Units 1-4 the construction of Size Reduction and Decontamination Workshop (SRDW) is planned [156]. For dismantling of the equipment in the turbine halls and other auxiliary buildings conventional, mainly manual or remote control, tools and cutting machines will be used. At first, the smaller parts and equipment have to be removed in order to clear additional space for removal and handling of large components.

In order to minimize the radiation exposure of the staff involved in the dismantling activities radiological investigation of Units 1 to 4 is initiated. Received data are used upon determination of succession of dismantling activities and for optimization of the activities with the aim to minimize the dose rate of the staff. Detailed description of the Technological processes in SRDW is shown in Chapter 1 of the present report.

Depending on the technological process in the workshop also different zones will be established. Process of equipment fragmentation is related to the utilization of cutting instruments and thermal burners. Resulting thereof aerosols (incl. radioactive aerosols depending on the contamination of the equipment) and gases such as nitrogen oxides, carbon oxides etc. will be emitted depending on the applied methods (with the thermal burners). Use of asbestos or asbestos materials during the construction of Units 1 to 4 means that it is possible that some asbestos particles will be emitted during the dismantling process. It is planned to remove the asbestos from the reactor room and from the auxiliary equipment before the commencement of the Safe Enclosure Stage.

Different methods are applied for decontamination of the materials (described in Chapter 1); some of them include use of different chemical compounds and as a result of this emission of aerosols, including radioactive aerosols is expected. At the current stage of the decommissioning project, qualitative assessment of the emitted amount of aerosols has not been made yet, because it depends on a number of factors such as type, amount and level of contamination of the material, which will be fragmented, fragmentation level, methods applied for fragmentation and decontamination, etc. During the next project stages, it is necessary to provide a more precise assessment of the type and quality of the expected aerosols.

It is planned that all decontamination systems will be equipped with filtration ventilation system. An individual extractor, integrated into a common system that includes: cyclone, cartridge filter, fan, motor, and control filter, is planned for the workshop.

To prevent environmental impact design requirements for SRDW should include control of gaseous effluents to the environment.

In [156], Section 3.8.1 basic requirements for the design are described:

- Ensuring the minimum requirements for radiation monitoring;
- A record of all important parameters
- Ensuring effective for the entire department and local ventilation system areas and gaps in SRDW.

In Section 3.8.4 Design requirements for auxiliary equipment of SRDW are describes. In subsection "building system" is stated that that the installation of a ventilation system with HEPA filters having at least 99.97 % efficiency in purifying exhaust aerosols as well as local ventilation systems for decontamination and cutting material is required.

In [156] Annex 6 is mentioned the necessary to develop a program for radiation monitoring.
During the construction of the workshop on an independent site beyond the turbine hall there will be some uncontrolled dust emissions caused by the excavation and embankment works as well as by gases discharged by the internal combustion engines of the construction machines. These emissions are restricted in view of time and scope. Such impact is restricted within a radius of about 50 m from the construction site.

During the execution of the indoor activities a biological protection and selection of suitable filtrating ventilation system and a system for control of gaseous discharges is provided. That makes it possible to achieve compliance with the normative requirements allowing avoidance or minimization of the impact on the atmosphere air.
Sites for management of the materials of activities from the decommissioning of Units 1-4 of Kozloduy NPP

The aim of the project is the organization of sites for temporary safe storage of radioactive materials (RAM) and non-radioactive waste (NRW) from decommissioning activities. Storage of solid radioactive materials (RAM) is provided in project 19. These materials will be stored in containers for a period not exceeding 5 years, until the specific activity of the contaminated items is reduced to the level of exemption from regulatory control. Similar facility is currently operating in Greifswald NPP. Three sites within Units 1-4 of Kozloduy NPP are examined as two of the sites suitable for temporary storage of radioactive materials (RAM) and one site for storing non- radioactive waste from decommissioning (described in Chapter 1).

Sites for temporary storage of RAM from activities of the decommissioning of Units 1-4 is designed and operated in a manner ensuring minimum risk to personnel, the public and the environment, in accordance with the ALARA. To ensure safe, efficient and cost effective management of materials and waste generated during decommissioning of Units 1-4 of Kozloduy NPP sites for temporary storage must be build. Materials - RAM under the Regulation on Safety of Radioactive Waste Management [3] (liable to discharge after treatment in SRDW or after storage for natural decay to 5 years) - are stored in suitably equipped 20 'ISO containers [203].

On the territory of Kozloduy NPP open sites for temporary storage of RAM will be detached for the following purpose: - Temporary storage RAM (maximum stay after checking 5 years); - Temporary storage of RAM before transporting for decontamination in SRDW. Sites are located within the Kozloduy NPP and within an

area with controlled access. They are open and secured with draining systems for rain and surface waters. The sites are designed to accept and store 20 'ISO containers for sorting in one to three rows in height. All sites are featured with the necessary bearing capacity (mechanical resistance and stability), and durability of the structure of the surface and the soil under service and seismic loads. The sites are designed to ensure safe maneuvering of material handling equipment and handling of containers. The project of the sites is considered with all existing underground communication technology (shafts, tunnels technology, depth markers, pipelines, cable routes, etc.) as well with the conditions and facilities for their service.

Dimensions of the site are consistent with the design requirements for distances from adjacent buildings and the requirements for distance between buildings of a certain category of fire safety. Based on the feasibility and technical specifications of the project [203] originally designated places for three sites have been accepted for temporary storage of materials from decommissioning activities, namely:

- Site 1 - located next to the receiver station, divided into two separate parts:
- Site 1a - located north of the receiver station;
- Site 1b - located south of the receiver station;
- Site 2 (Site Kotlovan) - located south of the Domestic sanitary housing-2. For storage of non-radioactive waste (materials from the dismantling released from regulatory control) is provided Site 3. Types and quantities of radioactive waste from decontamination of dismantled equipment will be specified after drafting a workshop for size reduction and decontamination of dismantled equipment. At this stage, five-year schedule is developed for completion of the processing of radioactive waste streams. Possible ways of waste managing, including standing facility until clearance, are obtained.

At Kozloduy NPP solid waste, construction, industrial and hazardous waste will be generated. The majority of these wastes cannot cause significant pollution of the air, considering the organized system for the collection and transport. For construction waste contracts with external companies will be concluded. These companies will be obliged to transport and dispose construction waste on places set by the Kozloduy NPP.

Industrial waste is mainly - scrap metal from old outworn machine parts, outworn steel ropes, brass waste, tires, sludge from plant waste water, etc. As reported by staff members such waste is sold to licensed firms, but specific data on them is not available to experts. Outworn tires will be stored in the room next to the garage. Expected hazardous wastes are fluorescent and mercury lamps - batteries, packaging of chemicals, waste oil, etc.

B) Stage 2 of the decommissioning

Stage 2 of the process of decommissioning includes dismantling of the equipment in a safe storage area and then the release of the building from regulatory control. Dismantling activities in the area of safe storage are described in detail in Chapter 1 of this report and include the dismantling of the equipment in the reactor building and the transporting part of it in SRDW. During this activities impact on air will be negligible.

Gaseous releases

Gaseous releases data after Units 1-4 final shutdown are presented in detail in Chapter 1.10 of this report.

Assessment of the gaseous emissions during the preparation of SE and control of the SE is based on the data prepared before 2004 and it is very conservative. Recently, the methodologies for counting and reporting of the emission results were changed. It could be supposed that no increase of the emissions is expected compared with the ones from the last 4-5 years.

Emissions of noble RNG and short-live iodine isotopes

According to the design data after the removal of the fuel no emissions of radioactive noble gases - RNG (Kr, Xe isotopes) and of short-live iodine isotopes (^{131}I, ^{133}I, and ^{135}I) are expected.

Radiological impact on the critical individuals as a result of radiation by noble gases or inhalation of ^{131}I will be absolutely negligible compared with the impact resulting from the respective discharges during the normal operation.

In Units 1-4 KNPP Technical Specification [152] the following limits are proposed for annual emissions through the ventilation pipes of EP-1:

Table 4.2-1 Limits of annual discharges through the ventilation stacks of EP-1 of Kozloduy NPP.

Emission components	VS-1 Units 1, 2 and AB-1	VS-2 Units 3, 4 and AB-2	4.1.4.2.3 Conventional pollution of the sewage waters	Total for NPP
RNG, [TBq]	100	100	200	5600
Iodine-131 (^{131}I), [Bq]	3	3	6	65
LLA, [GBq]	3	3	6	50
Tritium, (^{3}H) [TBq]	10	10	20	250
^{14}C, [GBq]	1000	1000	2000	38000

Long-live aerosols

Activities that will be carried out during the preparation of SE could be compared more or less with the ones during the period of long outage, with a reduction of the maintenance/inspection activities, but with an increase of the cleaning/decontamination activities and activities for conditioning of the radioactive waste.

According to the SE design the proposed limit of annual emissions during the preparation of SE of LLA in VS-1 is 3 GBq. According to the EWN [50] experience and according to the data, presented in 11.4.1 of this report, the LLA emissions into air during the whole decommissioning process will not exceed 20 MBq.

Dust and gas emissions from waste transportation

The annual consumption of diesel fuel for waste transportation activities is assessed as about 90 t. Pursuant to the fast inventory methodology (Methodology for determination of harmful emissions under the balance methods, MEW, EEA. 2007. http://eea.government.bg/bg/legislation/air/mpg-07/Metodika_2007.html), the following annual hazardous emissions will be released: NMVOC – 657 kg, NOx – 2718 kg , CO – 1134 kg, CO_2 – 333 t, N_2O – 1.08 kg, CH4- 27 kg, PM – 2160 kg.

The potential accidents in EP-1 include fires, process interruptions, installation failures, spills, flooding, explosions, load dropping, traffic accidents, etc. The most significant impact on the atmospheric air is expected in case of explosions and fire, failures of installations and ventilation and filtrating systems in particular. As a result of these accidents it is possible that some gas emissions and aerosols will be discharged, including radioactive emissions, which will depend on the type and scales of the accident. During the decommissioning process different hazardous, toxic and explosive substances are used. Leakages, evaporations, spills and fires may occur, if there is no proper control. In case of earthquakes no demolition is expected of RAW temporary storage compartments and the decontamination compartments, so there is no risk of radioactive aerosols release. The impacts will be temporary and local until the execution of control over the accidents and no transboundary impact is expected.

There is potential option for ***cumulative impact*** between the operation of the operating Units 5 and 6 of Kozloduy NPP and operation of the Size Reduction and Decontamination Workshop so the respective measures have to be foreseen.

In Appendix 11.4.2 the conventional emissions into air during the entire decommissioning process are presented. These emissions are caused predominantly by waste transport activities. According to Appendix 11.4.1 of this report the annual consumption of diesel fuel for transportation activities is approximately 100 m^3 per year. Based on EWN experience [50] the emission factors from the transport activities are:

- NOx – 5 g/kWh;
- PM10 – 0.16 g/kWh.

In this case the calculated emission quantities are: 300 g NOx and 10 g PM10 per ton waste.

Based on the EWN experience [50], we could conclude that conventional emissions into the air during the whole decommissioning process are lower than the permissible values.

Table 4.2-1 gives the annual releases from the Units' ventilation stakes and according to the decommissioning project the planned limit of annual releases during the SE preparation for LLA trough the VS-1 is 3GBq. According to the EWN [50] experience and according to the data, presented in item 11.4.1, the LLA emissions into the air during the whole decommissioning will not exceed 20 MBq. Taking into account that the predominant winds in the region are mainly from NW, W and N, the probability of aerosols transfer to Romanian direction is strongly restricted. The analysis of the Investment Proposal and of the possibilities for pollution of the ambient air in the 30-kilometer area around Kozloduy NPP, which is on the Romanian

territory, shows that during the decommissioning of Kozloduy NPP Units 1 to 4 the planned activities on the border of the SE area, the construction and operation of the Size Reduction and Decontamination Workshop (SRDW), the Decay Storage Site for Transitional RAW (DSS) and the Site for Conventional Waste from Decommissioning (SWD) will generate less 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 the ***transboundary*** impact is reduced to a minimum level.

D) Close down and reclamation Stage

The decommissioning completion includes all activities performed at Stage 1 and Stage 2 of this process. According to the EWN experience [50] this means that a big reduction of all radiological and non-radiological emissions into environment and in the atmospheric air will occur respectively.

The following conclusion could be drawn about the impact during and after decommissioning of Units 1-4 of Kozloduy NPP.

Probability of occurrence:	During the whole decommissioning
Territorial scope of impact (geographic region; affected population):	Area of the building sites and NPP.
Reversibility of the impact (reversible, irreversible):	After completion of decommissioning:
Duration of the impact (short term, medium term and long term):	Until reclamation
Frequency of impact occurrence (*permanent/temporary*):	Constant
Type of the impact (positive/negative; direct/non-direct; secondary; cumulative and synergy):	Negative

4.3 Waters

A) Pre-decommissioning (SPD)

During the execution of the Pre-decommissioning Stage and Decommissioning Stage with two substages Stage 1 and Stage 2 different waste management activities will be executed. After sorting of the dismantled materials depending on their pollution degree they may be:

- Decontrolled and transported beyond the site of Kozloduy NPP with or after decontamination;
- Stored for progress of natural decay process;
- Delivered as RAW for suitable processing and conditioning.

Potential impact on the waters during the Preparation Stage is related to the designed construction works. It is planned to construct a Size Reduction and Decontamination Workshop (SRDW); to extend the existing facility for Repository for Conventional Municipal and Industrial Waste (RCMIW), after its filling in, the reconstruction and enlargement of the existing storage 009 and the construction of new sites for temporary RAW storage category 1.

The construction works include construction, equipment and commissioning of 4 sites, road infrastructure and 300 m railway. Sites 1 (spatial separation in 2 parts 1a and 1b), 2 and 4 for storage of RAW Category 1, will be situated on the existing green areas. For these sites the rainfall waters will be collected in a pit and after radiation control they will be discharged to the rainfall sewage system Radiation control will be made of the water and precipitates from the rainfall waters drainage pit.

During the preparation for decommissioning water will be used for potable residential needs as well as for technological purposes.

The possible impacts on the surface waters during the construction activities at the stage of preparation for decommissioning of Units 1-4 of Kozloduy NPP may be summarized as follows:

Increasing of water consumption for potable residential and technological purposes

Water will be required for potable residential needs of the workers participating in these activities as well as for cleaning and for activities executed on the construction sites (wet processes etc.) This means that there will be some increasing of the water consumption. Considering the fact that the policy of the management of Kozloduy NPP is to keep the staff working in the operation by involving them into the decommissioning activities no considerable increasing is expected. However, such quantities will be limited and the water supply system of Kozloduy NPP will not face any problems in this regard. Currently, the general water consumption slightly exceeds 50 % of the permitted water quantities, which means that the water supply will continue using the same water sources, not changing the conditions under the permits issued for water use.

The scope of such impact will be local. Regardless the negligible impact it will be negative and direct with restricted territorial scope and low degree within the range of

the created impact area around the water inlet facilities. It will be temporary (only for the term of preparation of decommissioning) and short term.

Generation of sewage waters

These sewage waters are generated mainly during the cleaning. They will be polluted mostly with suspended substances. Waste waters will not be a problem neither for the Kozloduy NPP sewage system, nor for treatment facilities of the power plant. Characteristics of the impact are similar to the above: there will be some impact, but it will be restricted within the site of Kozloduy NPP. The Impact will be negligible, but negative and non-direct, because the water is mixed with other waste water flows from the area. There will not be any secondary or cumulative impacts. The impact will be temporary (only for the term of construction activities) and short term. Results will be reversible, because later the water will be intaken into the main drainage channel, where the other flows of treated sewage waters inflow into the same water receiver.

Sewage waters generated during the construction will not destroy the quality of the surface waters in the adjacent basins. They will not impact the underground waters, because all sewage water flows will be collected and discharged for treatment in the treatment stations northern from Units 1-4 and treatment facility on the EP-2 industrial site until reaching the needed degree and then by the Main drainage channel (MDC) they will be intaken into the Danube River. No impact is expected on the condition of the underground water body *BG1G00000N2034* (pore waters in Neogen), because the eventually infiltrated small quantities of contaminated waters will stay in the comparatively thick aeration area with poor filtration properties not reaching the level of the underground waters under it.

The water will be the only natural resource, which will be used during the Pre-decommissioning (PDS),

Pursuant to permit N 1375000/20.04.2007 for intake of sewage waters in main drainage channel the formed sewage quantities in 2010 were 24.34 % of the permitted quantity. This gives reason to conclude that the drainage facilities will have capacity to collect the sewage waters generated during the construction activities foreseen for this stage. Their treatment will follow the practices established in Kozloduy NPP for the generated sewage water flows and observance of the restrictions.

During the stage of preparation of Units 1 to 4 of Kozloduy NPP for decommissioning no additional significant impacts are expected on the surface waters. The impact will occur during the stage without any cumulative results.

B) Stage 1 of the decommissioning

During this stage the following activities are foreseen:

- Preparation for Safe Enclosure
- Safe Enclosure of the reactor buildings (this area includes the reactor buildings of Units 1 and 2, reactor buildings of Units 3 and 4 and the scaffold bridges between them;
- Dismantling of the equipment beyond the Safe Enclosure Area.

During this stage the executed activities are related to fragmentation and decontamination of materials, temporary storage of non-radioactive and radioactive materials on internal sites and buffer/intermediate sites.

The end of Stage 1 will depend on the completion of the dismantling beyond the Safe Enclosure Area. Duration of Stage 1 is seven years.

During the first stage the conventional waste, which value of the measured dose rate of gamma radiation will not exceed 0.3 μSv/h, will be disposed on the existing Repository for conventional waste until its filling in. After its filling in an extension will be made in order to allow the receipt of the waste during the next 15 years. In relation to the existing Conventional Waste Management Program of Kozloduy NPP all types of hazardous waste are identified and their quantities are determined.

During the filling in process and after its extension the collection of both sewage water types will continue, for which separate collection pits are constructed - for the infiltrate and residential and surface waters and the monitoring of the water condition in two collection pits will continue under the programs for Self Conventional and Radioecological Environmental Monitoring.

During the period of operation of the Size Reduction and Decontamination Workshop the main activities are related to the fragmentation and decontamination of different equipment, technique and materials etc. and with the radiation control as well. The control is foreseen for the radioactive materials liquid, solid and gaseous emissions released into the environment as well as of the materials outgoing from the Workshop.

The materials subject to decontamination are pipelines, fittings, bodies and filters, pumps, electrical motors, tanks. They are made of stainless steel, carbon steel, copper, cast iron, galvanized tin etc. In case of efficient decontamination the fragmented equipment will not jeopardize the surface and underground waters.

Sites 1 (1a and 1b), 2 and 4 will be used for decay storage. The requirements of the Technical Specification related to them should be observed, namely design and execution according to the best available techniques of the European and Bulgarian legislation.

During the dismantling of the turbine hall 3 categories of objects are defined- category I – equipment without contamination, II – potentially contaminated equipment and III – contaminated equipment. Materials of Category I and II will be measured before the free release and the contaminated equipment will be treated as radioactive waste. Part of the radioactive waste – mainly concrete and epoxide resin of the floorings are subject to storage and disposal. Draft dismantling program is required and its strict implementation should guarantee the environmental protection including prevention of the soils' pollution.

Gaseous emissions of conventional controlled and uncontrolled sources, which are expected to be generated during Stage 1 of the decommissioning (breaker plant), will mostly emit dust, emergency diesel generators - dust (PM10), VOC, SO_2, NOx, and CO_2, Facility for treatment and Conditioning of Solid Radioactive Waste - SO_2, HCl, CO, dioxins and furans and the internal and external transport facilities - dust (PM10), NOx from the diesel fuel. The design has to foresee technical solutions to maintain the levels of all emissions in compliance with the levels permitted by the license, which

will guarantee the protection environmental and in particular of the waters in the plant area and the gaseous emissions in the adjacent lands.

The analysis of the impact of the activities foreseen for Stage 1 for execution of fragmentation and decontamination of materials, temporary storage of conventional and radioactive materials on internal sites and buffer/intermediate sites in connection with their safe storage and dismantling of the equipment beyond the Safe Storage Area shows that the impact on the environment will be low. At this stage an increase of the service water consumption for technological purposes is expected, but anyway the quantities will be limited and will not be problematic for the water supply system of Kozloduy NPP. Currently, the water consumption is within the range of 52-53 % of the permitted water quantities, which means that the water supply will continue using the same water sources not changing the conditions under the permits issued for water use.

