NON-TECHNICAL SUMMARY
ENVIRONMENTAL IMPACT ASSESSMENT REPORT ON

INVESTMENT PROPOSAL

FOR CONSTRUCTION OF NATIONAL DISPOSAL FACILITY FOR LOW AND INTERMEDIATE
LEVEL RADIOACTIVE WASTE – NDF

Sofia, January 2015

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ABBREVIATIONS

In Bulgarian	
SPD	State Property Deed
NPP	Nuclear Power Plant
AIS	Automated Information System
AMB	"Archaeological Map of Bulgaria"
AWS	Automatic Weather Stations
NRA	Nuclear Regulatory Agency
SC	Spray cooler
BDWMDR	Basin Directorate for Water Management in the Danube Region
BOD_5	Biological Oxygen Demand
HFS	Housing and Faeces Sewage
GIS	Geographical Information System
MOD	Main Outlet Ditch
LNHIW	Landfill for non-radioactive household and industrial waste
DNHW	Depot for Non-Hazardous Waste
EIAR	Environmental Impact Assessment Report
SE RAW	State Enterprise "Radioactive Waste"
EBRD	European Bank for Reconstruction and Development
EURATOM	The European Atomic Energy Community
EMF	Electromagnetic Fields
EA	Ecological Assessment
PE	Production of Electricity
EU	European Union
ASUNE	Act on the Safe Use of Nuclear Energy
WA	Waters Act
PZ	Protected Zones
LCH	Law on Cultural Heritage
EPA	Environmental Protection Act
UPAPZ	Urgent Protective Action Planning Zone (a zone of 30 km defined for the purposes of Emergency Planning),based on the dose rate) and it coincides with the Monitored Area (MA)
PPZ	Precaution Prevention Zone
SPA	State Property Act
FC	Factory Constructions
PT	Protected Territories
LWM	Law on Waste Management
SDA	Spatial Development Act
EEA	Executive Environmental Agency
EAEMDR	Executive Agency "Exploration and Maintenance of the Danube River"

IEZ	Individual Effective Zone
IEL	Individual Emission Limits
IP	Investment Proposal
QAA	Quality of Ambient Air
SZ	Surveillance Zone
IAEA	International Atomic Energy Agency
MDA	Minimal Detected Activity
MH	Ministry of Health
MAF	Ministry of Agriculture and Food
ICPDR	International Commission on Protection of the Danube River
ICRP	International Commission on Radiological protection
ISAR	Interim Safety Assessment Report
MoEW	Ministry of Environment and Water
MCE	Maximal Calculated Earthquake
MRD	Ministry of Regional Development
CM	Council of Ministers
MSK	Medvedev–Sponheuer–Karnik scale
NIAM - BAS	National Institute of Archaeology with Museum at the Bulgarian Academy of Sciences
NEN	National Ecological Network
MZ	Monitored Zone
NIMH	National Institute of Meteorology and Hydrology
NITCH	National Institute of Tangible Cultural Heritage
NICM	Natural Institute on Cultural Monuments
TCV	Tangible Cultural Value
SRP	Standards for Radiation Protection
NSEM	National System for Environmental Monitoring
NDF	National Disposal Facility for Low and Intermediate Level Radioactive Waste
NCRRP	National Centre of Radiobiology and Radiation Protection
NNPGC	New Nuclear Power-Generating Capacity
EIA	Environmental Impact Assessment
MSRP	Main Standards for Radiation Protection
OSG	Outdoor Switchgears
SNF	Spent Nuclear Fuel
PSA	Preliminary Safety Analysis
FP	Fission Products
HAC	Highest Allowable Concentrations
DE	Design Earthquake
GD	Government Decree
CM	Cultural Monument
WWTP	Waste Water Treatment Plant

RAW	Radioactive Waste
WFD2000/60/EU	Water Framework Directive
RHM	Regional Historical Museum
RIEW	Regional Inspectorate of Environment and Water
ReM	Radio Ecological Monitoring
GD	Government Decision
SMM	System for Meteorological Monitoring
WHO	World Health Organization
SDD Units 1-4	Specialised Division "Decommissioning of Units 1-4"
SD RAW Kozloduy	Specialised Division "Radioactive Waste"
SD NDF	Specialised Division NDF
SSCRAW	Storehouse for Storage of Conditioned RAW
STV	Specialized Transport Vehicles
WC	Warm Canal
TLDM	Thermo Luminescent Dose Meters
UACEG	University of Architecture, Civil Engineering and Geodesy
ETC	Educational and Technical Centre
FDP	Fine Dust Particles
DFPEM	Disposal Facility for Polluted Earth Masses
HMS	Hydrological and Meteorological Station
CON	Chemical Oxygen Necessity
SFSF	Spent Fuel Storage Facility
DSFSF	Dry Spent Fuel Storage Facility
HTF	Hydrological and Technical Facilities
WRAWP	Workshop for RAW Processing
CZ	Clean Zone
In English	
EUR	European Utility Requirements
NPP	Nuclear Power Plant
UNSCEAR	United Nations Scientific Committee on the Effects of Atomic Radiation
CLP	Regulation № 1272/2008 on classification, labelling and packaging of substances and mixtures
IUCN	International Union for Conservation of Nature
REACH	Regulation (EC) No 1907/2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals Directive 67/548/EEC
PCBs	Polychlorated biphenyls, polychlorated terphenyls, monomethiltetrachlordipheyl methan, monomethicldichlordiphenyl methyl, monomethicldibromdiphenyl methan and each mixture containing over 0.005 weight %.

TERMS AND DEFINITIONS

barrier	every physical (engineering or natural) barrier which prevents or hinders the distribution of radioactive substances and protects the RAW from internal and external unfavourable impacts, as well it provides protection against ionizing emissions
geological disposal	disposing of RAW in a stable geological formation at a depth of a few hundred meters or more under the surface in order to guarantee long-term isolation of the radionuclides from the biosphere
closure	completion of all operations on a fixed moment after the disposal of the radioactive waste in a disposal facility. This includes the final engineering or other works, required to set the facility into a safe condition for a prolonged period of time
protected zone	a zone defined for the purposes of physical protection, located at the territory of the site of a nuclear facility or another object for usage or storage of nuclear materials or radioactive substances; the zone is under constant supervision from guards or electronic tools, it is surrounded by a physical barrier with a limited number of access points and the access is allowed only for individuals owning special permits
zone with supervised access	a zone defined for the purposes of physical protection which covers a territory around the protected zone of the nuclear facility; the access to this zone is supervised and can be limited for vehicles
Urgent protective action planning zone (UPAPZ)	a territory around the nuclear facility or the object in whose boundaries the central and local bodies of the executive authority organize the application of immediate protective measures in case of common emergency situation, i.e. prior to or immediately after radioactive substances are emitted in the environment, in order to prevent and limit the risk of severe deterministic effects on the population
site selection	the process for determination of the a suitable place for construction of a particular nuclear facility of an object with sources of ionizing emissions, including the conduction of an appropriate assessment and definition of the design base
category 2	low and intermediate level radioactive waste, in accordance with the Regulation for safe management of radioactive waste, RAW containing radionuclides in concentrations that require measures for safe isolation and storage but do not require special measures for heat removal during storage and disposal. RAW of this category is subdivided into the following way: a) category 2a – low and intermediate level radioactive waste containing mainly short-living radionuclides (with a period of half decay not longer than the one of caesium-137) as well as long-living radionuclides with significantly lower levels of activity, limited to the long-living alpha-emitters under 4.10^6 Bq/kg for each packaging and maximal average value of all packaging in the facility of 4.10^5 Bq/kg; such RAW is provided for to be

	isolated and stored safely for a period of up to a few hundred years; (b) category 2b – low and intermediate level radioactive waste containing long-living radionuclides with activity levels of the long-living alpha emitters exceeding the limits for category 2a;
surface disposal	disposal of RAW in a facility located at the surface or up to a few tens of meters under the surface with the usage of engineer and/or natural barriers
disposal	disposing of radioactive waste in a suitable facility or place without any intentions of its further extraction
storage	storing of radioactive substances into a facility which provides limitation of their impact with the intention of their extraction
radioactive waste management	all activities related to the manipulation, preliminary processing, processing, conditioning, storing and disposal of radioactive waste with the exception of their transportation out of the site

INTRODUCTION

The Report on the environmental impact assessment (EIA Report) of Investment proposal/IP for **„Construction of National disposal facility for Low and Intermediate Level Radioactive Waste (NDF)"** on Radiana site in the lands of the Harlets village, Kozloduy municipality, Vratsa region, EKATTE 775548 is elaborated on the basis of Article 95, paragraph 2 of the Environmental Protection Act (SG, 91/2002, last amended SG 22/11.03.2014) and Article 10, paragraphs 1 and 4, Article 10, paragraphs 1 and 3 of the *Regulation on the Terms and Procedure for Environmental Impact Assessments* (SG, No 25/2003 last amended in SG, No 94 of 30 November 2012).The EIA Report is elaborated on the basis of a signed contract between SE "RAW" and „Ekoenergoproekt" OOD by the Panel of experts for impact assessment of the IP on the different environmental components and factors.

The construction of NDF has been assigned to the SE "RAW" by the Council of Ministers Decision No 683/25.07.2005. By Decision No 21-9/10.11.2011 the Ministry of Environment and Water (MoEW) on Environmental Impact Assessment (EIA) approved the implementation of the Investment proposal for „Construction of National disposal facility for Low and Intermediate Level Radioactive Waste (NDF)". With letter No Ж -320 / 19.12.2013 from the MoEW SE "RAW" has been informed about the cancellation of the above Decision following Decision No 15645/26.11.2013 of the Supreme Administrative Court sitting with five Judges, delivered in administrative Case No 12075/2013 for maintained Decision No 11040/22.07.2013 of the Supreme Administrative Court sitting with three Judges, delivered in administrative case No 14 1090/2011.

In relation to the reasoning of the Supreme Administrative Court Decision (as a consequence of Decision No 15645/26.11.2013 of the Supreme Administrative Court sitting with five Judges, delivered in administrative Case No 12075/2013 for maintained Decision No 11040/22.07.2013 of the Supreme Administrative Court sitting with three Judges, delivered in administrative case No 14 1090/2011) and in accordance with the public interest, the MoEW recommends that an update of the Terms of Reference setting out the scope and content of the EIA should be carried out and consultations held. It has been elaborated an Updated Terms of reference for the scope and contents of the EIA report, subjected to a new procedure in accordance with the requirements of the MOEW. **The scope** of the updated terms of reference thoroughly complies with the requirement of Article 10 of the *Regulation on the Terms and Procedure for Environmental Impact Assessments* and with the requirements of the MOEW as stated in letter № Ж-320/19.12.2013 and letter with outgoing №26-00-1943/15.08.2014.

This EIA Report takes into account the interim results and conclusions achieved during the ongoing projects for justification of the NDF construction.

Additionally, all reasoning for omissions mentioned in the Supreme Administrative Court decision is taken into account.