The scope of such impact will be local. Regardless the negligible impact it will be negative and direct with restricted territorial scope and low degree within the range of the created impact area around the water inlet facilities. It will be temporary (only for the term of Stage E 1-7 years) and medium-term one.

The quantities of the sewage waters related to the decontamination of the radioactive equipment and installations, described in details in Chapter 2 of this report will be increased respectively.

For reduction of the secondary radioactive pollution, mobile facilities are imported both for decontamination of the radioactive equipment on site before dismantling and for processing the liquid low level radioactive waste. For decontamination of tanks and pools Project “Decontamination and Water Treatment Equipment” is executed. Delivered equipment should provide decontamination ratio ≥ 50 for decontamination of the waters.

Technology, which is in use in Kozloduy NPP since 2005 for treatment of liquid RAW includes pre-treatment through process of homogenization, distillation and filtration, when so called evaporator concentrates) will be generated as radioactive waste. The purified unbalanced water after the evaporation of the concentrate is discharged in the environment after the execution of chemical and radiation control.

The technology used for radioactive water treatment by evaporation ensures that, if the regulatory limits of the radioactivity will be observed the harmful and hazardous substances in the discharged water will not exceed the permissible emission limits according to the permit issued to Kozloduy NPP.

Liquid RAW are neutralized by sodium hydroxide before their transfer to the sewage system of the unit and finally to SWT-3 and after the dismantling of SWT-3 they will be supplied to the module Danube system.

It is expected that the quantity of liquid RAW discharged in the contaminated sewage system (if the water treatment system of the water jet decontamination facility is not in operation) will not exceed 20 m^3/week and to be considerably less in the case when the system is in operation.

In connection with the EC2004/2/EURATOM and NRA recommendations concerning the monitoring on the KNPP effluents discharge, it was foreseen to implement the

Project 12 "Liquid and gaseous releases optimization monitoring system" The purpose of this system is to optimize the current monitoring and control system over the liquid and gaseous releases from Kozloduy NPP. It includes recording of the volume activity of the unbalanced and sewage waters discharged from Kozloduy NPP in the hydrosphere; transfer of the recorded data through the communication system realized on the basis of the current communication system in Kozloduy NPP and archiving of the collected information.

Liquid discharges related to the activities during the Safe Enclosure Preparation

Activities that will be executed during the stage of SE preparation could be compared with the ones in case of continuous outage during the refuelling, therefore, during the SE preparation stage the limits of the discharge of liquid fuels will be equal to the limits applicable during the normal operation of Kozloduy NPP. Control levels of total β - γ activity, without ^{3}H are 8.88×10^{10} Bq/year, which is considerably lower than the maximal permissible level [6, 36]. The control levels under ^{3}H (2.96×10^{12} Bq/year.) are also lower than the maximal permissible ones 2.109×10^{13} Bq/year [6, 36]. Details about the quantities of the generated liquid RAW during the different decommissioning stages are described comprehensively in Chapter 1 Section 1.11.

Regarding the generation of liquid RAW during the SE their quantity will be quite small as compared with the one generated during the normal operation and during the SE preparation of the Units.

Presently, these limits are as follows:

Table 4.3-1 Annual Limits* for emissions of liquid RAW of Units 1 and 2 during the SE preparation

Sources	Control levels (Bq/y)	Maximal permissible level (Bq/y)
Total β - γ** activity, without ^{3}H	8.88×10^{10}	4.44×10^{11}
^{3}H	2.96×10^{12}	2.109×10^{13}

*^{54}Mn, ^{58}Co, ^{60}Co, ^{134}Cs and ^{137}Cs

Radioactive discharges into the Danube river from the monitored radiation sources as a result of the above operations are comprehensively examined and assessed in *NPP Kozloduy Units 1&2/Technical Design for Decommissioning/TASK 3 - Interim Report 1/Environmental Impact Report/Chapter II [6]*, as well as in the Decommissioning plan of Units 1 and 2 of Kozloduy NPP – Chapter 13 KPMU/DPL/013 [36]. Due to this, only the final conclusions will be presented here.

Table 4.3-2 Forecast quantities of liquid RAW from Units 1 and 2 during SE preparation and SE operation

Source of LRAW	Dimension	Quantity*	RAW description	Forecast activity (by the moment of RAW generation)
Decontamination of Reactor Refuelling	m^3 m^3	1252 (from Spent Fuel Pool)	Liquid RAW 1. Water solution and suspense	Co-60: 4.2E+08 Bq/t; ^{137}Cs-:

Source of LRAW	Dimension	Quantity*	RAW description	Forecast activity (by the moment of RAW generation)
Cavity, Spent Fuel Pool, Racks of the Spent Fuel Pools, Emergency Boron Tank		1226 (from Emergency Boron Tank)	2. Concentrate of SWT-3 evaporator with boric acid concentration 12 g/l	5.1E+08 Bq/t; ^{239}Pu-: 3.7E+06 Bq/t
Decontamination of primary circuit and SVO 1 equipment	m^3 m^3	Appr. 430 Appr. 1415	1. Spent Decontamination solution 2. Cleaning solution	
Showers	m^3/y	At least 4800	Water solution of cleaning surface active substances (soap, shampoo)	
Contaminated laundries	m^3/y	3120	Water solution of cleaning surface active substances (detergent) and decontamination reagent.	
Floors, Corridors and Drainage channels, Sewage system and rainfall waters from AB-1	m^3/y	300	Water and water solution of the cleaning surface active substances and decontamination reagent.	

*All above quantities should be doubled due to SE of Units 3 and 4.

The liquid RAW from pre-dismantling decontamination activities, waters from the decontamination of the materials from the lining of Units 1 and 2 as well as the liquid waste from cleaning of the floors and corridors are treated like floor drain and they are processed at evaporation plant systems. Thus only the secondary condensate is discharged into Danube River. After radiological control and without treatment the sewage waters from showers can be discharged to the Danube River.

Following the table summarizes the forecast of annual discharges into the Danube River β-γ activity and of ^{3}H from the main emitters through the liquid waste of Units 1 and 2 during the stage of SE Preparation.

Table 4.3-3 Forecasted annual discharges into the Danube River of β-γ - activity and of H³ from the main emitters through the liquid waste of Units 1 and 2

Discharge type	Measure	Year after the final shutdown of the reactors				
		1	2	3	4	5
β-γ	Bq/year	9.4 E+09	3.8 E+09	3.8 E+09	4.0 E+10	3.8 E+09
Activity	% of the control level (4.44 E+10 Bq/g)	21	8.6	8.6	91	8.6
Tritium (^{3}H)	Bq/year	5.6 E+11	N*	N	2.56 E+12	N
	% of the control level (7.75 E+10 Bq/g)	7.2	N	N	33	N

N* - negligibly low activity

Source: *NPP Kozloduy Units 1&2/Technical Design for Decommissioning /TASK 3 - Interim Report 1/Environmental Impact Report/Chapter II [6]*

As it is shown in the table the annual discharges of liquid waste during the stage of preparation of the annual discharges of liquid waste during the preparation of SE of Units 1 and 2 vary from 3.8 GBq to 40 GBq [36]. They are a result of the activities executed during the year. Highest activities of the liquid discharges are foreseen during the fourth year after the final shutdown of Units 1 and 2, due to contamination of the Reactor Refuelling Cavity, of the Spent Fuel Pool, removal of the precipitate deposited on the bottom of the spent Fuel Pool, drainage and conditioning of the content of the Boron Emergency Tank of Units 1 and 2, when the discharges of β-γ - activity reach 91 %, and ^{3}H activity is -33 % of the control levels (respectively from 18 % and 4.6 % of the respective maximal permitted levels).

Decontamination of the equipment of Units 3 and 4 will double the emitted activities. This should be considered when planning the needed activities.

All discharges β - γ of emitters, ^{3}H and H_3BO_3 are assessed based on the application of proven technologies for waste treatment (high efficient filtration installation for immersion and use of ion exchange resigns). The aim is to avoid generation of big quantities of conditioned solid waste with high content of borates with low specific activity, which would be generated from the spent solutions for decontamination of pools, racks and emergency Boron Tank in the evaporators SWT3.

Radiological impact

However, in order to estimate the radiological impact by the discharges into the Danube River at the stage of SE it should be considered that the accumulated individual effective dose is a result of the different exposure pathways – with food,

fish, potable water, meat, milk and leaf vegetables, swimming, stay on the river bank etc.

Extrapolation of the effective dose for critical groups of the population as a result of the detected discharges for 1998 causes the following effective dose (all ways of supply are combined) during the stage of SE:

- 1st year after the final shutdown of the reactors: 2.0 10-3 μSv
- 2nd year after the final shutdown of the reactors: 8.3 10-4 μSv
- 3rd year after the final shutdown of the reactors : 8.3 10-4 μSv
- 4th year after the final shutdown of the reactors: 8.7 10-3 μSv
- 5th year after the final shutdown of the reactors: 8.3 10-4 μSv

(FSR – final shut down of the reactor).

Effective dose will be doubled due to the decommissioning of Units 3 and 4 and related activities. Regardless the fact this over-background effective dose is extremely low compared with the annual effective dose. However, it should be considered that the cumulative effect should be taken into account, which is a result of the functioning of Units 5 and 6 that are also a source of radiation emissions.

Liquid discharges related to activities during the Safe Enclosure Stage (SE)

Taking into account the status of the Units and the fact that just a few operations will be carried out during the SE operations as well as the low number of the operators/technicians involved in these activities, it is calculated that the production of radioactive waste during the SE operation will be quite low in comparison with those produced during the normal operation and the SE preparatory phase of the Units.

A) Limits of radioactive liquid discharges

During the operation stage of SE the annual discharge limits of liquid RAW are reduced by 10 % as compared with the limits during the normal power operation, i.e., for Units 1 and 2.

Table 4.3-4 Annual Limits* for emissions of liquid RAW of Units 1 and 2 during the SE

Sources	Maximal permissible level (Bq/y)	Control levels (Bq/y)
Total β - γ** activity, without ^{3}H	$4.4.10^{11}$	$8.8.10^{10}$
^{3}H	$1.98.10^{13}$	$2.94.10^{12}$

*^{54}Mn, ^{58}Co, ^{60}Co, ^{134}Cs and ^{137}Cs

B) Generation and discharge of liquid RAW

The detailed assessment of the liquid radioactive waste releases during the SE control stage is given in the Decommissioning Plan of Units 1 to 2 [36] and can be summarized as follows:

Table 4.3-5 Annual discharges of liquid RAW of Units 1 and 2 during the SE

Origin	Volume of the discharged liquid waste, m^3/y	β-γ Activity excluding H^3, Bq/y	Note
Showers	80	8.10^5	$6.0\ 10^4$ Bq/y, if the waste are treated by the mobile evaporator unit
Contaminated laundries	200	6.10^7	
Floors, corridors and drainage channels	10	1.10^7	
Sewage drainage system and rainfall waters from AB-1	570	$2.1.10^6$	
Total	860	$7.3.10^7$	

Such quantities of RAW during the control of SE are shown in [36] and will be generated for Units 3 and 4 too.

Liquid RAW discharges are expected to be:

- $7.3E10^7$ Bq/y, i.e. 1.6 % of the operational limit, conservatively assuming that the special laundry waste are not processed by the mobile evaporator unit;
- $1.3E10^7$ Bq/y, i.e. 0.3 % of the operational limit, conservatively assuming that the special laundry waste is not processed by the mobile evaporator unit.

These forecasted releases are extremely low as compared with those forecasted during the SE preparation phase, even when expecting to be doubled due to the simultaneous SE of the Units 1 – 4.

Tritium discharge

Practically, no tritium (^3H) release is expected during the SE control stage.

In compliance with all valid licenses, permits, ordinances, rules etc., applicable for these activities the impact on the water quality of the waters of the Danube River, by the sewage waters generated during the activities of Stage 1 will be within the limits applicable for normal operation of the power plant. They will not impact the underground waters as far as all sewage water flows will be collected and deviated for cleaning by the MDC and afterwards they will be intaken in the Danube River. No impact is expected on the condition of the underground water body *BG1G00000N2034* (pore waters in Neogen), because the eventually infiltrated small quantities of contaminated waters will stay in the comparatively thick aeration area

with poor filtration properties not reaching the level of the underground waters under it.

C) Stage 2 of the decommissioning

- Deferred dismantling of the equipment within the Safe Enclosure Area.
- Transportation of the decontrolled dismantled materials
- Storage of RAW for progress of natural decay process;
- Decontrol of the site and buildings for use for other purposes.

During Stage 2 the dismantling of the equipment in the Safe Enclosure Area will commence i.e. radioactive contaminated equipment of primary circuit. Dismantling of the equipment of the auxiliary building shall be made by the End of Stage 2 according to the alternative for continuous dismantling 2.

In the SE area the foreseen activities will be carried out indoor. Potential sources of contamination are different media and thereof the soils are related to the decontamination of different equipment. These are the reactor refueling cavity, primary circuit and the equipment related to it, the spent fuel pool, decontamination of the technological systems, rooms and surfaces, activities for collection, sorting and transportation of the waste generated by the decontamination etc. A flow of service waters is expected to be generated. The design should foresee precisely the manner of treatment of radioactive waste and precipitates. Service water used in the pool will be treated by water treatment system (SWT-3).

Except radioactive contamination, during the decontamination process it is possible that a chemical contamination occurs. Chemicals used for decontamination are phosphoric acid, oxalate acid, products for cerium process etc. Considering the fact that the contamination could be made indoor the contamination is possible only in the emergency cases during the transportation and contamination of these materials.

After that a dismantling of the reactors and activated components around them will be made. At the end of this stage the buildings will be decontrolled and used for other industrial purposes.

After commissioning of the national repository the flow of conditioned radioactive waste will be directed to the RAW storage facility site. The RAW will be removed from the site of the Units.

As a result of the activities included in Stage 1 one part of the decontrolled dismantled materials will be transported beyond the site of Kozloduy NPP, other ones will remain stored in order to continue the natural decay or they will be transferred as RAW suitable for treatment and conditioning. Application of the safety measures elaborated in the project will guarantee the protection of the waters from pollution.

The analysis of the investment proposal does not assume any cumulative effect of the decommissioning activities of Units 1 to 4 of Kozloduy NPP, operation of Units 5 and 6 of Kozloduy NPP and the National Repository for disposal of RAW. During the operation of all above facilities the main objective is to maintain the levels of all emissions in compliance with the levels permitted by the license. Concrete technical

solutions are applied, which ensure the environmental safety, including the water safety.

At this stage the releases of liquid RAW are extremely low as compared with those forecasted during the SE preparation phase, even when expecting to be doubled due to the SE of the Units 1 – 4. Practically, no tritium (^{3}H) release is expected during the SE stage.

The EWN experience concerning the fragmentation and decontamination of the dismantled equipment shows that the flow rate of the waste water generated during these operations amounts to 300 m^3/y [50]. The Liquid RAW (LRAW) is collected in a special tank. After neutralization and chemical and radiation control the content of this tank is pumped and transferred to the evaporator system for generation of RAW and condensate.

The quantity of the consumed water is less than the annual waste water flow rate because the condensate from the evaporator is reused.

During the wastewater treatment in the evaporator no conventional water pollutant are intercepted in the water stream.

All LRAW are treated except the waters from the showers, which, after the dosimetric control, will be discharged directly into the Danube River.

Based soon the EWN experience during the decommissioning of the Units in Greifswald NPP (Section 11.4.1) it is shown that at the time of decommissioning the total activity discharged into the water for one year (without tritium) is reduced to 120°MBq, and regarding the tritium it is 50 GBq. This means that in comparison with the operational period of Units 1-4 (2484 MBq – 1998) the total activity (excluding tritium) was decreased approximately 20 times.

The technologies for decommissioning selected on the basis of the international experience and the proper distribution of the decommissioning activities in time guarantee the limitation of the expected direct effects of the activities on the water quality within the accepted norms. Environmental impact is negligible and can not cause any transboundary impact.

If the technological procedures and requirements related to the decommissioning activities will be observed in compliance with the best available techniques (closed water systems, purification of sewage waters, control of the intaken waters), the discharged sewage water will be less contaminated during the decommissioning than during the operation.

The accidents related to the safe operation of Kozloduy NPP EAD, such as low and high waters of the Danube River, pollution with oil products of the service water system, accidents with other sources of ionizing radiation and the related actions are subject to separate emergency plans, instructions and procedures.

The emergency condition is defined according to the procedures for primary assessment of the initial event, after it has been classified according to the potential consequences and related measures, which should be performed in one of the following three groups: Level I “Alert”, Level II “Facility emergency”, Level III “Local or General Emergency”.

Upon an accident at Kozloduy NPP the plan for interaction of the management group (MG) with the governmental authorities, local administration and local government is applied in compliance with the Emergency Plan. The non-failed facilities are maintained in safe condition and the consequences at site where accident has occurred and they should be liquidated by the emergency team of Kozloduy NPP in compliance with the current procedures and instructions given by the BNRA and the Ministry of Economy, Energy and Tourism.

In order to carry out the task, the involved responsible teams are informed about the radiation situation and the accident progress. Diagrams of the evacuation routes and sites where the tasks will be performed will be shown, taking the teams to the preliminary indicated points in the vicinity of the accident location, as well as orientation in the situation, support to radiation monitoring specialists; exchange of data to keep an on line connection and control.

The potable water supply for the region of Kozloduy NPP in case of incidents and accidents jeopardizing human health as a result of its contamination is provided according to the National Emergency Plan [133]. The three wells near the Danube River supply the main water quantity for the region of Kozloduy. The protective measures for the water sources are planned as follows:

- Plugging the drainage routes towards the identified sources of potable water;
- Sealing doors, lids and ventilation outlets of the compressed drainage tanks and other water supply equipment;
- Laboratory analysis in order to ensure the quality of the potable water;
- Termination of the supply from water sources, which contamination is proven.

It is indicated that all sources are tightly closed within the 3-km zone (site perimeter) upon receipt of a notification about an accident in Kozloduy NPP.

The Ministry of Territorial Development and Construction is responsible for the mobilization of the mobile and stationary water supply for rescue and support teams, as well as together with the evacuating population.

Detailed assessment of all stages of the decommissioning of Units 1-4, relating to the sources of generation (incl. radioactive solid waste decontamination facilities) and the amount of different radioactive or harmful liquid effluents, is made in Section 1.11 of the EIA of Kozloduy NPP. The radioactive discharges into the Danube River from the observed sources of radiation as a result of decommissioning are discussed and evaluated in details. It is assessed that the impact on the water during the decommissioning will be significantly lower compared with the period of normal operation of the plant and with the limit values, and other individual restrictions, as well as approximately with the same order as in the period after the reactors final shutdown (RFS) (described in Chapters 1 and 3 of EIAR).

The main activities related to decontamination of the radioactive equipment and installations are described in details in Chapter 1 of EIAR. For reduction of the secondary contamination due to transportation of solid and liquid RAW to the places

of their decontamination, mobile facilities for decontamination of the contaminated equipment in the pre-dismantling phase are provided as well as mobile facility for LL RAW treatment. For decontamination of the dismantled equipment of Units 1-4 of Kozloduy NPP during the decommissioning process the methods described in Chapter 1 of the EIAR are examined. They include decontamination with water jet, abrasive decontamination, chemical decontamination, electrochemical decontamination; ultrasonic decontamination, rigid decontamination with application of the Cerium regenerative process. The existing system for monitoring and control of liquid and gaseous effluents from Kozloduy NPP is optimized as well.

The technologies for decommissioning selected on the basis of the international experience and the proper distribution of the decommissioning activities in time guarantee the limitation of the expected direct effects of the activities on the water quality within the accepted norms. Environmental impact is negligible and can not cause any transboundary impact.

The measures required for avoiding the impact of the conventional and radioactive liquid effluents on the water quality are presented in Chapter 6 of the EIAR.