The EIA Reports takes into consideration all recommendations for additions and corrections in accordance with letter MoEW letter № 26-00-1943/05.12.2014 for defining an assessment of the quality of the EIA Report and the attached Report on the assessment of the impact degree of the Investment proposal "National disposal facility for disposal of low and intermediate active waste"(NDF), presented in the statement of the Investor with ingoing letter № 26-00-1943/20.10.2014.

The main objectives of this environmental impact assessment of the Investment proposal /IP/ of SE "RAW" are:

→ to determine at an early stage the impact on all components of the environment and the factors affecting it and mostly on the health of the population in the region and the servicing personnel during construction, operation and closure of the facility.

→ To propose measures for minimizing the negative impacts on the environment caused by the IP.
→ To outline the major ecological parameters of the IP and to clarify its environmental impact during construction, operation and closure of the facility.

As the NDF should be constructed, exploited and closed in a way that ensures long-term isolation of radioactive waste from humans and environment, this EIA Report assesses its closure and its potential impact during the post-operational period. According to the Bulgarian nuclear legislation, it is also subjected to licensing regime and a separate EIA procedure is required prior to the closure of the facility. The project is being developed in accordance to EBRD'2008 Environmental Policy and performance Requirements.

During the elaboration of EIA Report are observed the requirements stated in the laws, regulations, statutes, norms and standards of the Republic of Bulgaria and the main Directives of the EU related to the environment and the project.

As an appendix of the EIA Report it has been elaborating a Report on the impact level assessment of the Investment proposal with the subject and objectives for conservation of the protected areas in accordance with the *Regulation on Assessment of the Compatibility of any Plans, Programmes, Projects and Investment Proposals with the Subject and Purposes of Preservation of the Protected Areas* (SG No 73/11.09.2007, last amended SG № 94/30.11.2012)

An important aspect of the EIA is the public participation (public hearings). The respective activities related to the public consultations and disclosure are described in the Stakeholders Engagement Plan. This document is accessible on SE "RAW" website, gives accessible information for effective public participation, including contact information for the interest stakeholders to comment the EIA Report and the investment proposal and to write questines, comments and suggestions.

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1. CHARACTERISTICS OF THE INVESTMENT PROPOSAL

1.1. NDF SITE AND EXISTING INFRASTRUCTURE

After numerous complementary studies and comparisons with other selected sites based on the multi-criteria analysis, "Radiana" was defined as the site for the construction of the NDF. The site is situated in the vicinity of Kozloduy NPP between two roads, on the north – a road, controlled by Kozloduy NPP and regarded as internal for the plant, and on the south – a section of second-class road (national road No 11), connecting the village of Harlets, Mizia and the town of Kozloduy - **Figure 1.1-1.** The part in orange (▬) shows the area of Radiana site.

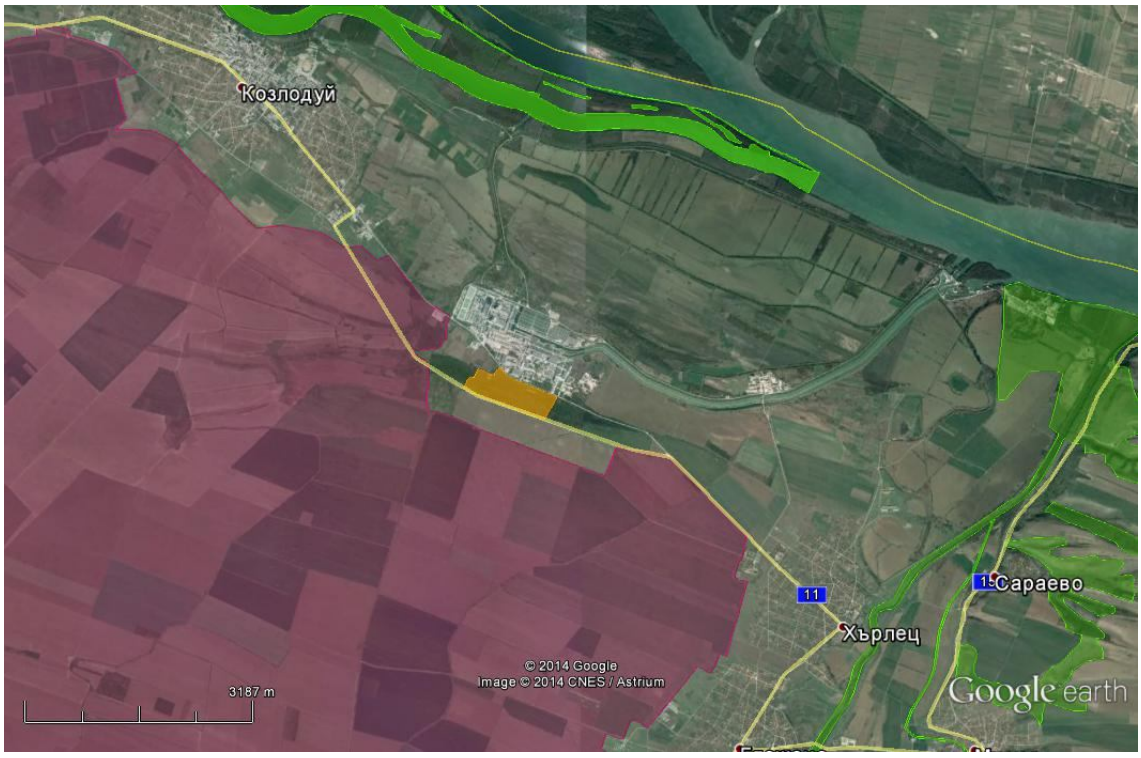


FIGURE 1.1-1 THE RADIANA SITE LOCATION

The site is positioned 3.3 km south-east from the regulatory line of town of Kozloduy, 4.3 km north-west from the construction boundaries of the village of Harlets and about 4.2 km south-west from the right bank of the Danube River. It covers an area of approximately 46 hectares, roughly rectangular in shape with maximum dimensions 470 x 1250 m which is located within the boundaries of the two-kilometer Precautionary action zone (PAZ) of „Kozloduy" NPP **-Figure 1.1-2.**

The site is situated at a slope. The average gradient of the site is 8º30'. The "Radiana" site falls within the northern periphery of the Mizia region. The slope outlines on the south the Danubian plain of Kozloduy. According to EU 'stress tests' the maximum elevation which can be flooded once for a period of 10,000 years with a probability of p=0.01% is 33.50 m i.e. well below the elevation of the site.

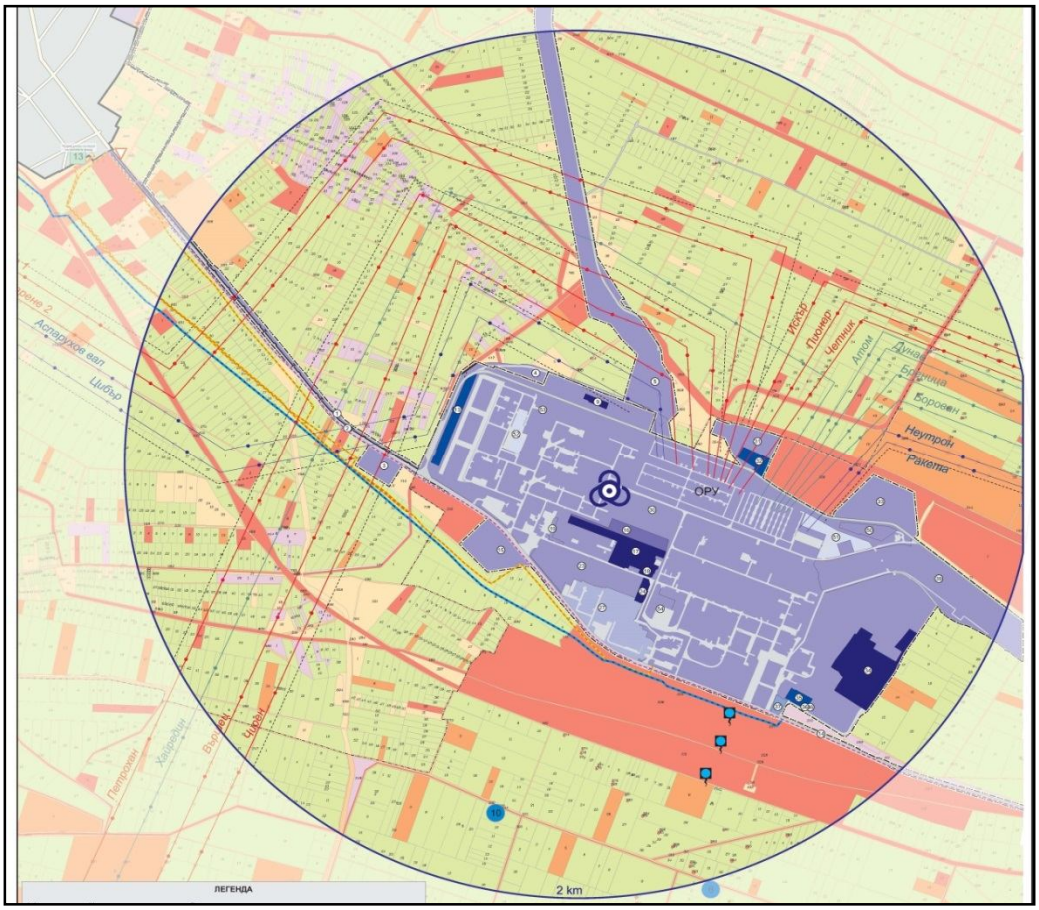


FIGURE 1.1-2 MAP OF THE TWO-KILOMETER PRECAUTIONARY ACTION ZONE (PAZA) AND THE RADIANA SITE

Over the past four decades the Radiana site has been examined in detail; first as part of the research to determine the location of NPP Kozloduy site, and between 2007 and 2011 detailed analysis were carried out for the implementation of the NDF site. In 2011 The Geological Institute of Bulgarian Academy of Sciences carried out a study: "Forecast of potential change of geological conditions of the plane part of Radiana site under the most unfavorable hydrological, hydraulic and climatic conditions, and erosion and flood risk assessment". The thorough investigation of Radiana site has shown that the site is not endangered by any flood or erosion process caused by the Danube River as the estimated maximum rise of water level is 0,9 m. It has been established that the geological characteristics or Radiana site are suitable for the desired objectives. For the purposes of the NDF design additional studies of the site were carried out in November and December 2012 by The Geological Institute of Bulgarian Academy of Sciences for justification of the Pliocene sediments upper surface elevation. Elaboration of geological and hydrogeological profiles of the plateau through the Radiana site to the Danube River" and Elaboration of hydrogeological map in the NDF area of Radiana site will further characterize the selected site for the NDF implementation.

1.2. LAND AREAS REQUIRED FOR THE IMPLEMENTATION OF INVESTMENT PROPOSAL AT CONSTRUCTION STAGE AND OPERATION STAGE

The status of the land within the site and the surrounding its area according to current information of the "Agriculture and Forests" municipal service and the Cadaster, Geodesy and Cartography Agency is given in **Figure 1.2-1** and **Table 1.2-1** shows their area.