In Chapter 4.3 of the EIAR the annual discharges of the main emitters of β-γ - activity and of ^{3}H trough the liquid wastes into Danube River are estimated during the normal operation of Units 3-4 at all decommissioning stages. Based on the EWN experience with the decommissioning of Greifswald NPP (section 11.4.1) it was demonstrated that during decommissioning the total activity (^{3}H excluded) released for a year in the water was decreased 20 times in comparison with Units 1 to 4 operational period.

In section 1.11 of the EIAR the radiological impact of the discharges into Danube river was assessed, taking into account that the accumulated individual effective dose is a result of all different exposure pathways – with food, fish, potable water, meat, milk and leaf vegetables, swimming, stay on the river bank etc. It was found that the radiological impact of the discharges in Danube River during all stages of decommissioning is extremely low compared with the individual limit annual effective dose pursuant to the Regulation for safety of NPPs. This is the reason to conclude that transboundary impacts for the human health are not expected.

The wastewater streams, sewage water and wastewater treatment facilities at Kozloduy NPP are described in Chapter 3 of the EIAR. Sewage water system of Kozloduy NPP is designed to collect residential sewage and rainfall waters from the site of Kozloduy NPP as well as a part of the industrial sewage waters and after control to supply them to the Main Drainage channel of the Kozloduy drainage system. There are local treatment facilities constructed for the above sewage waters.

The wastewater from the Dematerialized Water Production Facility is neutralized and after the respective control (measurement) of the pH, is discharged.

The quality of the conventional wastewater streams discharged into the Danube River is monitored in compliance with the In-house conventional monitoring program of the gaseous and liquid emissions of Kozloduy NPP EAD, approved by Vratsa RIEW. The origin and quantities of the waste water discharged in the Danube River are regulated by the respective Permits issued in compliance with the Water Act.

The treatment technology for decontamination of the radioactive contaminated waters by evaporation guaranties that in case the activity allowable limits are met, the content of harmful and hazardous substances in the discharged waters does not exceed the individual emission limits according to the Discharge Permit issued to Kozloduy NPP.

As per the Project "Design for supply of equipment for treatment of low level liquid RAW" the wastewater from the special laundries, showers and sump water from Units 1-4 of Kozloduy NPP, after shutdown, of SWT-3 has to be treated in Danube installation, which is a module type treatment facility with filtering, microfiltering and ultrafiltering. In case that the purification criterion is not achieved, the leacheate is transferred also trough the reverse osmosis module.

Water radiation status is monitored also in accordance with the Kozloduy NPP long-term program for environmental radiation monitoring. For the optimization of the currently operating monitoring and control system of the liquid and gaseous releases from Kozloduy NPP was implemented Project 12 "Liquid and gaseous releases optimization monitoring system".

Summarized results of the total water activity in the Danube river in the region of Kozloduy NPP at different control points along riverside up- and downstream of Kozloduy NPP (Chapter 3) show that the discharged unbalanced waters from the industrial activity do not impact the background beta-activity. Long-term investigations of Tritium in the waters of the Danube river water downstream of Kozloduy NPP show an activity lower than the allowable limit for tritium content in the potable waters.

The analysis of the Investment Proposal and of the possibilities for contamination of the waters in the 30-kilometer area around Kozloduy NPP, which is involved in the Romanian territory shows that during the decommissioning of KNPP Units 1 to 4 the activities on the border of the SE area, the activities for the construction and operation of the planned Size Reduction and Decontamination Workshop (SRDW), the Decay Storage Site for Transitional RAW (DSS) and the Site for Conventional Waste from Decommissioning (SWD) will generate less waste products than during the normal operation period. The same is valid for sewage waters. The analysis of the current state and the considerably limited emissions expected during the decommissioning in comparison with the normal operation shows that the transboundary impact is reduced to a minimum level.

D) Close down and reclamation Stage

The decommissioning process will be completed in 2037 and then the site and the buildings will be reconstructed in order to increase their efficiency and to improve the environmental indicators. Before the construction works start it will be agreed upon a conceptual design for close down and reclamation up to the condition of so-called "Brownfield". Buildings and underground infrastructure, which will be used for service of operating Units 5 and 6 will remain.

During the close down and reclamation stage the impact on the surfaces and underground waters is completely positive.

The expected impact on the surface and groundwater after the completion of decommissioning are completely positive. They are related to the termination of the following impacts:

- Reduction of water consumption by Kozloduy NPP;
- Reduction of the amount of the waste water released by Kozloduy NPP;
- Reduces pollution of surface water due to reduction of the discharge of waste water polluted by nutrients (BOD, DO, ammonium nitric, nitrite, nitrate, orthophosphate), by the release of suspended solids and metals (iron, manganese, lead, etc.), due to pollution with boron, radioactive contamination, release of hydrochloric, thermal pollution;
- Sources of pollution of the groundwater with nutrients (BOD, RC, ammonium nitric, nitrites, nitrates, orthophosphates), metals (COD, iron, manganese, lead, etc.), radioactive contamination, release of hydrochloric (sulphates, chlorides) etc. are expected to be reduced;
- As a result of the reduced impacts on the water habitats (sedimentation, fever, elevated concentrations of contaminants) improvement of the state of aqueous ecosystems is foreseen.

The following conclusion could be made about the impact during Pre-decommissioning and Post-decommissioning stages of Units 1-4 of Kozloduy NPP.

Occurrence probability:	Available
Territorial scope of impact (geographic region; affected population):	Within the examined affected surfaces and underground aquifers.
Reversibility of the impact (reversible, irreversible):	Reversible
Duration of the impact– (short term, medium term and long term):	Middle term
Frequency of impact occurrence (*permanent/temporary*):	Temporary, for the term
Type of the impact (positive/negative; direct/non-direct; secondary; cumulative and synergy):	Negative, direct, with a trend for improvement of the water properties.
Transboundary type of the impact:	Not expected

4.4 Lands and soils

During the decommissioning of Kozloduy NPP Units 1 to 4 the Pre-Decommissioning Stage (PDS), Stage 1 and Stage 2 of the Decommissioning are separated.

A) Stage of preparation of Decommissioning (SPD)

The activities, which will have conventional impact on the atmosphere air during the stage of preparation of Units 1-4 of Kozloduy NPP for decommissioning are mostly construction ones. A Size Reduction and Decontamination Workshop (SRDW), (3744°m^2) will be constructed. Impact on the soils will be mostly mechanical and will be related to construction works, machines and transportation activities as well as to the excavation and embankment works. Excavation and embankment works will be made, because the existing underground communications should be re-routed. The site of the Workshop is located south of the existing Turbine hall of Units 1 to 4 and to the east of the Reactor building of Units 1 and 2, to the north of Sanitary building 1 and within the perimeter of the fence of Kozloduy NPP Site. The land is owned by Kozloduy NPP. Use of land will not be changed. No construction of roads is foreseen, because the existing ones will be used. Impact on the soils will be temporary, local until the completion of the construction. A disposal facility has to be foreseen in the design for removed humus soil, which will be disposed and used for further reclamation.

Also, construction works will be executed for extension of the existing facility for Repository for Conventional Municipal and Industrial Waste (RCMIW), after its filling in. An area of 11 decares will be occupied.

Also, the construction activities at this stage include construction, equipment and commissioning of 4 sites, 10 decares including road infrastructure and 300 m railway. Sites 1 (spatial separation in 2 parts 1a and 1b), 2 and 4 for storage of RAW Category 1, will be situated on the existing green areas. The excavation and embankment works will affect the following areas: 60 x 30 m for site 1a, 1816 m^2 for site 1b, 55 x 58 m for site 2 and 40 x 76m for site 4. For site 3 where the conventional materials will be stored - borates, no new areas will be needed. The existing transformer site of Units 1 and 2 will be used having the area of 292 x 38 m. The land is owned by Kozloduy NPP. It is needed after the removal of the humus soil from the green areas to dispose it in a disposal facility and to use it for further reclamation. It is expedient to analyze the content of ^{137}Cs and ^{90}Sr in the disposed soil.

During the Pre-decommissioning stage it is not expected that the soils will be polluted by the residue of dust and gas emission contained in the air. During this stage there are no controlled emission sources. The non-controlled emissions are related to the CO, NOx, SO_2, hydrocarbons, smoke black and dust discharged into the atmosphere by the internal combustion engines of the transport sources, which service the facility as well as dust, which will be emitted during the levelling of the Workshop site, excavation and other ground works, unloading and reloading of embankment materials. Pollution caused by the internal combustion engines could not be avoided during any type of construction; it is negligible within the working day until completion of the construction stage. The dust emissions, which will be emitted, are

not hazardous for the soils in the region of construction site, adjacent areas and use of land, because they mostly contain dust particles.

The above stage is not related to generation of contaminated waters, which may have negative impact on the soils of the plant territory and next to it.

The potential radiological impact on the soils during this stage will be solid radioactive waste generated from the dismantling and contaminated construction materials, which are not subject to further treatment as well as the operational radioactive waste, stored in the storage facilities of the Auxiliary Building. If the accepted safety rules will be observed no such radiation impacts on the soils might be expected.

During the stage of preparation of Units 1 to 4 of Kozloduy NPP for PDS no considerable negative impact on the soils and adjacent lands is expected. The impact will be mechanical, short term, without cumulative effects.

B) Stage 1 of the decommissioning

Conventional waste, which value of the measured dose rate of gamma radiation will not exceed 0.3μSv/h, will be disposed on the existing Repository for conventional waste. After its filling in an extension will be made in order to allow the receipt of the waste during the next 15 years. In relation to the existing Conventional Waste Management Program in Kozloduy NPP all types of hazardous waste are identified and their quantities are determined. During the execution of the program for management of all types of waste that will be generated during the decommissioning of Units 1 to 4 of Kozloduy NPP, no pollution of the soils with conventional waste is expected. It is expedient to include also the soil monitoring in the Radiation Monitoring program.

The potential radiological impact on the soils occurs during the operation of the Size Reduction and Decontamination Workshop. The main activities are related to the fragmentation and decontamination of different equipment, technique and materials etc. and with the radiation control as well. The control of the radioactive materials incoming in the environment, liquid, solid, gaseous emissions into the environment is foreseen as well as the control of the output materials from the Workshop. Materials themselves that are subject to decontamination do not jeopardize the soils – these are pipelines, fittings, bodies and filters, pumps, electric motors, tanks. They are made of stainless steel, carbon steel, copper, cast iron, galvanized tin etc. In case of efficient decontamination the fragmented equipment will not jeopardize the soils.

Sites 1 (1a and 1b), 2 and 4 will be used for decay storage. If the requirements of the technical specification related to them will be observed, namely design and execution according to the best available techniques of the European and Bulgarian legislation, no pollution of the soils is expected.

The activities on the border of the SE area will be made indoor and do not jeopardize the soils of the Kozloduy NPP site as well as the adjacent lands. Considerable part of them is not related to the generation of sources of the impact on the soils. The sources of contamination of different media and from thereof impact on the soils are related to the decontamination of different equipment. These are the reactor refuelling cavity, primary circuit and the equipment related to it, the spent fuel pool, decontamination of

the technological systems, rooms and surfaces, activities for collection, sorting and transportation of the waste generated by the decontamination etc. After execution of the decontamination the possible sources for contamination of the soils are different precipitates and service waters used for technological needs. The design should foresee precisely the manner of treatment of radioactive waste and precipitates. Service water used in the pool will be treated by water treatment system (SWT-3). In case of efficient operation of the water treatment systems no pollution of the soils is expected to be caused by water leakage.

During the decontamination process it is possible that non-radiological contamination of the soils with chemicals occurs. These chemicals will be used for decontamination such as phosphoric acid, oxalate acid, products for cerium process etc. Considering the fact that the contamination could happen indoor the contamination is only possible in emergency cases during transportation and contamination of these materials. In case of efficient execution of the foreseen decontamination activities no impact is expected on the soils of Kozloduy NPP site as well as on the adjacent lands.

In case of dismantling of the turbine hall 3 categories of objects are detached-category I – equipment without contamination, II – potentially contaminated equipment and III – contaminated equipment. Materials of Category I and II will be measured before the free release and the contaminated equipment will be treated as radioactive waste. Part of the radioactive waste – mainly concrete and epoxies resign of the floorings are subject to storage and disposal. Draft dismantling program is required and its strict implementation should guarantee the environmental protection including prevention of the soils' pollution.

During Stage 1 of the Decommissioning also gaseous emissions of conventional organized and non-organized sources will be generated. Such are the breaker plant, which will mostly emit dust, emergency diesel generators - dust (PM10), VOC, SO_2, NOx, and CO_2, Facility for Treatment and Conditioning of solid RAW - SO_2, HCl, CO, dioxins and furans and the internal and external transport facilities - dust (PM10), NOx from the diesel fuel. The design has to foresee technical solutions to maintain the levels of all emissions in compliance with the levels permitted by the license, which will guarantee the protection of the soils on the plant area and the adjacent lands.

Pollution of the soils with borates is also not expected. They will be temporary stored on site 3 in skip containers and then they will be removed beyond the territory of Kozloduy NPP.

C) Stage 2 of the decommissioning

Stage 2 of the Decommissioning of Units 1 to 4 of Kozloduy NPP includes activities for delayed dismantling of the equipment within the Safe Enclosure area. The foreseen activities are not sources for soil pollution. As a normal result of the activities included in Stage 1 the decontrolled dismantled materials will be transported beyond the site of Kozloduy NPP, other ones will remain stored in order the natural decay to continue or they will be transferred as RAW suitable for treatment and conditioning. The application of the safety measures elaborated in the project will guarantee the protection of the soils from the plant site and adjacent territories.

From the most probable ***accidents*** (fire, interruption of processes, failures of installation, spills, flooding, explosions, load dropping, road accidents, etc) during

Stages 1 and 2 important for the soils are only the accidents that may occur outdoor. The impact on soils may occur in case of earthquakes and demolition of compartments for radioactive waste decay storage compartments, storage pits, decontamination compartments, breaking of the asphalt layer, which covers the contaminated ground, etc.

The region where the site of Kozloduy NPP is located, is seismically active, but without active tectonic dislocations. The Safe Shutdown Earthquake for seismic activity, level VII and Design Basis Earthquake for seismic activity of level VI according to the Medvedev-Sponheuer-Karnik scale are considered during the design phase. The likelihood for demolition of the compartments and storage pits and contamination of soil is not expected. A cracking of the asphalt layer which covers the contaminated ground could be assumed. In this case urgent measures for restoration of the covering layer should be undertaken.

The soil contamination may occur as a result of spills of different chemicals, explosions in the process of their storage and fires. The impact shall be only local and temporary, until accidents are taken under control.

The analysis of the investment proposal excludes the probability for any ***cumulative effect*** on the soils caused by the decommissioning activities of Units 1 to 4 of Kozloduy NPP, operation of Units 5 and 6 of Kozloduy NPP and the National Repository for disposal of RAW. During the operation of all above facilities the main objective is to maintain the levels of all emissions in compliance with the levels permitted by the license. Concrete technical solutions are applied, which ensure the environmental safety, including the soils safety.

The analysis of the Investment Proposal and of the possibilities for contamination of the soils in the 30-kilometer area around Kozloduy NPP, on the territory of the country shows, that during the decommissioning of Kozloduy NPP Units 1 to 4 the planned activities on the border of the SE area, the activities for the construction and operation of the Size Reduction and Decontamination Workshop, the RAW Storage Sites for RAW Category 1 and the Repository for Conventional Waste will generate much lesser waste products than during the normal operation of the Units. The soils monitoring, conducted on the territory of Kozloduy NPP proves, that the NPP has no contribution in ^{137}Cs and ^{90}Sr content of the soils and this means that no transboundary effect is expected to be caused by the Investment Proposal.

D) Close down and reclamation Stage

The Post-decommissioning stage of Units 1 to 4 of Kozloduy NPP will include activities that will have positive impact on the soils. These are dismantling and decontrol of buildings, facilities and waste. The reclamation of the destroyed areas will have positive impact on the soils and will allow different using of the land.

The following conclusion could be made about the impact during and after decommissioning of Units 1-4 of Kozloduy NPP.

Probability of occurrence:	During the construction:
Territorial scope of impact (geographic region; affected population):	19,680 decares from the site of Kozloduy NPP.
Reversibility of the impact (reversible, irreversible):	Reversible
Duration of the impact (short term, medium term and long term):	Short term, prior the reclamation
Frequency of impact occurrence (permanent/temporary):	Temporary
Type of the impact (positive/negative; direct/non-direct; secondary; cumulative and synergy):	Negative, direct

4.5 Earth interior

A) Pre-decommissioning (PDS)

During the Pre-decommissioning stage different construction works will be carried out, which may have negative conventional impact on the stability of the geological environment.

The loading of the construction sites will determine the final condition of stability of the geological environment as considering the high seismicity.

As per the Terms of Reference the new decay storage sites and SRDW will suffer additional loading by the construction equipment and later by the located storage containers and equipment situated in the workshop.

The impact on the geological base will be long term, local and negative regarding the strength of the foundation. No ***cumulative*** effects are expected.

B) Stage 1 of the decommissioning

During the dismantling of the equipment beyond the Safe Enclosure Area some negative short term impact may affect the stability of the foundation, which may provoke engineering and geological processes in the site region. The impact will be only local. No ***cumulative*** effects are expected.

B) Stage 2 of the decommissioning

During the delayed dismantling some negative impact may affect the strength of the geological environment that will worsen the physical and mechanical properties of the environment. The following transportation of the dismantled materials may cause real risk of overloading of the geological environment and as a result of this some anthropogenic geological processes may occur, which will impact the seismic stability of the whole site, but not to have only fragmentary impact on the commented slabs.

It is important to specify the manner of use of the fee buildings after the dismantling and to verify the stability of the environment before their refurbishment for the next functioning. No radiological impacts on the Earth interior are expected. It is not expected that any potential ***accidents*** on the territory of Kozloduy NPP will negatively impact the Earth interior. No cumulative effect is expected from the decommissioning activities of Units 1 to 4 of Kozloduy NPP, the operation of Units 5 and 6 of Kozloduy NPP and from the National Repository for disposal of low and medium active RAW, because all three sites are not sources of pollution of the Earth interior. The Investment Proposal may not have any transboundary impact on the Earth interior in Romania.

D) Close down and reclamation Stage

The Post-decommissioning stage of Units 1 to 4 of Kozloduy NPP will include activities that will not have negative impact on the Earth Interior.

4.6 Landscape

A) Pre-decommissioning Stage (PDS)

The Pre-decommissioning Stage of Units 1 to 4 of Kozloduy NPP will have minor conventional impact on the landscape. The construction activities related to the construction of Size Reduction and Decontamination Workshop, enlargement of the existing disposal facility for conventional waste, 1 site for conventional waste and 3 sites for radioactive waste, road infrastructure and 300 m railway will affect the rock base, the component soils and vegetation The construction activities will affect negligibly the rock base and the soils. The humus layer of the soil will be disposed and used for reclamation of the destroyed lands. Vegetation will be destroyed. The sites will be located in a part of the meadow landscape, from which the following areas will be affected: Workshop - 3 744 m^2, for site 1a – 60 x 30 m for site 1b- 1816 m^2 for site 2 – 55 x 58 m and for site 4 – 40 x 76 m. The meadow landscape located on their place will be replaced by anthropogenic landscape. The main medium generatrix of meadow landscape will be restricted due to reduction of its total area due to the increasing of the anthropogenic landscape. Also, 10 woods will be cut, which are located at the place suitable for site 1a. The general visual impression of the landscape site will be changed.

Solid radioactive waste generated during this stage as a result of the dismantling and polluted construction materials are potential sources of radiation contamination. If the accepted safety rules will be observed no such radiation impacts on the different landscape components might be expected. The above stage is not related to discharged immission or contaminated waters, which may have negative impact on the soils of the landscape of the plant territory and next to it.

During the stage of preparation of Units 1 to 4 of Kozloduy NPP for PDS no considerable negative impact on the landscape is expected. The impact will be mechanical, short term on some components and without cumulative effects.

B) Stage 1 of the decommissioning

Stage 1 of the decommissioning is related to the extension of the existing disposal facility for conventional waste. New areas will be affected – 6750 m^2, which will cause worsening of the visual perception of the landscape. For the improvement of the landscape overview it is expedient to construct a green belt around the new part towards the disposal facility. The disposal facility itself shall not be a source of considerable negative impacts on the landscapes due to the availability of Program for management of conventional RAW of Kozloduy NPP. Its execution has to ensure the management of all types of waste that will be generated during the decommissioning of Units 1 to 4 of Kozloduy NPP.