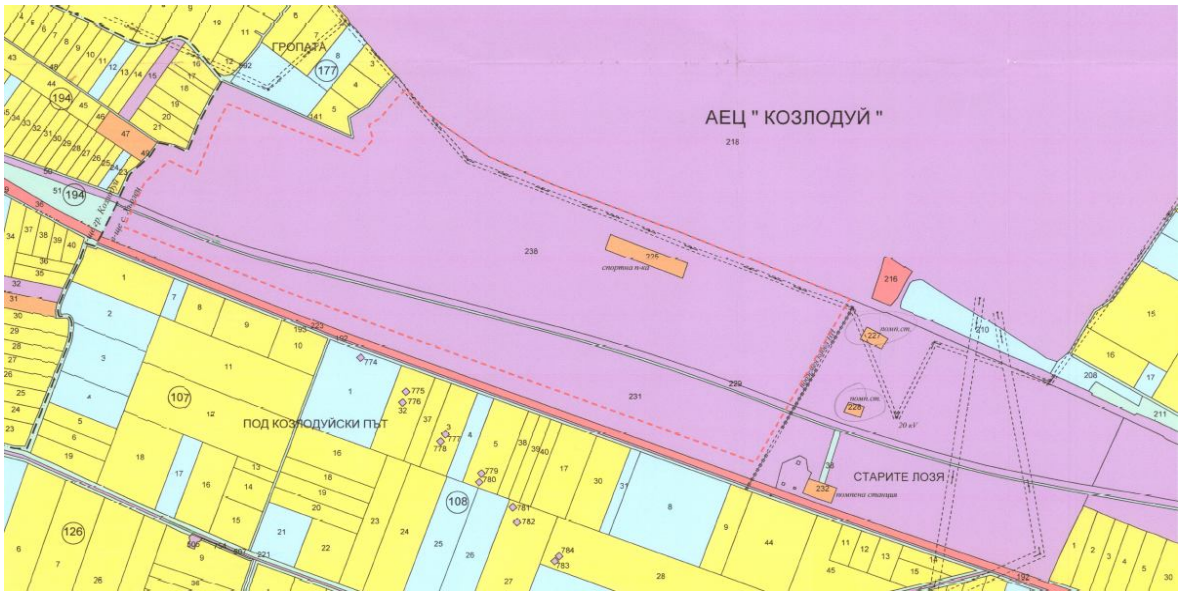


FIGURE 1.2-1 MAP OF PROPERTY AT THE RADIANA SITE AND ITS VICINITY.

Legend by type of property: - state property; - state private; - municipal public; - municipal private; - private; - legal persons.

TABLE 1.2-1 STATUS OF PROPERTY AT THE RADIANA SITE AND ITS VICINITY

№ of property	Owner	Purpose of permanent use	Type of property	Area, dka
000254, formed by 000238	The State , which granted to SE "RAW" for the purposes of NDF construction by DCM №393/5.07.2013	another urban territory	State property	309.633
000355 formed by 000231	The State, granted to SE "RAW" for the purposes of NDF construction by DCM №393/5.07.2013	another urban territory	State property	129.871
000229	MAF-HMS	Irrigation canal	State private	15.606
000225	Municipality of Kozloduy	Sports territory	Municipal private	4.26
000005	Municipality of Kozloduy	Field road	Municipal public	4.656
			TOTAL	**464.026**

The land is mainly a state property, granted to SE "RAW" for the construction purposes of NDF by DCM №393/5.07.2013 by acts of state property on behalf of SE "RAW" No 3220/03.09.2013 and No 3219/03.09.2013 issued by the district governor of Vratsa region. There are also small land plots which are municipal private property, as well as municipal public property and state private property.

The Investment Proposal affects:

- property No. 000355, owned by SE "RAW", State property with PPU "another urban territory"
- property No. 000254, owned by SE "RAW", State property with PPU "another urban territory"
- part of property No. 000005 with PPU – "field road";
- part of property No. 000229 with PPU – irrigation canal;
- property No. 000225 with TPU "sports territory".

The investment proposal does not affect private land plots and has no boundaries with private lands. The nearest private lands are situated at a distance of 30 m. A territory balance, according to the project, is shown in **Table 1.2-2.**

TABLE 1.2-2 TERRITORY BALANCE

Territory	Area, m2	Percent, %
Disposal cells – first stage	7 558.3	1.63
Disposal cells – second stage	7 558.3	1.63
Disposal cells – third stage	7 558.3	1.63
Buildings and facilities zone	5 480.3	1.18
Landscaping area	244 480.0	52.69
Undisturbed areas	132 572.8	28.57
Ground – roads and others	58 818.0	12.68
Total	464 026.0	100.00

The site will be fenced and secured in accordance with the requirements of the NRA for physical security of the radioactive waste management facilities[1].

The main activities during the construction period will be carried out at the Radiana site. Additional areas will be required for temporary storage of 90 000 m^3 loess, which be used for the execution of the loess-cement cushion, 68 000 m^3 humus, used for the back filling.

In compliance with the requirements of Act on the safe use of nuclear energy and *Regulation for the conditions and procedure for establishing of special-statutory areas around nuclear facilities and facilities with sources of ionizing radiation* will be established Precautionary action zone (PAZ) and Supervised Zone /SZ/. The PAZ defined in the purpose of NDF is confined within the boundaries of the site – inside the area surrounded by an outer fence – **Figure 1.2-2**.