It is not expected that the operation of the Size Reduction and Decontamination Workshop, sites 1 (1a and 1b), 2 and 4, Decay Storage Site 1 and site 3 for storage of borates are sources of impact on the landscape. Their technical specifications require the application of the best available techniques and compliance with the European and Bulgarian legislation, which will guarantee the protection of the landscape.

The radiological impacts on the landscape components are not expected.

During stage 1 of the Decommissioning gaseous emissions of conventional controlled and uncontrolled sources will be generated. The design has to foresee technical solutions for their minimizing in compliance with the respective legislation and prevention of pollution of the landscape components.

The analysis of the Investment Proposal shows that during the construction and operation of the Size Reduction and Decontamination Workshop (SRDW), the Decay Storage Sites (DSS), category 1 and the Site for Conventional Waste will generate fewer waste products than during the normal operation period of Kozloduy NPP Units. In this regard no considerable, negative impacts are expected on the landscape components. No ***cumulative effect*** is expected.

C) Stage 2 of the decommissioning

Stage 2 of the decommissioning of Units 1 to 4 of Kozloduy NPP includes activities, which are not related to impacts on the components of the landscapes, nor to damage of their vertical or horizontal structure. The activities are mostly deferred dismantling of the equipment within the framework of the Safe Enclosure Zone, transportation of materials beyond the Kozloduy NPP Site, storage of materials for natural radioactive decay etc.

The activities of Safe Enclosure Area will be executed indoor and are not hazardous. Potential sources of pollution of different components are the reactor refuelling cavity, primary circuit and the equipment related to it, the spent fuel pool, decontamination of the technological systems, rooms and surfaces, activities for collection, sorting and transportation of the waste generated by the decontamination etc. After execution of the decontamination the possible sources for contamination are different precipitates and service waters used for technological needs. It is foreseen to treat the service water used for technological needs by water treatment system (SWT-3). In case of efficient operation of the water treatment systems no pollution of the landscape components is expected to be caused by water leakage.

The execution of the activities will be subject to the elaborated safety measures, which will guarantee the landscape protection.

From the potential accidents like failure of installations, spills, explosions, load dropping, traffic accidents and other impacts on the landscape structure only those which have occurred outdoor could have an impact on the landscape infrastructure. They will affect the components such as soils and vegetation. The impact will be local and temporary until the accident will be controlled.

The impact on the components geological base, soils and vegetation may be expected in case of earthquake, demolition of the radioactive waste decay storage compartments, decontamination compartments, asphalt layer, covering the contaminated ground, etc. The impact will be local and temporary until the accident will be under control.

The contamination of the component soils and vegetation may be caused by accidents related to spill of different chemicals or explosion while they are stored. The impact will be local and temporary until the accident will be controlled and ***cumulative impact*** is not expected.

No cumulative effect is expected on the landscapes as caused by the decommissioning activities of Units 1 to 4 of Kozloduy NPP, operation of Units 5 and 6 of Kozloduy NPP and the National Repository for disposal of low and medium RAW. Their operation is not related to the availability of emmission in the air, generation of sewage waters in the landscape or others which may be sources of considerable negative impacts causing cumulative effect on the landscapes. No ***transboundary impact*** on the landscapes of Romania is expected.

D) Close down and reclamation Stage

The Post-decommissioning stage of Units 1 to 4 of Kozloduy NPP will have positive impact on the landscapes. The foreseen activities are dismantling and decontrol of buildings and facilities. The visual impression by the landscape will not be considerably changed

The reclamation of the destroyed areas will have positive impact on the soil component and will allow different using of the land. Depending on the planned used for the territory of the former Units 1 to 4 of the power plant it is possible a new landscape to occur.

The following conclusion could be made about the impact during and after decommissioning of Units 1-4 of Kozloduy NPP.

Probability of occurrence:	During the construction:
Territorial scope of impact (geographic region; affected population):	19,680 decares from the site of Kozloduy NPP.
Reversibility of the impact (reversible, irreversible):	Reversible
Duration of the impact (short term, medium term and long term):	Short term, prior reclamation
Frequency of impact occurrence (permanent/temporary):	Temporary
Type of the impact (positive/negative; direct/non-direct; secondary; cumulative and synergy):	Negative, not direct

4.7 Protected Territories and Protected Areas

Impact of the NPP on the vegetation and habitats in the protected territories (PT) and Protected Areas (PA) in Bulgaria

Up to now there are no specialized monitoring held of the radio-ecological status of the vegetation and habitats in the protected territories and protected areas related to the EIA of Kozloduy NPP. Results of the monitoring held up to now of the soil and vegetation components in the region of 30 km from Kozloduy NPP provide grounds for conclusion that by the impact of the power plant the radio-ecological status is not changed considerably on the status of the territory of the protected territories assessed in the EIA in the region of the village of Selanovtsi and Protected territories BG0000533 Islands Kozloduy, BG0000199 Tsibur, BG0000614 Ogosta River, BG0000508 Skat River under the Directive for protection of the habitats of the wild flora and fauna and BG0002099 Zlatiata for protection of the wild birds. Grounds for such conclusion are as follows:

- No negative impact is determined on the natural and derivative vegetation and agricultural plants on the areas of protected territories and protected areas.
- The analysis of the soil pollution in the region of Kozloduy NPP until 1999, shows that it is not possible to prove the contribution of the power plant for the value of ^{137}Cs and ^{90}Sr content in the soils of PT and PA. As a whole the functioning of the power plant has no impact on the soil parameters that could be also considered for the habitats as a whole.
- The Monitoring of the pollution of the soils in 2009, 2010 and 2011 shows that the most important pollutants are ^{90}Sr and ^{137}Cs and their concentrations are lower than the other regions in the country, which is a sign that the environmental radiological status of the habitats is not impacted by the operation of the power plant.

Impact of Kozloduy NPP on the transboundary territories

The Romanian territory is located in the area around Kozloduy NPP and it is examined and assessed in the present EIAR.

The border of the neighbour country Serbia is located at approximately 100 km from Kozloduy NPP so its territory is not subject to assessment.

Impact of the Investment proposal for the decommissioning of Units 1-4 of Kozloduy NPP on the vegetation and habitats in the PT and PA

A) Pre-decommissioning Stage (PDS)

The activities foreseen for the Pre-decommissioning stage for Units 1 to 4 of Kozloduy NPP are mostly construction ones and will be executed on the site of the power plant. No direct conventional impacts are expected on the Protected Territories and Protected Areas.

During the Pre-decommissioning Stage a pollution of the air by uncontrolled emissions is expected, which are related to the emitted gases into the atmosphere CO, NOx, SO_2, hydrocarbons, smoke black and dust discharged during the levelling of the

workshop site, the excavation and other Earth works, unloading and reloading of bulk materials. This air pollution is assessed as negligible within the working day until the completion of the construction stage and it is not expected to have negative impact on the neighbour Protected territories and Protected areas.

The generation of solid and radioactive waste from the dismantling and contaminated construction materials could be considered as contaminated construction materials. If the accepted safety rules are observed no negative impacts are expected by these types of waste on the Protected Territories and Protected Areas.

B) Stage 1 of the decommissioning

The activities foreseen for this stage are: Preparation for Safe Storage; Safe Storage of the Reactor Compartments and dismantling of the equipment beyond the Safe Storage Area. The activities on the border of the SE area will be carried out indoor and do not jeopardize the Protected territories and Protected Areas located within the territories around Kozloduy NPP.

Considerable part of the activities within the SE area is not related to the generation of sources of the impact on the components of the Protected Territories and Protected Areas. The sources of non-radiological pollution and potential impact on different environmental components are related to the decontamination of different equipment. During the decontamination process it is possible that contamination with chemicals occurs which will be used for decontamination. Considering the fact that the decontamination will be made indoor the contamination is possible only in the emergency cases, during transportation and storage of these materials In case of efficient execution of the foreseen decontamination activities no impact is expected on the components of the Protected Territories and Protected Areas.

Conventional waste, which value of the measured dose rate of gamma radiation will not exceed 0.3 μSv/h, will be disposed on the existing Repository for conventional waste. After its filling in an extension of the disposal facility will be made in order to allow the receipt of the waste during the next 15 years. Considering the availability and execution of the Waste Management Program no significant negative impacts are expected on the Protected Territories and Protected Areas next to Kozloduy NPP.

During substage 1 of the Decommissioning gaseous emissions of conventional controlled and uncontrolled sources will be generated. Such are the breaker plants, which will mostly emit dust, emergency diesel generators - dust (PM10), VOC, SO_2, NOx, and CO_2, the facility for treatment and conditioning of solid RAW - SO_2, HCl, CO, dioxins and furans and the internal and external transport facilities - dust (PM10), NOx from the diesel fuel. The design has to foresee technical solutions to maintain the levels of all emissions in compliance with the levels permitted by the license, which will guarantee the protection of the components of Protected Territories and Protected Areas.

Potential source of radiation contamination may be the dismantling of the Turbine Hall. Three categories of objects are detached- category I – equipment without contamination, II – potentially contaminated equipment and III – contaminated equipment. Materials of I and II category will be measured before the free release and the contaminated equipment will be treated as radioactive waste. Part of the radioactive waste – mainly concrete and epoxies resign of the floorings are subject to

storage and disposal. Draft dismantling program is required and its strict implementation should guarantee the environmental protection in the Protected Territories and in the Protected Areas.

C) Stage 2 of the decommissioning

The activities foreseen for this stage are: Delayed dismantling of the equipment within the Safe Enclosure Area; Transportation of the decontrolled dismantled materials; Storage of RAW for progress of natural decay process; Decontrol of the site and buildings for use for other purposes.

The foreseen activities are not sources for pollution of the environmental components in the Protected Territories and protected Areas and the application of the safety measures elaborated in the project will guarantee the protection of the adjacent areas of Protected Territories and Protected Areas at this Stage. No cumulative effects are expected from the conventional and radiation impacts on the Protected Territories and Protected Areas from the decommissioning of Units 1 to 4 of Kozloduy NPP, operation of Units 5 and 6 of Kozloduy NPP and the National Repository for disposal of RAW.

Out of the accidents stipulated in the design as the most probable important accidents for the vegetation and habitats in the protected territories and protected areas are fire, interruption of processes, installation failures, spills, flooding, explosions, load dropping, road accidents and other accidents, which may occur outdoor. The negative impact on the protected territories and protected areas may occur as a result of spills of different chemicals, explosion in the process of their storage and fires. The impacts shall be only local and temporary, until accidents are taken under control. This gives reason to make the conclusion that ***transboundary*** impacts on the protected areas on the Romanian territories are not expected.

D) Close down and reclamation Stage

The foreseen activities are not sources for pollution of the environmental components in the Protected Territories and Protected Areas and the application of the safety measures elaborated in the project will guarantee the protection of the adjacent areas of protected territories and protected Areas at this Stage.

As a conclusion the following forecast could be made about the impact during and after decommissioning of Units 1-4 of Kozloduy NPP.

Probability of occurrence:	during the construction:
Territorial scope of impact (geographic region; affected population):	locally
Reversibility of the impact (reversible, irreversible):	Reversible
Duration of the impact (short term, medium term and long term):	short term, until reclamation

Frequency of impact occurrence (permanent/temporary):	temporary
Type of the impact (positive/negative; direct/non-direct; secondary; cumulative and synergy):	non-direct, secondary

Conclusions:

- The expected negative impacts on protected areas in European Natura 2000 network are discussed in detail and assessed in an integrated assessment of compatibility, which is an integral part of this EIA.
- On the grounds of the analysis made of the potential conventional and radiation impacts the conclusion could be drawn that under the adopted technology in case Alternative 2 is launched and in compliance with proposed measures the implementation of Investment Proposal will have no negative impact on protected area BG0002009 Zlatiata under the conservation of wild birds and protected areas BG0000533 Kozloduy Islands, BG0000614 Ogosta River BG0000508 Skat River and BG0000199 „Tsibar“ under the Directive of natural habitats.
- According to the data submitted formally by the Romanian side for the purposes of the EIA-R, three protected areas on the Romanian territory are included in the 30-km area surrounding Kozloduy NPP. The Protected Area ROSCI0045 is under the Habitat Directive and Protected Areas ROSPA0010 and ROSPA0023 are under the Bird Directive;
- It can be summarized that the protected areas on both sides of the Danube River are interconnected and form a complex ecological system which shall be considered as a whole. If the accepted decommissioning technology will be observed the negative impact on the environmental complex of the Protected Areas as a result of the Dismantling of all 4 Units of Kozloduy NPP will not be considerable.

4.8 Mineral diversity

For the Project implementation no mineral resources will be used. Due to this reason it is not expected that they are affected by the project implementation.

During the close down and reclamation of the destroyed areas it is not expected that any conventional or radiological impact on the Earth interior occurs.

As a conclusion, the following forecast could be made about the impact during and after the decommissioning of Units 1-4 of Kozloduy NPP.

During the decommissioning

Probability of occurrence:	Big
Territorial scope of impact (geographic region; affected population):	In the region of the examined area - local
Reversibility of the impact (reversible, irreversible):	The impact is not expected to be reversible, if some engineering and geological processes will be provoked.
Duration of the impact (short term, medium term and long term):	Short term
Frequency of occurrence of the impact (permanent/temporary):	During the loading of the areas with equipment and execution of the dismantling works.

Post-decommissioning

Occurrence probability:	Small only during the execution of delayed dismantling.
Territorial scope of impact (geographic region; affected population):	in the region of the examined area - local
Reversibility of the impact (reversible, irreversible):	Irreversible
Duration of the impact (short term, medium term and long term):	Short term
Frequency of occurrence of the impact (permanent/temporary):	During the loading of the area with equipment and execution of the dismantling works.

4.9 Biodiversity

4.9.1 Flora and vegetation

The influence of the IP for decommissioning of Units 1-4 of the Kozloduy "NPP" on the flora and vegetation is estimated.

A) Pre-decommissioning stage (PDS)

During the Pre-decommissioning stage the following activities will be carried out: construction oft a Size Reduction and Decontamination Workshop (SRDW); extension of the existing facility for Repository for Conventional Municipal and Industrial Waste (RCMIW), and construction of new sites for temporary RAW storage 1 category.

During the construction works for building, equipment and commissioning of sites for disposal of RAW of Category 1, road infrastructure and 300 m railway some individuals and vegetation habitats of the green system of Kozloduy NPP will be affected. The excavation and embankment works will affect elements of the green system of the following areas: 60x30 m for site 1a, 1816 m^2 for site 1b, 55 x 58 m for site 2 and 40 x 76 m for site 4. For site 3 the conventional materials will be stored - borates. In this case it is not expected to affect any vegetation groups.

During this solid radioactive waste stage will be generated from the dismantling and contaminated construction materials, which are not subject to further treatment and the operational radioactive waste, stored in the storage facilities of the Auxiliary Building. If the accepted safety rules are observed, no negative impacts are expected by these types of waste on the flora and vegetation in the neighbour territories.

During the Pre-decommissioning period some air pollution is expected by uncontrolled emissions related to the CO, NOx, SO_2, hydrocarbons, smoke black and dust discharged into the atmosphere by the internal combustion engines of the transport sources, which service the facility during this period as well as dust, which will be emitted during the levelling of the Workshop site, excavation and other ground works, unloading and reloading of embankment materials. This air pollution is assessed as negligible within the working day until the completion of the construction stage and it is not expected to have negative impact on the flora and vegetation of the neighbour territories.

B) Stage 1 of the decommissioning

The activities foreseen for this stage 1 are: Preparation for Safe Enclosure; Safe Enclosure of the reactor buildings (this area includes the reactor buildings of Units 1 and 2, reactor buildings of Units 3 and 4 and the scaffold bridges between them) and dismantling of the equipment beyond the Safe Enclosure Are, including: temporary storage of conventional waste and materials; fragmentation and decontamination of materials, generation of gaseous emissions of conventional controlled and uncontrolled sources. Non-radiation impact on the flora and vegetation from the temporary storage of conventional waste and materials is not expected. Conventional waste, which value of the measured dose rate of gamma radiation will not exceed 0.3°µSv/h, will be disposed on the existing Repository for conventional waste. After its filling in an extension of the disposal facility will be made in order to allow the receipt of the waste during the next 15 years. Considering the availability and

execution of the Waste Management Program no significant negative impacts are expected on the flora and vegetation of the territories next to Kozloduy NPP.

The activities on the border of the SE area will be carried out indoor and do not jeopardize the flora and vegetation located within the territories around Kozloduy NPP.

The sources of conventional pollution and potential impact on the flora and vegetation are related to the decontamination of different equipment. In this regard the design should foresee precisely the manner of treatment of radioactive waste and precipitates.

Except a radioactive contamination, during the decontamination process a possible chemical contamination with chemicals that will be used for decontamination could occur, namely phosphoric acid, oxalate acid, products for cerium process etc. Considering the fact that the contamination could be made indoor the contamination is possible only in the emergency cases during the transportation and contamination of these materials.

In case of efficient execution of the foreseen decontamination activities no impact is expected on the flora and vegetation.

In case of dismantling of the turbine hall 3 categories of objects are detached-category I – equipment without contamination, II – potentially contaminated equipment and III – contaminated equipment. Materials of category I and II will be measured before the free release and the contaminated equipment will be treated as radioactive waste. Part of the radioactive waste – mainly concrete and epoxide resign of the floorings are subject to storage and disposal. Draft dismantling program is required and its strict implementation should guarantee the protection of the flora and vegetation.

During stage 1 of the Decommissioning gaseous emissions of conventional controlled and uncontrolled sources will be generated. Such are the breaker plants, which will mostly emit dust, emergency diesel generators - dust (PM10), VOC, SO_2, NOx, and CO_2, Facility for treatment and conditioning of solid RAW - SO_2, HCl, CO, dioxins and furans and the internal and external transport facilities - dust (PM10), NOx from the diesel fuel. The design has to foresee technical solutions to maintain the levels of all emissions in compliance with the levels permitted by the license, which will guarantee the protection of the flora and vegetation on the site and in the adjacent lands.

C) Stage 2 of the decommissioning

The activities foreseen for stage 2 of the decommissioning are: Delayed dismantling of the equipment within the Safe Enclosure Area; Transportation of the decontrolled dismantled materials; Storage of RAW for progress of natural decay process; Decontrol of the site and buildings for use for other purposes.

The foreseen activities are not sources for pollution of the environmental components in the Protected Territories and Protected Areas and the application of the safety measures elaborated in the project will guarantee the protection during this stage of the flora and vegetation in the adjacent areas.

Decommissioning process is related to a number of activities aiming to prepare the nuclear facility in a condition of short time safe enclosure (Stage 1) and after that the dismantling of the equipment in the SE area (Stage 2). Main activities for both stages are described in details in Chapter 1. The analysis of these activities shows that a potential impact could be expected on different vegetation species and vegetation communities only in the KNPP site. In this regard a number of activities, which are related to the reduction of the potential hazards, are foreseen to be executed still before the beginning of the safe enclosure. Potential negative impact on the flora is related to the inflammable and hazardous materials, radioactive waste and spent nuclear fuel. In this regard to prevent the impact on the flora, their removal and safety elimination and in time storage is needed. For the execution of the design objectives to "maintain the levels of all emissions in compliance with the levels permitted by the license" some concrete technical solutions should be elaborated in order to guarantee the environmental safety including the flora safety.

During the execution of the activities on the border of the SE area and execution of building activities for preparation of SE no direct impact on the vegetation and habitats is expected. Only the dismantling of the equipment is related to the radiation risk.

Nevertheless the activities on the border of SE area should be performed indoor and they do not endanger the vegetation from the NPP site as well as the adjacent areas, occupied by vegetation, it could be supposed that the "construction measures" will affect only a part of the territory of the NPP site and will not influence the flora and vegetation in the adjacent territories.

Impact on the flora and vegetation may be expected from the activities that may be a source of environmental pollution related to the decontamination of different equipment.

It is foreseen that different decontamination methods will be used during decommissioning. The methods are described at sub-chapter 1 of present report. During the execution of these activities no direct impact on the vegetation is expected. After execution of the decontamination the possible sources for contamination of the soils are different waste, precipitates and service waters used for technological needs. In case of efficient operation of the water treatment systems no impact on the vegetation is expected to be caused by water leakage.

Except a radioactive impact, during the decontamination process it is possible that a negative impact will be caused by the chemicals that will be used for decontamination such as phosphoric acid, oxalate acid, products for cerium process etc. in the emergency cases during the transportation and contamination of these materials.

In case of efficient execution of the foreseen decontamination activities, no impact is expected on the flora and habitats of Kozloduy NPP site as well as on the adjacent lands.

The Project [156] specifies that a new building for SRDW will be constructed; the location of the workshop is fixed as well as the necessary area for the building and the auxiliary activities service. There will not be any impact on the flora.

During the *SRDW operation* as considering that the main activities are related to the radiation control of the fragmentation and decontamination of different equipment, technique and materials etc., no negative impact on the flora and habitats is expected.

During the decommissioning of Units 1 to 4 of Kozloduy NPP some liquid and solid RAW will be generated and for the liquid waste the limits for emissions will be accepted to be lower than the limits during the normal operation of Units 1-4 of Kozloduy NPP and they are defined in Unit's licenses as mode "E". For the liquid waste the limits for emissions will be accepted to be lower than the limits during the normal operation of Units 1-4 of Kozloduy NPP and they are defined in Unit's licenses for mode "E". For the liquid radioactive waste in the technical specification a treatment is foreseen until generation of a waste called evaporation concentrate. In this way a minimization of the waste will be achieved as well as the long-term and safety isolation from the environment.

During Stage 2 of the decommissioning activities the amount of radiological releases into water is much lower than during the operation of Units. This means that no influence on the flora on the Kozloduy NPP site and around the site is possible.

Type and quantity of RAW from the decontamination of the dismantled equipment will be specified after preparation of a design for Size Reduction and Decontamination Workshop of the dismantled equipment.

Having a view on the expected radiation impacts on the flora caused by the radioactive materials stored in storage facilities and storage pits (nick-named "mogilnik"), cemented materials, soils isolated with asphalt layer etc. it should be clarified whether they will be stored at the same places or will be moved after the decommissioning.

In case of organized system for collection and transportation of the waste, impact on the flora and habitats could be minimized. For the municipal waste it is foreseen to collect it in specially placed vessels and containers. Later it will be periodically transferred to the regional storage "Oryahovo". For the construction waste there will be contracts concluded with outside companies, which should transport and dispose the construction waste to the places determined by Kozloduy NPP.

In relation with the elaborated Conventional waste management program in Kozloduy NPP some measures are identified of all types of hazardous waste and their quantities are determined. During the execution of the Program for management of all types of waste that will be generated during the decommissioning of Units 1 to 4 of Kozloduy NPP, no impact on the flora and habitats by the conventional waste is expected.

The most probable ***accidents,*** which are significant for the flora, are fires, interruption of processes, failure of installations, spills, flooding, explosions, load dropping, road accidents and other accidents that may occur outdoor. The negative impact on the flora may occur as a result of spills of different chemicals, explosion in the process of their storage and fires. The impacts shall be only local and temporary, until accidents are taken under control.

No ***cumulative*** effect on the flora and vegetation is expected from the decommissioning activities of Units 1 to 4 of Kozloduy NPP, the operation of Units 5 and 6 of Kozloduy NPP and of the National Repository for disposal of RAW, because

the main objective for the operation of all above sites is the maintenance of the levels of all emissions in compliance with the license and some concrete technical solutions will be applied, which ensure the environmental safety. The decommissioning of Units 1 to 4 of Kozloduy NPP is not expected to have transboundary impacts on the flora and vegetation in Romania.

D) Close down and reclamation Stage

The decommissioning completion includes all activities performed in Stage 1 and Stage 2. According to the EWN experience [50] this means big reduction of all radiological and non-radiological environmental emissions. Therefore, after the completion of the decommissioning of Units 1-4 of Kozloduy NPP no negative impact on the flora is expected. No transboundary impacts are expected.

As a conclusion the following forecast could be made about the impact during and after decommissioning of Units 1-4 of Kozloduy NPP.

Probability of occurrence:	During the construction:
Territorial scope of impact (geographic region; affected population):	Local
Reversibility of the impact (reversible, irreversible):	Reversible
Duration of the impact (short term, medium term and long term):	Short term, until reclamation
Frequency of impact occurrence (permanent/temporary):	Temporary
Type of the impact (positive/negative; direct/non-direct; secondary; cumulative and synergy):	Indirect, secondary

4.9.2 Fauna

A) Pre-decommissioning Stage (PDS)

During the Pre-decommissioning of Units 1-4 KNPP and the associated infrastructure the following direct and indirect non-radiological impacts could affect the animal species and their habitats:

Anticipated impacts on some animal species, their habitats and potential risks.

Deterioration of habitats

Direct deterioration of natural habitats and species habitats as a result of the pre-decommissioning activities, which are related to excavation of earth, uprooting of the

semi-natural vegetation, disposal of waste from the activity on the semi-natural and agricultural vegetation, damages caused during the construction and maintenance of the infrastructure needed for decommissioning.

Death of specimens

Destroying of individuals or direct deterioration of their habitats including during the reclamation and maintenance of the needed infrastructure within the borders of the natural distribution of their populations, possible death rate in case of increasing of the populations of invasion species – enemies or competitors of vegetation or animal species, subject to protection in the neighbour protection areas, fragmentation of habitats of the species.

Chasing away of animals due to increased human presence

Noise and lighting pollution, enforced anthropogenic presence during the pre-decommissioning of the Units causes chasing away of individuals and respectively destroys the normal population structure.

Based on EWN experience [50] the increase of noise pollution and human presence are not expected and in so far no negative impacts on the environment will arise.

Invasion of alien species in the natural habitats, invasion of the expansive diverse fauna

B) Stage 1 of the decommissioning

During the decommissioning and reclamation of the site, it is possible to establish new habitats with the initial phase of vegetation fluctuation and bringing in alien, invasive and synanthropic animals, tares and ruderal vegetation, which would change the new species structure of the habitats and the habitats of the species. These degrade the nature protection status and they could be enemies and competitors of the vegetation and animal species subject to protection in the region as well as to the species typical for the habitat. These processes are possible and are predicted for the region of the investment proposal.

Potential negative conventional impacts during this stage are:

- Extinction of the slow moving and hiding animals and their eggs, larvae and babies in different activities related to the implementation of the investment proposal. This impact is relatively short-term.
- Destruction of the soil communities for excavation or embankment of the soil bed. Short-term impact, which is reversible.
- Creation of barriers hindering the natural genetic exchange for slowly moving animals. Short-term impact. When constructing fencing equipment.
- Anxiety in animals as a result of increase of the noise and other irritants. Permanent long-term impact.
- Increased risk of fires in case of increased anthropogenic presence. Long-term impact with a low percent of a potential occurrence.

- Unintentional introduction of invasive species and prerequisite for invasive expansion. Long-term impact, which could also have cumulative or synergetic effect.
- Direct extinction or damage of the habitats during excavation and explosive activities. Irreversible impact.
- The radiological impacts on the flora are not expected. Potential sources of radiological impacts may be only ***emergencies*** such as spill of liquid radioactive waste from decontamination, spill of decontamination chemical products, etc. In case the accident covers a territory beyond the plant, the expected impacts will be negative, local and temporary - until the accident is handled. Cumulative effects are also possible, if the accident coincides with the other sources of radioactive contamination.

C) Stage 2 of the decommissioning

During the decommissioning of all four Units besides the above also the following long-term changes are possible:

- Changes in the structure of the communities of invertebrates and other species of small invertebrates. Long-term impact, which could also have cumulative or synergetic effect.
- Changes of the conditions of the environment causing potential change of the animal habitats. Long-term impact, which may also have cumulative effect.

Table 4.9.2-1 summarizes the potential impacts as a result of the investment intentions and their relation to:

- Scope regarding their location towards the protected areas;
- At which phase of the project implementation they could occur in view of the effect on the habitats and types, whether the impacts would have a long-term or temporary impact, regarding the duration of the impacts, whether the impacts are permanent, short- term, periodical, incidental (they could either occur or not);
- With which other impacts of the investment intent they have a combined impact on a given parameter for favourable nature protection of species and habitats of the animal species, subject to the protection in the nearest protected areas. The connections between the direct impacts are assessed. The combined effect shall be assessed;
- What other plans, programs and investment intents may have a cumulative effect.

Table 4.9.2-1 Summarized potential types of impacts as a result of the accident and incidents of the investment proposal.

Type of impact	Scope of impact (in the frames of the investment proposal, in the vicinity of protected area)	Phase of impact Duration Periodicity	Possible combined impacts	Possible cumulative impacts (other projects)
Direct extinction of anthropogeni-zed habitats	Beyond the boundaries of the protected territories and protected areas but in the vicinity of three protected areas	During the decommissionin g of the Units, short-term, temporary and reversible	Temporary degradation of the quality of the adjacent habitats during the decommissionin g activities Chasing away of individuals due to the noise intensity and increased human presence during the construction of the SRDW and Site for management of decommissio-ning activities materials Establishment of new ecotones and change of the anthropogenic habitats, mainly in the region of the investment proposal.	Potential accidents and incidents through air, water and soil pollution are possible
Fragmentation of the anthropogenic	Especially in the region of	During implementation of the	Partial fragmentation of valuable	Existing infrastructure serviced the two

Type of impact	Scope of impact (in the frames of the investment proposal, in the vicinity of protected area)	Phase of impact Duration Periodicity	Possible combined impacts	Possible cumulative impacts (other projects)
habitats	the Investment Proposal	investment proposal Short-term and temporary	habitats of small importance in the region of the Units sites. Chasing away of specimen due to noise pollution and human presence during the construction of the SRDW and Site for management of decommission-ning activities materials	Units
Chasing away of animals due to increased human presence during the construction of the SRDW and Site for management of decommission ing activities materials	Only in the region of the Investment Proposal	During the activities related to the closure Temporary Short term	There is a combined impact on the quality of the habitats, as well as this may facilitate the damage and interruption of the possible bio-corridors. This effect is mainly for the big mammal and birds	The existing infrastructure in combination with the activities for decommission-ing of the two Units and further reclamation
Noise pollution	Mainly in the region of the Investment Proposal	During the decommission-ing Short-term Temporary	Through chasing away the sensitive species of birds and mammals	Existing infrastructure and decommission-ing activities
Invasion of	Mainly in	During the		There is not

Type of impact	Scope of impact (in the frames of the investment proposal, in the vicinity of protected area)	Phase of impact Duration Periodicity	Possible combined impacts	Possible cumulative impacts (other projects)
alien species in the anthropogeni-zed habitats.	the region of the investment proposal beyond the protected areas	decommission-ing Long-term Permanent		such probability.

The decommissioning of Units 1 to 4 of Kozloduy NPP is not expected to ***have transboundary impacts*** on fauna.

D) Close down and reclamation Stage

The dismantling and decontrol of buildings, facilities and waste will have positive impact on the different groups of vertebrates and invertebrates.

The following conclusion could be made about the impact during and after close down of Units 1-4 of Kozloduy NPP

Probability of occurrence:	During the construction:
Territorial scope of impact (geographic region; affected population):	19,680 decares from the territory of Kozloduy NPP.
Reversibility of the impact (reversible, irreversible):	Irreversible
Duration of the impact (short term, medium term and long term):	Short term, until completion of reclamation
Frequency of impact occurrence (permanent/temporary):	Temporary
Type of the impact (positive/negative; direct/non-direct; secondary; cumulative and synergy):	Negative, direct

4.10 Material and cultural heritage

When assessing the impact of the decommissioning process on the material and cultural heritage it should be taken into account that all decommissioning activities are located on the Kozloduy NPP site.

This means that the impact on material and cultural heritage is only possible when such heritage is located near by the power plant site.

A) Pre-decommissioning Stage (PDS)

Possibilities for protection of the archaeological heritage located next to the site territory and measures for prevention, reduction or negative impact on the cultural and historical heritage include as follows:

- Organization and execution of the construction works should be subject to protection and storage of the cultural heritage, especially during the construction works and eventual transportation of earths – activities that could damage and cause a deterioration of the already discovered and known or archaeological cultural monuments, which are not discovered yet.
- In the event of detection of new archaeological sites of the relevant territory during implementation of Investment proposal, to be immediately informed the relevant authorities and institutions, and actions taken under the regulations in Bulgaria
- For all other actions concerning archaeological monuments, lies administrative or criminal liability in accordance with the country legislation

B) Stage 1 of the decommissioning

The activities of Stage 1 of the decommissioning are not related to direct conventional and radiation impacts on the archaeological monuments on the territory considering that during the organization of the work (decommissioning activities- dismantling decontamination, cutting, transportation, and conditioning) recommendations based on the analyses and assessments are observed.

C) Stage 2 of the decommissioning

The activities of Stage 2 of the decommissioning are not related to the impact on the sites of cultural heritage.

There is no potential risk for the cultural heritage caused by the accidents and emergencies occurred as a result of the activities during the decommissioning of Units 1 to 4 of Kozloduy NPP as well as cumulative effects and transboundary impact.

D) Close down and reclamation Stage

No impact on the cultural and historical heritage is expected

The following conclusion could be made about the impact during and after decommissioning of Units 1-4 of Kozloduy NPP.

Probability of occurrence:	Not expected
Territorial scope of impact (geographic region; affected population):	Not expected
Reversibility of the impact (reversible, irreversible):	Not expected
Duration of the impact– (*short term, medium term and long term*):	Not expected
Frequency of impact occurrence (permanent/temporary):	Not expected
Type of the impact (positive/negative; direct/non-direct; secondary; cumulative and synergy):	Not expected

4.11 Health risk

4.11.1 Health risk for personnel

A) Pre-decommissioning Stage (PDS)

According to the Decommissioning Strategy for Units 1-4 [7] during the Pre-decommissioning stage the following new important facilities should be constructed: Size Reduction and Decontamination Workshop from Units 1-4 of Kozloduy NPP, operation and construction of Sites for management of materials of activities of decommissioning of the Units, two of the sites are provided for temporary storage of radioactive materials (RAM) liable to release from regulatory control and one site for temporary storage of non-radioactive waste (materials from the dismantling) exempt from regulation.

.These facilities will be constructed at the existing site of Kozloduy NPP.

During the construction the facilities will be a source of common dust and noise. Generated common dust and noise will not exceed the standard noise levels at more than 100 m away and in view of the population it would not cause any negative health impact.

Also, no considerable increase of the transportation flow is expected as a result of the machines transporting construction materials.

Only the construction workers will suffer from the general dust and noise impact. During the installation and construction works some working groups will be exposed to general and local vibrations as well as to metal aerosols, infrared and ultraviolet radiation (welding). There are effective devices for collective and personal protection against the exposure to these harmful physical factors and their use will minimize the negative health impact.

B) Stage 1 of the decommissioning

The first stage includes the stages of Preparation and control of Safe Enclosure of reactor compartments 1 and 2 and dismantling of the equipment beyond the Safe Enclosure Area.

Meanwhile, a dismantling of the equipment beyond the Safe Enclosure Area is planned as starting from the non-contaminated buildings and turbine Halls of Units 1-4 of Kozloduy NPP, namely:

- Dismantling of the non-contaminated equipment;
- Dismantling of the turbines;
- Dismantling of the secondary building.

Decommissioning strategy of Units 1-4 [7] of Kozloduy NPP stipulates that all activities that will be carried out should comply with the health protection and safety of the staff and the employment and environmental protection. Decommissioning activities are planned in advance including elaboration of work schedules for dismantling of the equipment.

For each of the activities or group of activities of decommissioning depending on their complication, it is foreseen a work package/procedure to be prepared containing detailed description of the activities together with the following information:

- Number, qualification and experience of the participating people;
- Activities for training of the participating people;
- Equipment and facilities for execution of the activity
- Needed protection equipment;
- Auxiliary activities;
- Devices for measurement of radioactivity;
- Time needed for execution of the activity;
- Doses expected pursuant to ALARA principle;
- Other activities interacting with the certain activity.

Execution of all above requirements will minimize the specific risk of the solar exposure of the staff, involved the real activities for dismantling, decontamination and storage of RAW and conventional waste.

Decontamination of the Turbine hall

The propose of that activity is to remove contaminations exceeding permissible levels before starting the dismantling of non-contaminated or potentially contaminated systems, thereby prevent cross-contamination. Upon discharge, washing and ventilation of tanks for lubricants and fuels potentially contained gases are removed and prevent the risk of fire or explosion.

During the execution of these activities it is expected to generate liquid radioactive waste. In connection with Low levels of gaseous discharges from Units 1-4 shown during 2009-2011, it can be concluded that radiological impact on personnel from noble gases exposure or inhaled ^{131}I will be negligible compared with that obtained from the respective discharges during normal operation.

Radiological impact on the people as a result of radiation by noble gases or inhalation of ^{131}I will be absolutely negligible compared with the impact resulting from the respective discharges during the normal operation.

Activities for dismantling of the equipment in the Turbine Hall

During the dismantling of the equipment in the turbine hall the experience of the maintenance staff will be used, which was gained during the scheduled maintenance of the facilities. For transportation of the dismantled components next to the zones for reduction of the size the cranes existing in the building will be used. For the assessment of their operability a program for assessment of the residual life-time of the facilities is going on including the main lifting equipment.

Workers, involved in the dismantling facilities will be exposed to:

- Dust and metal aerosols, including radioactive aerosols. Dust irritates the mucous membrane and upper respiratory tract. Passive exposition of metal

aerosols could cause so called "zinc fever" taking a course as severe pneumonic reaction. Specific toxic effect depends on the type of the metal aerosols.

- Radioactive aerosols are a real risk for internal radiation so a strict individual dosimetric control is required (Annual limit of the occupational radiation is 50 mSv and the accumulated individual effective dose for 5 series years could not exceed 100 mSv).
- During the dismantling of the insulation equipment some asbestos dust will be generated containing asbestos particles. It is clear that the asbestos is a proven carcinogen for the lungs and pleura. All individual protection measures will be applied (wearing of anti-dust masks during the demolition of the insulations and waste collection).
- During the installation and construction works some working groups will be exposed to general and local vibrations, 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 unfavourable health effect.

Decontamination in SE area

During the execution of decontamination or removal of some "hot spots", higher exposure of the staff during the preparation or operation of SE, dismantling and transfer of the contaminated equipment to SE zone, could be caused.

Decontamination of the rooms and surfaces

Although all methods for decontamination have filtration ventilation system, it is quite difficult to estimate both the extent of the specific health risk caused by the radiation exposure and the health risk as a result of the rest physical and chemical factors of the work environment.

In order to restrict the impact on the population and workers (both for the ones, involved activities in SE and for the others involved in SE), strict design requirements and forecast doses should be elaborated regarding the Size reduction and decontamination workshop, the Decay storage sites for transitional RAW and for conventional waste from the decommissioning restricting up to the minimal extent the radiation load and cumulating irradiation effect.

Activities for dismantling of the equipment

Probably, different sizes of cutting and hoisting equipment and tools will be used. Besides, plasma melting facility for treatment of solid RAW will be installed, but it is not subject to this EIAR. The Plasma melting facility is subject to a different EIAR procedure.

Activities during the Safe Enclosure control

The SE control will generate only a small quantity of low and very low radioactive waste (Ventilation filters, Condense collected in the contaminated sewage system, Rainfall water collected around AB-1, Waste from the contaminated laundries and the

bathroom). During the entire SE the activities for collection, sorting, treatment and transportation of this waste will go on.

During the SE period some radiation hazards could occur when replacing the aerosol filters. Periodical inspections and equipment tests are routine activities during which it is difficult to control the dose exposure of the staff performing them. If the safety operation rules will be observed no ***cumulative impact*** on the personnel is expected.

C) Stage 2 of the decommissioning

Typical for this stage is a big scope of dismantling activities of the facilities in the reactor compartment. According to the EWN [50] experience and according to the data, presented in Section 11.4.1 there will be small emission of aerosols into the atmosphere during the dismantling and from the including the activities in the Size Reduction and Decontamination Workshop (SRDW) [156].

According to the EWN [50] experience and according to data, presented in Section 11.4.1 the average annual dose rate during the decommissioning period is 200 mSv for 350 exposed persons.