[1] Regulation on Ensuring Physical security of Nuclear Facilities, Nuclear Material and Radioactive Substances, SG No 77/03.09.2004

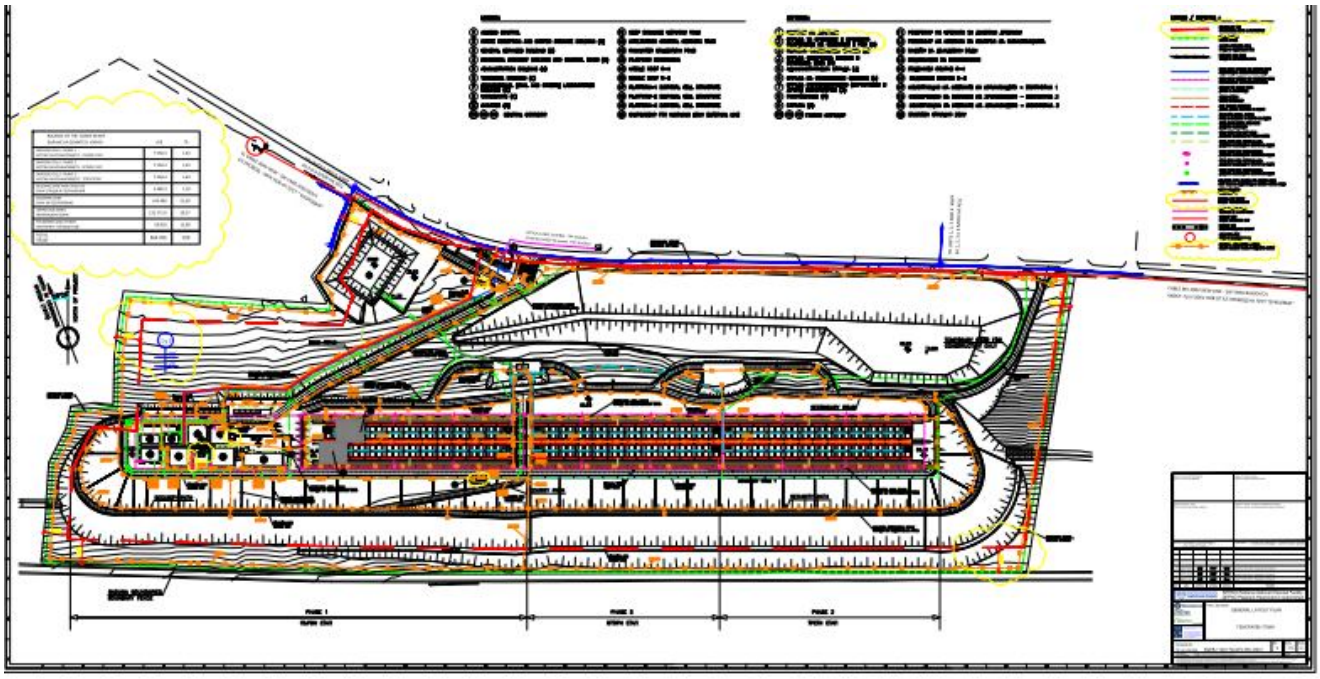


FIGURE 1.2-2 GENERAL PLAN OF NDF AT THE RADIANA SITE

1.3. INFRASTRUCTURE

The infrastructure of the site "Radiana" doesn't require large investments and demands no major infrastructural activities because it is situated in immediate proximity to the site of NPP "Kozloduy", which is provided with all utilities. It is estimated for the electricity and water-supply to be delivered by CEZ Bulgaria EAD (a company with a single equity proprietor), „Water and Sewage Service Ltd. – Vratsa, who are providing the required connection points of contact and metrical equipment.

There is a public water-pipe going through the site which supplies NPP "Kozloduy" and is property of "Water and Sewage Service" Vratsa Ltd. The drinking water is provided from 3 wells – type "Ranei", situated on the ledge of the Danube River prior to town of Kozloduy. The build in system is with sufficient capacity providing potable water to the NPP including the necessities for water with drinking quality during the construction, operation and closure of the NDF. The section of the water pipeline, which crosses the Radiana site will be moved northward between the site's fence and the existing factory road as the present supply capacity for NPP "Kozloduy" is being preserved and also provide a water supply branch to the NDF. The utilization of that water is going to be according to the legal requirements and the contract conditions with „Water and Sewage Service" Ltd. – Vratsa.

There is no constructed or existing sewage system on the Radiana site. The Investment proposal envisages its division: for domestic-waste water from the administrative area, and for rain and drainage water from the disposal cells.

Discharging of domestic wastewater will take place in the domestic wastewater sewage of NPP "Kozloduy" and surface water will be lead away in a main drain of the "Blatoto" drain system, managed by "Irrigation Systems" EAD – Mizia[2] department. The water from the drain system of "Blatoto" is transferred through a PS (pump station) into the Danube River. On a subsequent stage of the IP will be estimated if the surface water from the NDF will be led away directly in a main

[2] Letter from Irrigation Systems Plc., Mizia branch, Outgoing No 1011/06.06.2014

drain canal or indirectly through the NPP "Kozloduy" sewage system. There will be a rainwater collection pond which will be situated in close proximity to the road leading to NPP "Kozloduy" on the most inferior part of the site. Only rain water from the site, clean water from reservoirs for infiltration control and clean water from deep drainage network will be directed to the pond. In the next stage of planning, a specification on water quantities and water discharging pattern will be performed.