This CED summarizes the radiation during the execution of all activities during the decommissioning: the dismantling of the equipment; the treatment, transport and storage of waste from dismantling and operational waste from dismantling in Units 1 – 4, including the SRDW and the Decay Storage; post operation activities and maintenance of all needed facilities; radiation protection and last, but not least the guarding. The detailed data for CED for the personnel during execution of the dismantling activities in SE area are presented in section 11.4.1 based on EWN experience.

The radiological consequence for the staff health may occur in case of improper handling and transportation of radioactive waste and improper storage of radioactive waste during dismantling activities. The impacts will be negative, local, and temporary until incident mitigation.

The most possible ***accidents***, which can have impacts on the personnel is an accident during replacement of aerosol filters or an accident related to leakages of hazardous chemicals during the equipment decontamination or explosion. Even in this case the risk for the staff will be low, short term and local.

If the safety operation rules will be observed no ***cumulative impact*** on the personnel is expected.

4.11.2 Population health risk

The impact of the processes and activities for decommissioning of Units 1-4 of Kozloduy NPP Units on the Public Health will be insignificant due to the fact that the hazardous/radioactive materials will not leave the territory of the site of the Units (as in case of planned shutdown of the Units in the period of their normal operation). In Kozloduy NPP the main impact on the population is caused by the nuclear fuel during the normal operation of the Units.

The risk assessment of Public Health during decommissioning is presented in Chapter 1.14 of this report. Before commencement of the decommissioning activities of the Units the nuclear fuel is removed from the Units and is transported to the disposal

facilities for RAW storage therefore in this case no measures are needed for reduction of the impact on the population health.

Nevertheless, based on the analysis made in the Safety Analysis Report during the decommissioning of Units 1 and 2 [58] in case of the most severe accident "Break of the aerosol HEPA filter" with conservative assumptions, the results show that effective dose for critical group of population (older man) is 2.56E-05 mSv and it is far below the acceptable limits for this critical group of 1mSv per year or less than 5°mSv for five consecutive years after the accident.

Therefore, during the execution of the decommissioning activities for Units 1-4 of Kozloduy NPP the impact of the population will be negligible even in case of the potential serious accident "Break of the aerosol HEPA filter" the effective dose for the critical group of the population will be much lower than the permissible values.

The results presented in Decommissioning Safety Analysis Report [58] for Units 1 to 4 KNPP in case of the most severe accident "Break of the aerosol HEPA filter" show that the effective dose for critical group of population (older man) is very low in comparison of the acceptable limits for this group (see Chapter 1.14.1 and 1.14.2).

Transboundary impacts on the health status of the population in Romania from the territory of the concerned 30-km area surrounding Kozloduy NPP are not expected.

D) Close down and reclamation Stage

During the reclamation activities related to the ground levelling, covering with earth and soil, arrangement of green areas etc. will be executed and machines with internal combustion engines will be used, which will emit noise, dust and toxic motor gases. These activities will be carried out on the site of Kozloduy NPP and its considerable distance from the populated areas excludes any negative health effect on the population.

As a conclusion the following forecast could be made about the impact during and after decommissioning of Units 1-4 of Kozloduy NPP.

Occurrence probability:	The probability some health problems of the population to be reported during the decommissioning and post decommissioning periods of Units 1-4 is **very low.** As a result of the impact of work environment factors - noise, unfavourable micro climate, dust and toxic substances during the decommissioning of Units 1-4 the workers may face some health problems. The probability of occurrence is very low.
Territorial scope of impact (geographic region; affected population):	The population in 30-km area. Building workers on the construction sites.
Reversibility of the impact (reversible, irreversible):	As related to the population and the workers the impact is reversible.
Duration of the impact – (*short term, medium term and long term*):	Regarding the workers the impact will be sort-term impact only during the period of execution of certain construction works.
Frequency of impact occurrence (permanent/temporary):	Occurrence of the health impact will be temporary.
Type of the impact (positive/negative; direct/non-direct; secondary; cumulative and synergy):	Impact on the workers will be negative. No cumulative and/or synergy impact is expected

4.12 Risky energy sources

The main pollutants generated during the decommissioning of Units 1-4 of Kozloduy NPP will be the following harmful factors:

- Ionizing radiation;
- Non-ionizing radiation;
- Head discharges;
- Noise;
- Vibrations;
- Other factors.

4.12.1 Ionizing radiation

Considering the updated strategy for "Continuous Dismantling" [7] and decommissioning plan of Units 1 to 4 [36] that has to be assessed, the activities complying with the respective technologies will be carried out at two stages. The following characteristics of the selected Strategy could be considered useful for reduction of gamma radiation:

- Even distribution of the dismantling activities;
- Even loading of the existing radioactive waste treatment plants;
- Optimal use of the existing personnel knowledge and experience.

RAW management is made within the framework of the complex program for RAW control in Kozloduy NPP ID N DOD.ED.PM.387/02 [162]. The objective stipulated in the program is mainly directed to the staff and population protection in the area against the non-regulated impact of the ionizing radiation, including gamma radiation that could be caused by improper RAW treatment.

Safety assessment program during the decommissioning is needed for the purposes of risk assessment aiming to reduce the risk of the impact of the ionizing radiation on the plant staff, population and environment caused by the execution of the foreseen activities. It also conforms to the Updated Decommissioning Strategy of Units 1-4 of Kozloduy [7] and is in compliance with the contemporary standards, criteria and world experience during the decommissioning of the nuclear facilities as observing certain specific features.

The radiation protection concept presented in the decommissioning plan [36] allows compliance with the requirements and radiation protection norms upon execution of all foreseen activities and in compliance with it programs for monitoring, instructions, rules etc. are elaborated aiming to reduce the radiation impact, including the radiation impact on the environment.

Analysis of the radiological monitoring during the last three years in the region of the Kozloduy NPP site and in the areas established around it, during the operation only of Units five and six determines the impact on the radiation gamma background in the environment as negligible. Total activity located on the operational site is generated

by the activity related to the energy generation located within the region of Units five and six and the activity located in the region of Units 1-4 subject to decommissioning.

- Residual activity after the shutdown of the reactors is located as follows:
- Contaminated equipment in SE area;
- Contaminated surfaces in the area of SE, TH, AB etc.;
- RAW in the area of SE, TH, AB and regulated storage facilities.

Ionizing radiation generated by it is limited up to the reasonable minimum by regulated biological protection.

During the execution of the SE activities within the entire period a re-allocation of the existing residual activity will be made, which will change the location, quantities and radiation extent, within the framework of the operational site of Kozloduy NPP and in certain environmental circumstances.

In conclusions, the realization of the decommissioning activities, including the dismantling works and these related to the radiation protection, the impact on the gamma background radiation outside the Kozloduy NPP operation site and on the Romanian territory is insignificant. The forecast insignificant impact on the gamma background radiation also in the EWN EIAR is confirmed by the already implemented decommissioning of Greifswald NPP ([50] see chapter 11 Appendices 11.4.1 and 11.4.2).

4.12.2 Non-ionizing radiations

During the decommissioning of Units 1-4 of KNPP considerable part of the electro-magnetic fields (EMF) in the EP-1 region will be decommissioning or in process of sequential decommissioning. This is valid for the following sources:

- part of the security systems;
- part of the mobile communication systems, including the wireless communication stations, basic station etc.;
- part of the accident annunciation systems, including radio stations, audio signalization, mobile systems etc.
- industrial high frequency generators;
- Substations, HV electric power lines, electrical motors and other electrical machines;
- generators, transformers, bus bars, breakers, part of outdoor and indoor switchyards etc.
- video monitors;
- Automated control systems and electricity generation systems;
- video displays.

During the implementation of the planned decommissioning activities and technologies and the use of the specified equipment, apparatus and facilities, which according the documentation are not significant sources of migrating EMF, no

additional environmental impacts is expected. This is also confirmed by the EWN [50] experience. In conclusion can be forecast that during the decommissioning of the Units the EMF impact on the environment outside of the sanitary protection area will be insignificant:

- decreased and decreasing in the time;
- spatially being limited or shall be limited, in accordance with the relevant regulatory documents;
- non-cumulative;
- not reaching the territory of Romanian Republic

4.12.3 Noise

For forecasting of the noise impact shall take into account:

- that the active significant noise generation sources in the environment, part of EP-1 auxiliaries are decreasing or will decrease after the decommissioning;
- that the new noise generation sources, connected to the realization of the decommissioning activities will be compliant with the norms and the Best Available Techniques (BAT);
- that the noise generation sources will be located on the EP-1 NPP site;
- that the values of the results from measurements performed and the noise levels specification before the decommissioning (measurement loop-1 – the site border and on the impact places) presented in 3.8.3, do not exceed the allowable limit value pursuant Regulation 6 for the environmental noise characteristics;

In consideration of these conditions, it can be forecasted in conclusion that during the decommissioning of the Units, the noise effect (including in the points of concern on the Romanian territory) on the environment will be insignificant:

- decreasing in the time;
- limited or being limited in compliance with the allowable limits, given in the statutory documents;
- non-cumulative.

In addition, according to the experience of EWN [50] and the data, given in section 11.4.1 of this report, the noise impact will be only temporary in result of the new buildings construction preparation or during walls drilling.

4.12.4 Vibrations

Building demolition is not foreseen during completion of the decommissioning activities except during the preparation for the erection of new civil structures. Considerable vibrations are not expected during SRDW operation, based on the EWN [50] experience. Despite of this the forecast of the vibration impact shall be taken into account that:

- the active existing source of vibration in the environment, part of EP-1 auxiliaries are or will decrease after the decommissioning;
- the new vibration sources during the completion of the decommissioning activities will be with vibration characteristics meeting the statutory allowable limits and corresponding to the best available techniques;
- the sources of vibration will be located within the site of the NPP, EP-1.
- the requirements of vibrations extinction are met or will be in compliance with the statutory document provisions;
- demolition of buildings or structures is not foreseen;

In reference of these conditions in conclusion can be stated, that during the decommissioning of the Units the impact from vibrations (including in the places of concern on Romanian territory) on the environment will be insignificant:

- decreasing in the time;
- limited within the borders of KNPP site;
- non-cumulative.

4.12.5 Other factors

Workers, involved in the dismantling facilities will be exposed to:

- dust and metal aerosols;
- asbestos;
- infrared and ultraviolet radiation.

Passive exposition of metal aerosols could cause so called “zinc fever” taking a course as severe pneumonic reaction. Specific toxic effect depends on the type of the metal aerosols.

It is clear that the asbestos is a proven carcinogen for the lungs and pleura. All individual protection measures will be applied (wearing of anti-dust masks during the demolition of the insulations and waste collection).

During the installation and construction works some working groups will be exposed to infrared and ultraviolet radiation (welding).

The following conclusion could be made about the impact during and after decommissioning of Units 1-4 of Kozloduy NPP.

Probability of occurrence:	During the decommissioning and post-decommissioning periods
Territorial scope of impact (geographic region; affected population):	Local
Reversibility of the impact (reversible, irreversible):	Reversible
Duration of the impact (short term, medium term and long term):	Short term, until reclamation
Frequency of impact occurrence (permanent/temporary):	Temporary
Type of the impact (positive/negative; direct/non-direct; secondary; cumulative and synergy):	Indirect, secondary

4.13 Waste and hazardous substances

In Chapter 1, section 1.12.2 are set quantitative and qualitative characteristics of conventional waste which is expected to be released in three stages of implementation of IP. To support environmental management of waste it is recommended to create a database of the movement of conventional waste. According to art. 8. (1) of the Waste Management Act (SG. 53, 13.07.2012) the transmission and reception of the manufacturing, construction and hazardous waste are carried out only on the basis of a written contract with persons holding permits, an IPPC or registration document referred to Article 35 for the operation and waste disposal site with the appropriate code according to the ordinance of art. 3 for the classification of waste. Waste from dismantling must be sorted on site and must be directed to an appropriate course of treatment. For different waste streams landing sites for temporary storage must be determined. On the territory of Kozloduy NPP a site for location of treatment facilities for waste is defined according to the requirements of Regulation 7/2004. Special places for scrap metal (ferrous and non-ferrous metals OCHTSM) should be divided. Scrap can be sold or sorted and prepared for sale on the site.

Full control of the movement of materials is implemented. In conventional waste management collection points on site, processing facilities and transportation should be established. The team should maintain the documentation of initial waste management and platform scales. Requirements included in national laws as a result of the transposition into national law of EU Directive 83/477/EEC and subsequent amendments involving the removal of asbestos-containing thermal insulation and other asbestos materials in bearing structures are:

- The requirement to assess the risk of the work, with a possible risk from the effects of asbestos;
- The requirement to notify the relevant national authority (the established procedure for notification) for this kind of work, giving information about:
- The type and quantity of asbestos, included activities and processes;
- The nature and probable duration of the work;
- The place where work is done;
- The methods applied in the work involving handling of asbestos or asbestos-containing materials.
- The characteristics of the equipment used for: Protection and decontamination of people engaged in work, protection of other people on the site or near it;
- The requirement to establish a system of sampling for asbestos in the air, and this must be carried out by suitably qualified personnel;
- The requirement workflows to be organized in a way minimizing the release of asbestos in the air;
- The requirement to take actions for ensuring the safety of workers;

– The requirement to establish a system for monitoring the health of people working with asbestos.

In accordance with the Regulation of prevention of environmental pollution by asbestos [14] and the Regulation of protection of the risks in working with asbestos [41] is prepared an updated detailed list of places in RO and MH where insulation is with materials containing asbestos, and evaluation of the quantities of hazardous materials [155]. Removal of the heat insulation or other asbestos materials in the bearing structures such as roof panels, interior/exterior wall cladding and lining panels, pipes and tanks, etc., during a license for operation is executed before the dismantling of piping, thus prevents the possibility of inhalation or ingestion of asbestos dust during cutting and grinding.

There are other hazardous waste such as contaminated fibers, mercury in certain instruments or devices, various oil/gas, lead covering and probably other hazardous chemicals and materials related with the premises for accumulators, etc. Waste materials such as plastic or rubber insulation, concrete and other construction materials and used liquids will be removed. Detailed classification and characteristic of all waste is given in Chapter 1, paragraph 1.12.2.

Best practice set in the Strategy requires, wherever is possible, the removal of these materials to be ensured before dismantling for ensuring efficient operation without the risk of this type of hazards. This requires organization of campaign for elimination of the hazards preceded the main dismantling. Removal must be made after examination and sampling to identify the existing dangerous materials.

Fluorescent and mercury lamps should also be divided in their own waste stream.

It can be concluded that in strict compliance with all measures related to the removal of oils, chemicals and other hazardous waste and asbestos insulation, a significant impact on the workers and the environment is not expected. During the first stage of IP it is planned to dismantle equipment outside the area of BS which is not necessary in the next stages of IP and uncontaminated or slightly contaminated.

Dismantling in the turbine hall will be carried out after removal of the waste (oils from turbine generators and transformers) and hazardous materials (asbestos), removal of insulation in the turbine hall of units 1-4 and organizing facilities for temporary storage. In the management of waste generated during the implementation of the IP within the Kozloduy NPP, in accordance with Art. 8, par. 2 WMA (SG. 53 of 13.07.2012), the owner of waste is obligated:

– To implement the orders for the collection, transportation and treatment of waste;

– To take all measures to prevent mixing of:

– a) hazardous waste with other hazardous waste or with other waste, substances or materials; mixing includes and dilution of hazardous substances;
b) utilizable waste with non-utilizable waste;

- To organize safe storage of waste that can not be provided treatment in accordance with the requirements of the Waste Management Act, on the territory of the Republic of Bulgaria;
- In existence of hazardous waste to identify the responsible person and to organize safe management;
- To keep records of waste in the manner provided by this act and the regulations for its implementation;
- At a time of request to provide access of the control authorities to installations that generate waste, to facilities storing waste and waste documentation;
- To provide instruction and periodic training of staff working with hazardous waste;
- To calculate and implement the necessary measures for not spreading of pollution after the closure of facilities and activities, as well as the installation or facility for waste treatment;
- To provide the necessary financial resources for the implementation of the monitoring plan;
- To notify the competent authorities for impending changes of raw materials and processes that could lead to a change in the amount or type of waste and its hazardous properties.

-

Temporary storage of waste

Sites for temporary storage of RAM from dismantling of Units 1-4 are situated on the territory of Kozloduy NPP and are labeled with numbers 1a, 1b, and 2. For temporary storage of non-radioactive waste (materials from dismantling released from regulatory control) is provided Site 3 (fig. 4.13-1). The terrain of the site is owned by the Kozloduy NPP. Complied with the terms of Article 8, paragraph 4 of Regulation 7/2004 for the requirements of sites for emplacement of facilities for treatment of waste when sites for activities and/or operations for the treatment of industrial and hazardous waste is provided on the place of their formation, they must be included in the infrastructure of the respective industrial plant.

Site 3 is located on the fixed terrain of the Transformer site of Units 1 and 2 with size 292 x 38 m. Site 3 is located between the Turbine Hall (MH) and the fence of Transformer site in north direction. The transformers of the site will be dismantled, except for one of them (1TP transformer).Two transformers are dismantled, the rest are disconnected and are on their places. The area between the railway for transformer and turbine hall is of concrete pavement, and north of it to the fence is grass.

The site is drained by a channel parallel to the Turbine Hall at a distance of about 4 m. The requirements of art. 20 of Regulation 7/2004 for sites for emplacement of facilities for treatment of waste are observed as water bodies and water facilities (retention basins, decanters, etc.) are located on or near the site for waste treatment and not threaten to flood its territory.

Firewalls between transformers (4 pcs.), tables of switches and the foundations of the stands, wearing braces to any outlet are not dismantled. The foundations of the transformers are left too. Oil tanks are filled with break stone.

Circulation pipes (steel Ø2000h20) -4 units pass along the site. Transformer site is provided for storage of non-radioactive waste that will be stored in tanks until their transfer to the subsequent treatment to the company holding a permit under art. 35 WMA.

Fig. 4.13-1 The Sites location for radioactive material and nonradioactive waste

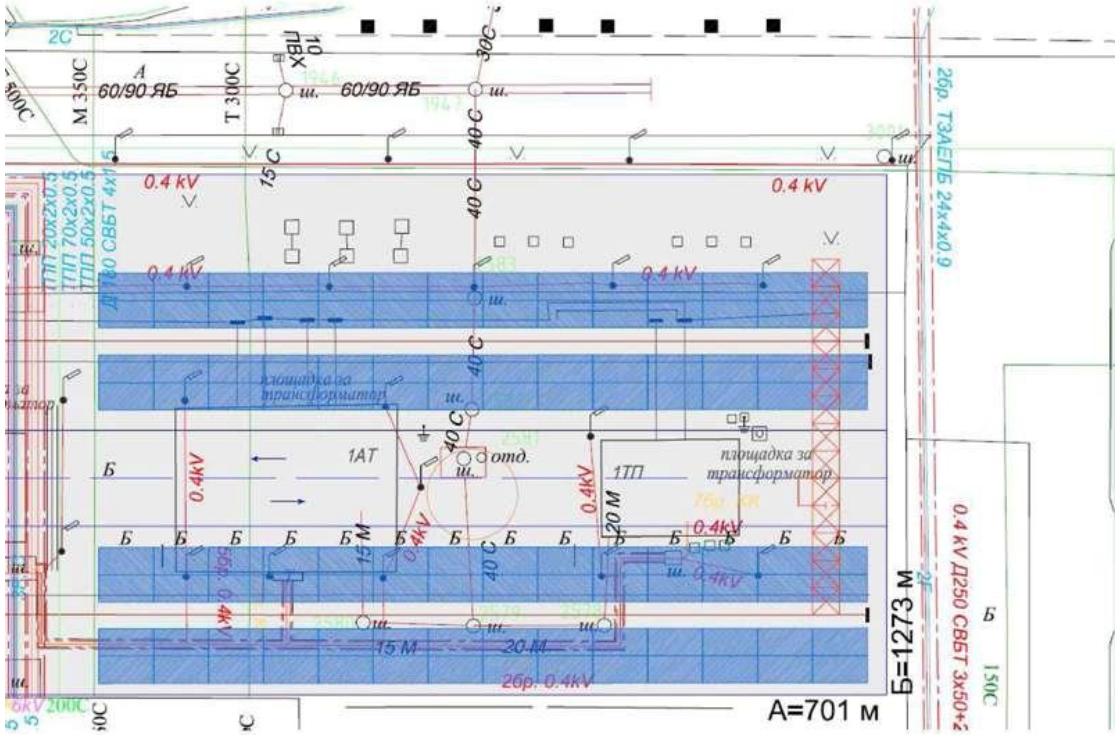

Fig. 4.13-2 Schemes for arrangement of skip containers on Sites for nonradioactive waste temporary storage from equipment dismantling (Part 1)

The site can be conditionally divided into three parts, as on each part the waste is ordered in containers. Schemes of arrangement of the containers on the transformer site are shown in fig. 4.13-2, fig. 4.13-3 and fig. 4.13 4. In these figures are shown internal transport infrastructure and their relation to the existing road infrastructure on the site of Kozloduy NPP.

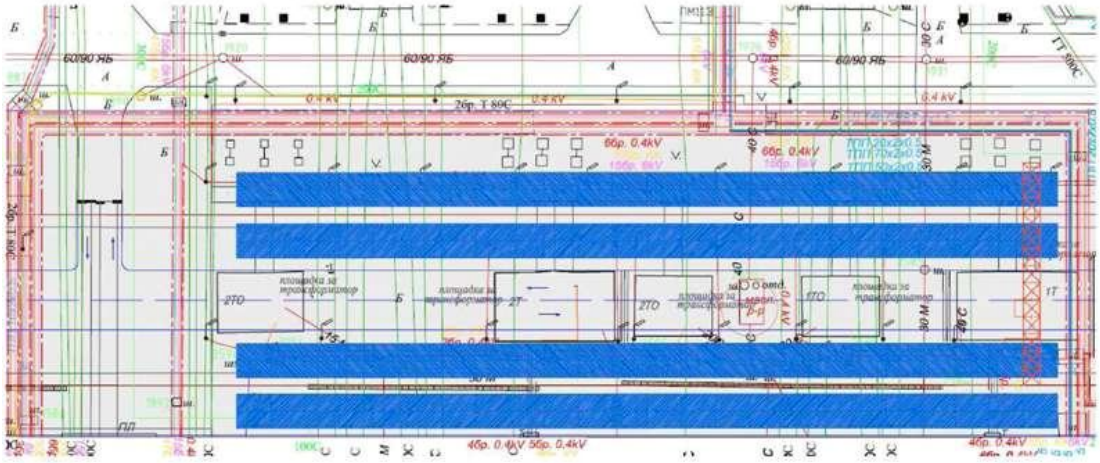

Fig. 4.13-3 Schemes for arrangement of skip containers on Sites for nonradioactive waste temporary storage from equipment dismantling (Part 2)

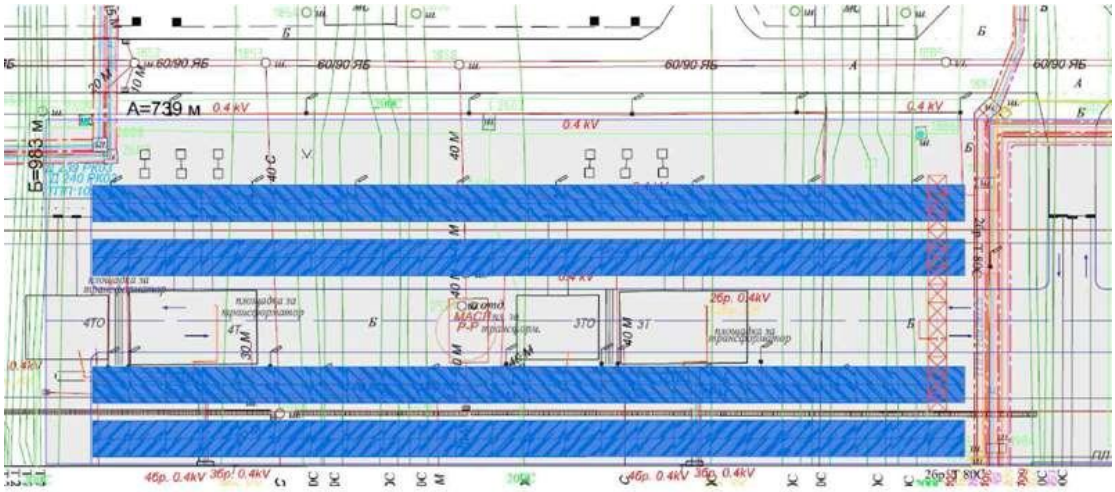

Fig. 4.13-4 Schemes for arrangement of skip containers on Sites for nonradioactive waste temporary storage from equipment dismantling (Part 3)

These schemes show that the requirements of Regulation 7/2004 for the requirements of sites for emplacement of facilities for treatment of waste are observed for minimum utilization rate of the site 0.80.

When storing waste at Site 3, according to art. 39 (6) of the Waste Management Act (SG. 53/2012), in cases where on one site activities with waste from metal packaging, discarded electronic equipment (WEEE) and ferrous and non-ferrous metals and waste resulting from the their pre-treatment are executed, they must be stored

separately on divided parts of the site. In subsequent transfers of waste from metal packaging and ferrous and non-ferrous metals formed after preparation before recovery of WEEE, they must be reported separately with code and name according to the ordinance of art. 3 WMA.

Transportation of waste

Final activity of management of waste during the decommissioning of Units 1-4 of the Kozloduy NPP is their transport. It must respond to the requirements for different types of waste in accordance with the Regulation for treatment and transportation of industrial and hazardous waste and their further chance. Non-radioactive waste that cannot be recovered through recycling will be transported to the conventional/industrial waste landfill. Shipments to the landfill will be carried out by trucks with a capacity of 10 tones. The construction of site for the storage of conventional waste (Site 3 - Fig. 4.13-1) from the decommissioning of Units 1 to 4 is planned and is undergoing expansion of existing Repository for Conventional Municipal and Industrial Waste (RCMIW) provided as "Stage 2".

Non-radioactive waste that can be used as secondary raw material for utilization - the transport of metal waste will be made directly to companies that will use them. Hazardous waste is separated during the decommissioning and is delivered directly to specialized organizations for the relevant waste where it is processed in accordance with the laws [167].It can be concluded that observing the measures provided in the Program for radioactive waste management and existing good practice in the management of these wastes significant impacts are not expected. However, for this purpose it is necessary to design and built at first the planned Hazardous waste landfill.

Non-radioactive construction materials – before further treatment non-radioactive construction materials will be sent by trucks for temporary storage in the buffer areas established specially for the collection during the decommissioning of Kozloduy NPP. The management of construction waste generated during decommissioning of Units 1-4 is recommended to comply with the requirements of Regulation for management of construction waste and for use of recycled building materials (promulgated SG. 89/13.11.2012).

As conclusion we can summarize that the impact of non-radioactive (conventional) waste during the implementation of IP will be local, daily, without cumulative effect, predictable and in compliance with the best practices for management of chemical substances and mixtures a negative impact on components of the environment and human health is not expected.

In Chapter One, Section 12.1 a detailed description of the sources, types and quantities of RAW during decommissioning is given. A categorization of types RAW and streams of radioactive materials from decommissioning, expected in the respective stages of implementation of IP is presented.

The categorization of RAW from decommissioning is in accordance with the Bulgarian legislation. A further categorization, introduced in Kozloduy NPP based on directly measurable operating parameters and taking into account the specifics of the methods for processing RAW in SE "RAW Kozloduy", is used.

After sorting of dismantled materials, depending on the degree of contamination, they can be:

- Released from control and transported outside of Kozloduy NPP without or after decontamination;
- Stored for flow of natural radioactive decay;
- Passed as RAW for appropriate treatment and conditioning.

In section 1.6 of Chapter 1 the main activities related to waste management and RAM in particular stages of decommissioning are described, and the way for their management. During the implementation stages of decommissioning various activities in waste management will be carried out.

The general approach to waste management includes: separate collection, transportation, treatment and storage, the implementation of organizational and technical measures for ensuring safety at all stages of management

In section 1.6 of Chapter 1 are describes the basic and auxiliary equipment and systems related to management and temporary safe storage of radioactive waste from decommissioning. For the safe management of radioactive waste implementation of a number of supporting projects is provided, the most important of them are examined in this EIAR, namely:

- Size reduction and decontamination workshop (SRDW)
- Sites for management of materials from decommissioning of Units 1-4 of Kozloduy NPP.

Based on the analysis of the existing system of waste management in Kozloduy NPP and provided in IP methods and projects for RAW from decommissioning has been found that these activities comply with safety and environmental standards,

Storage of radioactive waste, as the main objective of this project will comply with the Regulation on the Safety of Radioactive Waste Management, and in particular:

- During storage of RAW will be provided insulation for contained in the waste nuclides and hazardous substances from the public and the environment for the entire period of storage.
- Radioactive waste will be stored in a way, facilitating subsequent activities.
- Radioactive waste, subject to subsequent release from control will be stored separate from other waste and will be marked appropriately

According to the Regulation on the safety of the decommissioning of nuclear facilities under conditions of sufficient storage (sites for temporary storage of RAW and RAM) or permanent storage of RAW (national repository for short-lived, low and intermediate level radioactive waste), for decommissioning of Units 1-4 of Kozloduy NPP is reported the application of technologies, design solutions and techniques that reduce to the possible minimum generation of waste (Size reduction and decontamination workshop; facility for treatment and conditioning of radioactive waste with a large coefficient volume reduction) as decontamination, sorting and conditioning of waste; appropriate technologies for waste management are used

(organization of sites for management of materials from decommissioning) and resources for transportation.

The management of radioactive waste during decommissioning is analyzed and reported [36]: source, amount, category and nature of the waste that will be generated during decommissioning; generation of secondary RAW and their reduction to the possible minimum; opportunities for releasing of RAW from regulatory control, opportunities for reuse and recycling of materials, equipment and buildings, availability of facilities for recycling or reprocessing of waste.
The requirements for packaging and transport of RAW are observed, the project is provided with sufficient measures and projects to prevent potential impact of RAW on the staff, population and environment.
As part of the plan for the decommissioning of the Units are developed and updated conception and programs for waste management under the Regulation on the procedure for issuing licenses and permits for safe use of nuclear energy.
For this project are taken into account the requirements of the Regulation on radiation protection during activities with sources of ionizing radiation related with the releasing of control and in particular the possibility arising from permissible activities for the decommissioning of radioactive substances or materials containing radioactive substances to be used or recycled without restrictions on their origin, type and way of application, in case that the specific activities of individual nuclides contained in them are smaller or equal to the levels for releasing from control in Annex № 7of Regulation. The requirements of the above regulations are accounted for the reuse or recycling of radioactive substances or materials when specific activities exceed the levels for releasing of control in Annex № 7, as the NRA and the Ministry of Health may determine the conditions required for the use of these materials as appropriate.
It is necessary and provided levels for releasing from control of metals for recycling to be consistent with the requirements, listed in Annex № 8. For metals, containing a mixture of nuclides, required sum of the ratios of specific activities of individual nuclides to their respective levels specified in Annex № 8 must be less or equal to 1, in order to be admitted to rendering.

In connection with implementation of international best practices for the management of radioactive waste from decommissioning the experiences from the EWN decommissioning of NPP "Greifswald" is used, as an annex to Chapter 4 the results and analysis of the implementation of this project are presented, and conclusions on the environmental impact resulting from the analogous practices.

A) Pre-decommissioning Stage (PDS)

During the pre-decommissioning activities the asbestos from Units 1-4 will be removed and disposed. The quantities and characteristics of the radioactive and non-radioactive asbestos as well as the disposal locations are specified in the Decommissioning plan [36].

In compliance with the decommissioning schedule [36], the safe storage preparation of Units 1 to 2 commences upon enforcement of the decommissioning permit. Quality Assurance program for Stage 1 of the decommissioning of Units 1-4 of Kozloduy NPP firstly includes the activities for removal of asbestos, inflammable materials and conventional waste. In order to reduce the potential hazards from the facility the

activities for removal of these materials from Units 1 to 2 are already under implementation.

The inflammable materials include the oils from the transformers and turbine generators. In each unit 120 t oil is stored. The total oil quantity of Units 1-4 amounts to 453 t.

Radioactive waste

During this stage, gaseous, liquid and solid radioactive waste are generated, types, characteristics and quantities of such waste are given in Chapter 1, Sections 1.10, 1.11 and 1.12. Solid waste will be generated in the treatment of solid and liquid waste, and by the dismantling of contaminated equipment and contaminated constructional materials. Waste is expected to be properly treated in such facilities and transmitted for subsequent storage. It is expected to be generated liquid waste in PDS, mainly from the processes of decontamination of equipment processing of ion exchange resins and bottoms, and more. This liquid waste will be collected and processed. It is expected that gas emissions will be generated during the process of recast of operational waste, equipment and more, which emissions will be recovered and purified from the ventilation systems of Units 1 to 4 and from the ventilation systems of the new facilities and with controlled release into the environment Based on the experience of EWN presented in Appendix 11.4.2 [50] can be concluded that from the decommissioning of Units 1-4 of the Kozloduy NPP no impact is expected on the environment and people to have a negative and cross-border effect.

B) Stage 1 of the decommissioning

Besides RAW, generated during the works for dismantling and demolition of the site, also a big quantity of conventional waste is generated from the buildings, facilities, systems and respective elements. The typical materials are:

- Asbestos;
- Chemical preparations (acids, NaOH etc.);
- Spent oils;
- Scrap;
- Cables;
- Debris (bricks, concrete etc.);
- Chemically contaminated waste (e.g. chemical packaging);
- Soft constriction materials (wood, glass, artificial fibres etc.)
- Electricity systems;
- Luminaries and fluorescent tubes
- Municipal waste and other materials.

Preliminary assessment made on the basis of the experience from the decommissioning of Greifswald NPP shows that the material of categories 2 and 3 after the free release (without building waste) is approximately estimated as 65000 t.

The same estimation indicates that it is expected that 80 % of the generated conventional waste will be utilized.

Radioactive waste

During this stage solid, liquid and gaseous radioactive waste is generated, characteristics and quantities of such waste are given in Chapter 1, Sections 1.10, 1.11 and 1.12. Based on the experience of EWN, presented in Appendix 11.4.2 [50] can be concluded that the decommissioning of Units 1-4 of the Kozloduy NPP is not expected to have impact on the environment and people neither to have negative and cross-border effect.

C) Stage 2 of the decommissioning

Solid RAW waste will be generated upon removal of the radioactive equipment from the sites. The waste will be treated in suitable manner in respective facilities and submitted for further storage. Liquid RAW will be generated mainly by the processes for decontamination of the equipment. These liquid RAW will be collected and treated.

Detailed description of the type and the quantities of generated waste (gaseous, liquid, solid) at the different stages of the decommissioning are presented in Chapter 1 section 1.10, 1.11 and 1.12 and in Chapter 3.

No negative impacts on the environment and the population are expected and neither are transboundary effects expected.

Dangerous waste are separated during the operation and will be directly supplied to some organizations specialized in the respective waste, where they will be processed in compliance with the respective legislation [167]. A conclusion could be made that, if the measures, stipulated by the updated Program for management of conventional waste, will be observed, no considerable impacts could be expected. However, for this purpose it is needed to design the foreseen disposal facility for hazardous waste as soon as possible.

D) Close down and reclamation Stage

During the execution of the close down and reclamation activities some conventional waste is expected to be generated: municipal and construction waste. During the execution of the activities at this stage some conventional sewage water flows are expected to be generated such as residential sewage and rainfall waters. Generation of conventional controlled and uncontrolled gaseous emissions from the transportation, construction equipment, dust from treatment of materials, smells, etc.

Chemical substances and mixtures

In compliance with the EPA classification of Kozloduy NPP is made in respect to storage and use of chemicals and the plant is classified as "an upper-tier". In this regard a permit for the operation of such an undertaking has been issued. The control in this area is carried out by Regional Inspectorate of Vratsa. It is expected that exactly comply with applicable permits and regulations applicable to work with dangerous substances and chemicals during the execution of the activities in the stages of decommissioning and dismantling activities, the environmental impact will be negligible.

Stage 1 "The preparation for safe storage"

It is expected that during Stage 1 "The preparation for the safe storage" the consumption of reactants will be related primarily to the operations of cleaning and decontamination. Until delivery of mobile installation "Danube" for treatment of slightly radioactive water, concentration of liquid waste by evaporation is the only way for their processing. Therefore, the used chemicals will correspond to those used for purification of the gangway leads. The use of chemical substances and mixtures needed to obtain small quantities of desalinated water will proceed.

Stage 2 "Dismantling in the safe storage area"

Dismantling of the equipment in a safe storage area is planned for Phase 2 of IE. Part of the dismantled equipment with low radioactivity will be subjected to decontamination by any of the methods specified in 4.1.3.2 [39]. The amount of the used chemicals substances and mixtures will depend on the amount of dismantled equipment and the method for decontamination. All chemicals associated with the preparation of desalinated water are used. The chemicals associated with the methods of deactivation are set below [39]:

- **H_3PO_4** - phosphoric acid (60 %): used in chemical decontamination. Consumption around 4000 l per year;
- **$H_2C_2O_4$** - oxalic acid (3-6 % solution) – used for electrochemical decontamination. Consumption of 1700 kg per year.

The quantity of used substances and mixtures with solid deactivation of cerium [39] depends on whether to the dismantled equipment 1) are included deactivation tubes RCV or 2) are not included. This determines the total surface which must be deactivated and depending on it, - the necessary chemicals. The total surface of the stainless steel in case 1 (not including tubes GHG) is 22331 m2 and in case 2 (including tubes GHG) is 82571 m2. In both cases, the surface of carbon steel is 400 m2. The corresponding number of lots for decontamination is: for case 1) - 944 lots and for case 2) - 2514 batches.

The following chemicals are used:

- **$Ce(SO_4)_2$** - oxidizer used in solid decontamination with cerium to dissolve the smear layer (0.05 m solution) Consumption - for case 1 – 60 kg; for case 2 – 160 kg;

- **H_2SO_4** – used for adjusting the pH during the oxidation in solid decontamination with cerium;
- Liquid **O_2** cylinders - for the production of ozone (O_3) which is used for regeneration of Ce^{4+} in all three layers (outer, inner and core alloy) (100.12 g/m^2). Designed to ensure the efficiency of the regeneration of the cerium> 65 %. Based on this efficiency consumption of ozone is calculated: 26 gO_3/m^2
- **H_2O_2** was added to the solution used for deactivation to reduce Cr^{6+} to Cr^{3+} (16.27 g/m) and Ce^{4+}, which is the solution to Ce^{3+}. Consumption: 850 g/m^3.
- **$K_4Fe(CN)_6.H_2O$** – to connect in a complex with Co and Cs c $K_4Fe(CN)_6 . H_2O$. Consumption: 1kg/m³ solution.
- **NaOH** – used for precipitating the metals as hydroxides
- (pH is increased by addition of NaOH to pH = 3) and for purification of used solutions from Ce and sulfuric acid.

The cost of these chemicals depends on whether the calculation of the total surface for decontamination includes (case 1) or does not include (case 2) the tubes RCV. The total surface of the stainless steel in case 1 (not including tubes GHG) is 22331 m2 and in case 2 (including tubes GHG) is 82571 m2. In both cases, the surface of carbon steel is 400 m2. Diesel - the estimated annual consumption will be 100 m3 by assessment from EWN [50].

In conclusion, it can be summarized the impact of the use of chemical substances and mixtures of the IP will be local, daily, without cumulative effect, predictable and in compliance with the best practices for management of chemical substances and mixtures are not expected to negatively impact on the components of the environment and human health. Cross-border impact is not expected.

The following conclusion could be made about the impact during Pre-decommissioning and Post-decommissioning stages of Units 1-4 of Kozloduy NPP.

Occurrence probability:	Available
Territorial scope of impact:	Within the examined site
Reversibility of the impact (reversible, irreversible):	Reversible
Duration of the impact– (short term, medium term and long term):	Middle term
Frequency of impact occurrence (permanent/temporary):	Short term for the construction term
Reversibility of the impact:	Negative, direct, with a trend for reduction
Transboundary type of the impact:	Not expected

4.14 Discomfort

During the construction activities at the decommissioning stage of Units 1-4 of Kozloduy NPP, the construction sites and negligibly increased traffic will be sources of noise, dust and toxic gaseous. The emissions will be considerably lower than the limit values for noise and hygiene norms for dust and toxic gases. The population will not suffer any health risk, but it is possible to face some temporary discomfort. It will be valid mostly regarding the populated areas, which the trucks will pass through. The discomfort will be minor and temporary.