A power line "ELBA" 20 kV property of CEZ Electrification Bulgaria AD crosses the Radiana Site". The power line section crossing the site will be relocated according to CEZ directions for which there is elaborated detailed design. The power supply of the site will be realized through a power supply branch from the power line. For this purpose a power substation will be distributed in compliance with legal requirements.

The telecommunication cables will be distributed to the site by a diversion from the existing telecommunication cables on the basis of an agreement with BTK AD (Vivacom) for preserving the network, ownership of BTK.

The site is accessible from the north along the road controlled by NPP "Kozloduy". The transport of conditioned radioactive waste from the Specialized Division of SERAW (Specialized Division RAW – Kozloduy) will be carried through this road. There will be an internal road constructed on the site.

For the purpose of not disturbing the regime of NPP "Kozloduy" operation, the state road II-11 that is securing approach from the south to the Radiana Site is to be used primarily during the construction of the NDF as for this purpose a deviation from II-11 will be constructed.

M-1 irrigation canal which is part of Irrigation system "Asparuhov Val" passes through the site (at the moment about 38.6% from the system is available for irrigation). With the realization of the IP part of the canal is subject to replacement and/or relocation. There is elaborated design for relocation of the part of the canal that passes through the Radiana Site. The drop out section of the M-1 from the beginning section of NDF site to the discharging of the new relocated canal will be rehabilitated.

1.4. DESCRIPTION OF THE MAIN CHARACTERISTICS OF THE MANUFACTURING PROCESS

1.4.1. TYPE OF THE FACILITY

The investment proposal of SERAW for constructing NDF includes construction of **module disposal facility** for disposal of low and intermediate-active radioactive waste category 2a, under *Regulation for safe management of radioactive waste*, which is a multi-barrier engineered surface disposal facility. The selected type of disposal facility completely corresponds to the new *Regulation for safe management of radioactive waste*, in force since August 2013, according to which (Article 18, section 4) the disposal of RAW category 2a shall be done in **surface engineering disposal facilities.**

NDF is constituted of disposal facilities for disposing and auxiliary buildings and facilities. There will be provided physical security on the site and the NDF will be surrounded by a fence, secured and guarded in accordance with the *Regulation to ensure the physical protection of nuclear facilities, nuclear material and radioactive substances*.

The site is divided in "controlled area" and "supervised area". The disposal cells and the waste acception and buffer storage building for temporary operational storage of the packages of radioactive waste are situated in the controlled area. In the supervised area are situated the administrative buildings and the auxiliary facilities – a building for access control (a checkpoint), an

administrative building providing appropriate working conditions for the staff with offices, a conference room, space for archives and auxiliary equipment, a laboratory building for performing laboratory analyses, a building of service systems with workshops for various applications, industrial section which contains the energy supply systems and other service systems, a building for physical protection and a command room for 24-hour control and supervision of the object, a main service building located at the boundary between the controlled and the supervises areas, which provides radioactive protection, control of the access to the controlled areas, radiation control of people and materials. The access of staff and vehicles to/and out of the NDF area will be controlled through the checkpoint.

Based on the current international practice, Bulgarian and foreign regulations and recommendation documents, for disposal of low and intermediate RAW category 2a is selected an engineering surface facility[3,4] in accordance to the Bulgarian *Regulation for safe management of radioactive waste*. Regarding the specific conditions on the Radiana Site the disposal facility will be situated 35m under the ground surface.

The disposal facility is a multi-barrier engineering installation of modular type; its safety is ensured by passive means. The security is based on the implementation of a multilevel defence in depth which is accomplished by simultaneous appliance of system for physical barriers and technical and organizational measures ensuring the following levels of protection:

- → System of consecutive physical barriers along the propagation path of radioactive substances in the environment;
- → System of technical and organizational measures for protection of the barriers and their efficiency;
- → System of technical and organizational measures for protection of the operational personal;
- → System of technical and organizational measures for protection of the population and environment.

The system of physical barriers (multi barrier protection) has to ensure the safety during the process of operation of the facility and after the closure of the disposal facilities. In the post operation period the safety of the NDF is ensured completely by the engineering and natural barriers.

The disposal facilities should be protected from surface waters (rainfall, surface runoff due to rainfall and melting snow), through a drain system for the surface water, with a mobile roof, a light construction over the cells in operation.

It is provided for the facilities to be with an internal drain system which allows the capture and storage of water that has eventually penetrated (infiltrated) to the containers with conditioned RAW. The inner drain system will be constructed in a manner allowing the exact establishment of the cell with disposed radioactive waste in which moisture has penetrated and the assessment of the condition of the containers.

In accordance with the best practices in the developed European countries[5,6,7] and the legal requirements set with the *Regulation for safe management of radioactive waste*, the NDF project

[3] Strategy on Spent Fuel and Radioactive Waste Management up to the year 2030, approved by the Council of Ministers on 5 January 2011

[4] IAEA, IAEA Safety Glossary: Terminology Used in Nuclear Safety and Radiation Protection, 2007 Edition. Vienna, 2007

[5] I. Stefanova, Disposal of Low and Intermediate Level Waste, Sofia, publisher – Termit 97 Ltd., 2003

[6] I. Stefanova, Disposal of High Level Waste, Sofia, publisher – Termit 97 Ltd., 2004

provides technical possibility of retrieval of packages of radioactive waste during the period of operation of the disposal facility. The practice in developed European countries shows that public acceptability is better to disposal facilities where correction actions can be implemented.