The following conclusion could be made about the impact during and after decommissioning of Units 1-4 of Kozloduy NPP.

Occurrence probability:	The probability some discomfort of the population to be reported during the decommissioning and post decommissioning periods of Units 1-4 is **very low.**
Territorial scope of impact (geographic region; affected population):	The population from the populated areas through which the trucks will pass, Mainly the population of Kozloduy Municipality.
Reversibility of the impact (reversible, irreversible):	Completely reversible.
Duration of the impact– (*short term, medium term and long term*):	Short-term discomfort.
Frequency of impact occurrence (*permanent/temporary):*	Temporary
Type of the impact (positive/negative; direct/non-direct; secondary; cumulative and synergy):	Direct and indirect discomfort.

4.15 Social and socio-economical aspects

Under the adopted strategy, etc. "continues removal" [7] during the pre-decommissioning stage Units1-4 of Kozloduy NPP and stages 1 and 2 of the decommissioning, the staff of highly qualified and experienced professionals, who served the shut down reactors, are redeployed to employment in the new activities on the decommissioning. This is the primary goal of the Program for the management of the social consequences of decommissioning Units 1-4 of Kozloduy NPP [157] elaborated in 2006 by Directorate "Administration and Control" of Kozloduy NPP. Consideration of the position of interests, responsibilities, obligations, etc. of Kozloduy NPP on this goal can be regarded as an opportunity for a part of the staff, who will be relieved from the jobs occupied during the operation and redirected to positions related to the implementation of activities on the decommissioning of the Units 1 to 4 or to other suitable positions within the system of NPP in order to obtain employment, respectively, to provide for themselves and their families any income. Preserving that way the majority of the staff employed in the operation and its redirection, retraining and other measures, more globally considered in view of the interests of the society, it will practically mitigate the crisis effect and will reduce the unemployment in the region of Kozloduy NPP.

Maintaining and providing jobs for the bigger part of the specialists relieved from the operation, using their rich experience and knowledge will ensure the achievement of greater efficiency in the new activities on the decommissioning, ensuring continuity of the staff and it will also save time and money on recruitment, training and retraining, etc. In this regard, an agreement signed between Kozloduy NPP and SE "RAW" giving more detailed characteristic of the employment conditions re-contracting and transfer of the personnel of KNPP– EP-1 to the new employer SE "RAW". According to this agreement the employment relationship with the personnel is transferred to the new employer with keeping its current status towards its ex-employer unchanged. Upon such re-employment the occupational relationships with the employer are transferred to the new employer and will be kept as it was with the former employer by the moment of change.

The staff with permanent labour agreements under the positions from the job chart of Kozloduy NPP EP-1, Operation Division and with a work place in Units 1 and 2 is re-employed at analogical position by SE "RAW".

The new employer (SE "RAW") recognizes the length of service before and after the re-contracting, the additional remuneration for the length of service and professional experience provided by the ex-employer.

Besides, SE "RAW" guarantees the conservation of the social services provided by KNPP in analogical extent (in terms of extended annual full-pay leave, bonuses, social insurances etc.).

As a result of these measures the staff of EP-1 remains and the socioeconomic impacts of decommissioning the Units and the start of decommissioning activities is significantly reduced.

Besides, the preserving the qualified staff, directed to the new decommissioning activities would also have another positive effect - providing qualified personnel for

the possible construction and operation of a new Unit of Kozloduy NPP. In order to mitigate the effects from the negative economic and social impacts associated with the suspension of operation, future work and alternative employment for the staff occupied until now in the operation of the Units 1-4, as well as to ensure social protection of those part of the staff that will be released, it is necessary to undertake several measures.

As per the measures and activities stated in the Terms of Reference the number of the employees involved in Units 1-4 of Kozloduy NPP is reducing permanently. If in 2002 the number of workers working in Units 1-4 was 1420 people in 2008 this number was 1092 and in 2011 it was already 850 people. This number does not include the staff from other structural Units executing activities directly related to Units 1-4. They are a part of the staff of Safety Department, Security Division, Quality Division, Staff and Training Center Division, from Test Center for Diagnostic and Control. They are also affected by the transfer of Units 1-4 from operation to decommissioning mode. Besides, in Kozloduy NPP also work experts, employers and other categories involved in the operation of Units 5 and 6.

Meanwhile, some outside organizations work in Kozloduy NPP, which staff in 2011 was 3463 people.

All three stages for the pre-decommissioning and decommissioning of shutdown Units 1-4 of Kozloduy NPP include different waste management activities, which will be separated during their execution.

A) Pre-decommissioning Stage (PDS)

For execution of the activities foreseen for this stage, according to the adopted Alternative for continuous dismantling, the prepared calculations show that 695 people will be needed. These are people of different competency, positions, qualification etc. They include employees for management of the investment proposal, administrative staff, civil and installation experts, decommissioning experts etc.

Pre-decommissioning activities for Units 1-4 require construction within the site used by Kozloduy NPP of several facilities for waste treatment, which will be separated during the execution of the next 1 and stages. For this purpose a Size Reduction and Decontamination Workshop will be constructed. Dismantled contaminated materials from the Turbine hall, Auxiliary buildings 1 and 2 and the Reactor compartments will be treated there.

Also, during this pre-decommissioning stage a Decay storage facility for transitional RAW will be constructed. After their 5-year disposal in the facility the waste will be suitable for decontrol.

Besides these facilities during the pre-decommissioning stage a storage facility will be constructed for treatment of conventional waste during the decommissioning of Units 1-4 of Kozloduy NPP.

The activities for execution of pre-decommissioning will not have big negative effect in view of the social and economic aspect. They will help to achieve some temporary and short-term occupation of a part of the staff. It is hard to talk about cumulative effect as far as there is no accumulation in this case.

B) Stage 1 of the decommissioning

The activities for execution of Stage 1 of decommissioning include Safe Enclosure preparation and dismantling of equipment beyond the Safe Enclosure Area. For the execution of the scope and types of works during this stage 650 people will be required.

Operation activities in the size reduction and contamination Workshop include fragmentation and decontamination of different equipment, machines and materials. During the dismantling they will be split in three categories - 1st category - non-contaminated equipment, 2nd category - potentially polluted equipment and 3rd category - contaminated equipment.

The type of the activities during Stage 1 of the decommissioning, if the technological and standard requirements will be observed, does not assume any negative impacts both on the environment and on the population and economy of the examined territory. No cumulative effect is expected.

C) Stage 2 of the decommissioning

The activities planned during the execution of this stage include Delayed dismantling of equipment within the framework of the Safe Enclosure Area and control of the sites and buildings. For the execution of works foreseen for this stage 212 people will be needed and finally 100 people will be required.

The observance and application of the measures elaborated in the project and the requirements to the safe work during the dismantling and the following practices for transportation, storage etc. of the dismantled materials will impact the environmental protection and the facility of the examined 30-km area of Kozloduy NPP.

The analysis of the activities for execution of the Investment proposal for Pre-decommissioning and decommissioning of Units 1-4 of Kozloduy NPP shows that there are no reasons to expect cumulative effect regarding the population and the economic facilities in view of demographic and economic aspects as well as on the operation of Units 5 and 6 and RAW National Repository.

The safe decommissioning of nuclear facilities after termination of their operation (such as Units 1 to 4 of Kozloduy NPP), executed in accordance with the requirements of Art. 31 of the Regulation on the Safety Decommissioning of Nuclear Facilities, does not assume the risk impact on the demographic development of the population and the socio-economic situation as well as the structure of the territory adjacent to Kozloduy NPP. The risks for the population and the farms in the villages within the investigated area largely derive from the quality and security of the implementation of the measures proposed in Chapter 6, section 6.1, section 6.2, section 6.3, section 6.4, section 6.9 and section 6.10.

Occurrence of emergency situations in spite the observance of all imposed mandatory requirements is possible, even theoretically. They may have different sources, place, time, nature, scales, duration etc. The type of works foreseen for execution during the Pre-decommissioning stage and stages 1 and 2 of the decommissioning does not assume occurrence of such situations. If such ones occur they will be local, short-term and without considerable social and economic impacts.

This will practically mitigate the negative social and socio-economic impacts by:- preservation and providing jobs for the exempted from the operation professionals, using their experience and knowledge, achieving greater efficiency in the new activities, ensuring continuity and last but not least the negative crisis effect will affect less the level of unemployment. Preserving the qualified staff in the new activities on the decommissioning would also have another positive effect - providing qualified personnel for the possible construction and operation of a new Unit of NPP Kozloduy. The decommissioning activities on the four Units being shut down can not exercise economical or social effect on the economy and population in the Romanian territory in the concerned 30-km area around Kozloduy NPP site.

In the current ***Emergency Plan*** within the Kozloduy NPP are provided and activities for decommissioning. The emergency plan [132] provides technical and human resources, as well as instructions and procedures for actions in case of emergency event occurring on the decommissioning nuclear facility was elaborated according to [12] and [27]. The Emergency plan establishes the activation of the emergency organization of Kozloduy NPP, implementation of urgent protective actions for the personnel, the general public and the environment, as well as measures to protect the on-site facilities of Kozloduy NPP Plc in case of accident or other critical event, and interaction with the executive authorities.

The information and communication ways and the cooperation related to the necessary measures with the Romanian authorities must be improved and developed.

D) Close down and reclamation Stage

Under the adopted strategy, etc. "continuous removal" [7] during both stages of the decommissioning of the Units of service, the staff of highly qualified and experienced professionals, who served the stopped reactors, are redeployed to employment in the new activities on the decommissioning. The persons employed for these activities will be discharged and it will impact the employment in 30-km area of Kozloduy NPP. For mitigation of the social consequences, if the site would be used for other industrial purposes, the redirection of the free work force should be considered.

As a conclusion the following impact could be made about the impact during and after decommissioning of Units 1-4 of Kozloduy NPP:

Probability of occurrence:	Available
Territorial scope of impact (geographic	Local
Reversibility of the impact (reversible, irreversible):	Irreversible from social and economic aspects
Duration of the impact (short term, medium term and long term):	During the pre-decommissioning period of Units 1-4.
Frequency of impact occurrence	Temporary for the employees
Type of the impact (positive/negative; direct/non-direct; secondary; cumulative and synergy):	Negative for the employed in the pre-decommissioning and decommissioning of Units 1-4.

4.16 Summarized data about the potential impact of the investment proposal on the environmental components

The matrix which are used for the assessment of the expected impacts on the general public and the environment during the implementation of the decommissioning activities on Units 1- 4 of Kozloduy NPP is given below. Following alternatives for decommissioning of the Units described in Chapter 2.2 of this report are examined:

- Zero Alternative (A0) – Non-decommissioning;
- Alternative 1 (A1) – Deferred Dismantling;
- Alternative 2 (A2) Continuous Dismantling.

The matrix, which will be used for assessment of the expected impacts on the general public and the environment during the implementation of the decommissioning activities on Units 1-4 of Kozloduy NPP is prepared on the grounds of the requirements of the European documents [44-46] and experience of EWN [50].

The origin of the Matrix is the EU Document "EC Nuclear Safety and Environment, Environmental Impact Assessment for the Decommissioning Nuclear Installation" [1]. The parameters are chosen from this document as an applicable for quality assessment.

In case of negligible impact the matrix is not marked.

Table 4.16-1 Matrix for assessment of the potential impact on the people and the environment by different factors for Zero Alternative (A0), Alternative 1(A1) and Alternative 2 (A2)

Zero Alternative (A0)
negative impact
+ positive impact.

		Project Activities with the Potential to cause Impacts																	
		Modification of occupation levels	Modification of industrial sitter	Modification of industrial buildings	Modification of fencing	Demolition of buildings	Construction of new buildings	Refill and earth movements	Storage conventional waste	Recycling of wastes	Transport of materials	Handling of hazardous materials (radioactive and toxic)	Cease in releases of liquid and gaseous effluents	Use of rubble and other tips for inert solid wastes	Storage of radioactive wastes	Occurrence of fires	Possibility of escapes and leakage of contaminating liquids and gases	Personnel accidents	Structural failures due to the action of external agents	Surveillance and control operations
Environmental factors		A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16	A17	A18	A19
Physical Environment	E2 Air											-	-			-	-			-
	E3 Waters												-			-	-			-
	E4 Lands and soils											-								-
	E6 Landscape														-					
	E7 Protected territories												-			-	-		-	
	E8-1 Flora											-	-			-	-			-
	E8-2 Fauna											-	-			-	-			-
	E 11 Risky energy sources																			
Socio-economic Environment	E4 Lands and soils														-				-	
	E9 Cultural heritage																			
	E10 Infrastructure														+				-	
	E10 Health risk.											-				-	-		-	-
	E14 Social and economic aspects	-																	-	

Alternative 1 (A1)
negative impact
+ positive impact.

		Project Activities with the Potential to cause Impacts																		
		Modification of occupation levels employment	Modification of industrial sitter	Modification of industrial buildings	Modification of fencing	Demolition of buildings	Construction of new buildings	Refill and earth movements	Storage conventional waste	Recycling of wastes	Transport of materials	Handling of hazardous materials (radioactive and toxic)	Cease in releases of liquid and gaseous effluents	Use of rubble and other tips for inert solid wastes	Storage of radioactive wastes	Occurrence of fires	Possibility of escapes and leakage of contaminating liquids and gases	Personnel accidents	Structural failures due to the action of external agents	Surveillance and control operations
Environmental factors		A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16	A17	A18	A19
Physical Environment	E2 Air						-	-	-		-	-	+			-	-			+
	E3 Waters								-				+			-	-			+
	E4 Lands and soils		-				-	+	-	+		-		-			-			+
	E6 Landscape		-	+										-	-					
	E7 Protected territories												+			-	-		-	
	E8-1 Flora							-			-	-	+			-	-			+
	E8-2 Fauna							-			-	-	+			-	-			+
	E 11 Risky energy sources						-				-									
Socio-economic Environment	E4 Lands and soils						-	-	-					-	-				-	
	E9 Cultural heritage																			
	E10 Infrastructure			+			+			+					+				-	
	E10 Health risk.		-								-	-	+			-	-	-	-	+
	E14 Social and economic aspects	-					+			+									-	

Alternative 2 (A2)
negative impact
+ positive impact.

Environmental factors		Project Activities with the Potential to cause Impacts																	
		Modification of occupation levels employment	Modification of industrial sitter	Modification of industrial buildings	Modification of fencing	Demolition of buildings	Construction of new buildings	Refill and earth movements	Storage conventional waste	Recycling of wastes	Transport of materials	Handling of hazardous materials (radioactive and toxic)	Cease in releases of liquid and gaseous effluents	Use of rubble and other tips for inert solid wastes	Storage of radioactive wastes	Occurrence of fires	Possibility of escapes and leakage of contaminating liquids and gases	Personnel accidents	Structural failures due to the action of external agents	Surveillance and control operations
		A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16	A17	A18	A19
Physical Environment	E2 Air						-	-	-		-	-	+			-	-			+
	E3 Waters								-			-	+			-	-			+
	E4 Lands and soils		-				-	+	-	+		-		-	-		-			+
	E6 Landscape		-	+					-					-	-					
	E7 Protected territories												+			-	-		-	
	E8-1 Flora							_			-	-	+			-	-			+
	E8-2 Fauna							_			-	-	+			-	-			+
	E 11 Risky energy sources						-				-									
Socio-economic Environment	E4 Lands and soils								-					-	-				-	
	E9 Cultural heritage																			
	E10 Infrastructure	+		+			+		+	+					+				-	
	E10 Health risk.		-	-			-			-	-	-	+			-	-	-	-	+
	E14 Social and economic aspects	+					+			+									-	

The correlation of the activities from A1 to A19 to the decommissioning activities of KNPP is described in Chapter 2. Moreover the matrices show negative impacts marked with (-) as well as positive impacts marked with (+).

In case where the impacts negative and positive are marked together this means: Negative impact is connected with duration of activities, Positive impact is connected with the results of activities.

A1 Modification of occupation levels

This activity is related to the 3 Alternatives. Only for the chosen Alternative 2 for Continuous Dismantling, the impact is positive, because a part of KNPP personnel move to SE RAW.

A2 Modification of industrial site

The modifications are caused by the new projects Size Reduction and Decontamination Workshop (SRDW), Decay Storage Site (DSS) and Sites for Conventional Waste from Decommissioning (SWD) which is required due to the chosen Alternative Continuous Dismantling and for the Alternative Deferred Dismantling.

A3 Modification of industrial buildings

These modifications are related to the change in the purpose of some buildings and the implementation of the new projects related to decommissioning (Alternative 1 and Alternative 2).

A4 Modification of fencing

Not applicable.

A5 Demolition of buildings

According to the Updated Decommissioning Strategy [7] demolition of buildings at the end of Stage 2 of the decommissioning is not envisaged. But demolition of some building structure is possible in case of modification of some buildings. The impact of the environment is low.

A6 Construction of new buildings

This activity is related to the construction of SRDW and Decay Storage Site as well as for municipal waste from the decommissioning.

A7 Refill and earth movements

These activities are related to for the new projects: SRDW, Decay Storage Site and Site for Conventional Waste from the decommissioning.

The harmful impact on the soils is reduced by removal of the humus layer, its storage and use for other applications, mainly for reclamation purposes. From the other side the filling up of a new and not contaminated soil layer will not only restore the soil surface, but will also contribute to the environmental protection.

A8 Storage of conventional waste

These activities are related with the dismantling activities (Alternative 1 and Alternative 2); for Alternative Zero no impact.

A9 Recycling of wastes

These activities are related to the Stages 1 (dismantling inside the Turbine Hall) and 2 (dismantling inside the SE area) of Alternative 1 and Alternative 2. The resulting impacts are positive.

A10 Transport of materials

These activities are related to Stage 1 (dismantling inside the Turbine Hall) and Stage 2 (dismantling inside the SE area) as also during the construction of new buildings and facilities related to the decommissioning construction of SRDW, DSS and SWD, connected to decommissioning with high rate for reduction of the scope, valid for (Alternative 1 and Alternative 2).

A11 Handling of hazardous materials (radioactive and toxic)

These activities are related to "E" mode (all Alternatives) and to the Stages 1 and 2 (Alternative 1 and Alternative 2).

A12 Ceasing of release of liquid and gaseous effluents

After completion of Stage 2 of decommissioning.

A13 Use of rubble and other tips for inert solid wastes

These activities are related to Stage 1 and stage 2. Such type is the Site for Conventional Waste from Decommissioning.

A14 Storage of radioactive wastes

This activity is related to "E" mode (all Alternatives) and Stages 1 and 2 (Alternative 1 and Alternative 2).

A15 Occurrence of fires

This activity is related to all Alternatives. After the Stage 2 (Alternatives1 and Alternative 2) the impact is positive. The probability of occurrence is very low.

A16 Leakage of contaminating liquids and gases

This activity is related to all Alternatives. After the Stage 2 (Alternatives1 and Alternative 2) the impact is positive. The probability of occurrence is very low.

A17 Personnel accidents

This activity is related to all Alternatives. After completion of Stage 2 (Alternative 1 and Alternative 2) the impact is positive.

A18 Structural failures due to the action of external agents

The probability of occurrence is very low. After completion of Stage 2 (Alternative 1 and Alternative 2) the impact is positive.

A19 Surveillance and control operations

This activity is related to all Alternatives. After Stage 2 (Alternative 1 and Alternative 2) the impact is positive due to the significant reduction of this activity.

After the completion of Stage 2 of decommissioning the probability of occurs of events from A15 to A18 is zero.

4.17 Transboundary impacts

Detailed description of the transboundary impacts during the execution of the investment proposal is shown in a separated volume. The results of the analysis of the transboundary impact show that the transboundary impact is reduced to minimal level and is assessed as negligible. The assessments are made provided that the expected limit emissions during the decommissioning are taken into account as well as all proposed mitigation measures in Chapter 6.

The document takes into consideration the Romanian requirements set out in the letters sent to the Romanian ministry of environment and forests to the MEW N 26-00-939/19.10.2010 and letter by the MEW ref. N 26-00-693/24.08.2012