1.4.2. DISPOSAL TECHNOLOGY

In accordance with the requirements of the Bulgarian nuclear legislation for operation of facilities for radioactive waste management, the standards of International Atomic Energy Agency (IAEA) for safety and the best practices, the production process in the NDF has two aspects:

- **Performance of technical operations** for disposal of RCC;
- **Control on the state** of: disposed RCC; of the condition of the disposal facilities; of the site; and of the PAZ and the surveillance zone.

1.4.2.1. TECHNOLOGICAL OPERATIONS OF DISPOSAL

During the whole operational period of the facility, the radioactive waste arrive in a solid form - conditioned in a cement matrix and packed in RCC – reinforced concrete container for transport, storage and disposal of processed radioactive waste.

The technological disposal operations are – receiving RAW, check in control and operations of disposal of RAW in the facilities for disposal by the following sequence:

1. Specialized transport vehicle, loaded with RCC arrives at the checkpoint of the NDF. A check-up of the specialized transport vehicle is performed by a police guard – staff of the NDF for a fixation of the accompanying documentation and radiation control of the specialized vehicle.
2. The specialized vehicle enters the unloading area in the waste reception and buffer storage building where a mechanical unloading procedure of the RCC is performed.
3. Entry control and characterization of RCC is done by: detailed check of the documentation; visual control of RCC; dosimetric and radiation monitoring (verification of the input dose rate of gamma radiation, checking for surface contamination, gamma-spectrometric analysis); monitoring the status of the conditioned waste and the reinforced concrete container by non-destructive methods.
4. Temporary (buffer) storage of packages of radioactive waste.
5. Mechanical loading of the package with RAW on an internal factory vehicle. The bridge crane of the building is used to receive and temporary store and the process is controlled from the main control room.
6. Internal transportation for the package with RAW to the disposal location, placementat a predefined location. The operations are carried out remotely without the direct participation of the operator staff by using a remote-controlled crane.
7. Documenting.

[7] IAEA, Low and intermediate level waste repositories: socioeconomic aspects and public involvement, IAEA-TECDOC-1553, Vienna, 2007

It must be underlined that during load off-site the NDF a detailed dosimetric and radiometric check of the specialized transport vehicle and RCCs is being performed. The loading will be in accordance with the requirements of the *Regulation on terms and conditions for transportation of radioactive materials*. Each container of RAW (RCC) is produced under strict technological requirements with performance of process control and storage of information in the database. Thus in the placement of packages in the disposal cells will be known exactly what radioactive waste is conditioned, the characteristics of the cement matrix, the total activity and radionuclide inventory of the container. Additionally, in accordance with the requirements of the Bulgarian nuclear legislation, safety standards of the IAEA and best practices, NDF personnel will perform incoming inspection and characterization of the waste containers in order to verify the documentation provided.

The transport of RCC to the NDF will only be carried with a specialized vehicle, which complies with *Regulation on the terms and conditions for transportation of radioactive materials*, the requirements of the *European Agreement concerning the International Carriage of Dangerous Goods by Road* (ADR) and conditions of the license for the transportation of radioactive substances issued by the NRA.

The transport of conditioned radioactive waste, from the operation of NPP "Kozloduy" and decommissioning of units 1 ÷ 4 of NPP "Kozloduy" will be carried out with specialized vehicle of SERAW, and who currently holds a license for the transportation of radioactive substances. The transport will be carried out along the route: Storage facility for conditioned radioactive waste of SE "RAW"(Specialized Division "RAW-Kozloduy"), located on the site of NPP "Kozloduy"→ checkpoint NPP "Kozloduy"→ road controlled by the physical protection of NPP "Kozloduy"→ checkpoint of the NDF.

1.4.2.2. CONDITION CONTROL AND MONITORING

The control of the disposed containers with radioactive waste, disposal facilities and the site applies to the following:

1. Control on the condition of the RCCs: located in a disposal modules: Performed during operation of the disposal modules until their sealing.
2. Control over the drainage system of the modules for disposal for the possible existence of water penetration. It is performed during the operation of the modules and after their sealing in the period of active institutional control.
3. Monitoring of the modules for disposal and the site of the NDF.
4. Meteorological monitoring of the site.
5. Hydrological monitoring will cover monitoring of the groundwater flow from the site of the NDF. It takes place before and during the construction of the NDF (pre-disposal monitoring), during the period of operation (operational monitoring) and to a limited amount during the period of active institutional control (post-operational monitoring).
6. The radiatiological monitoring of the site, the Precautionary action zone and the Surveillance zone will take place before and during the construction of the NDF (predisposal monitoring), during the period of operation (disposal monitoring) and to a limited amount in the period of active institutional control (post-operational monitoring).
7. Geological control and monitoring of the site and the facilities. It takes place before and during the construction of the NDF (pre-service monitoring), during the period of operation (operational monitoring) and to a limited amount in the period of active institutional control (post-operational monitoring).

In the EIA Report, the post-operational monitoring is reviewed only for completeness. According to the Bulgarian nuclear legislation closure of the NDF is subject of licensing by the NRA and separate assessment of environment impact.

The monitoring program will match the requirements of the nuclear legislation, defined in the *Regulation for safe management of radioactive waste*and *Regulation for the conditions and procedure for establishing of special-statutory areas around nuclear facilities and facilities with sources of ionizing radiation*, the recommendations of EIA and the best practices, defined in the recommendations of IAEA[8].

1.4.2.3. EXPECTED TYPE AND QUANTITY OF RAW FOR DISPOSAL IN THE NDF. PRODUCTIVITY.

In the NDF will be disposed only low and intermediate level radioactive waste, category 2a according to *Regulation for safe management of radioactive waste*, generated on Bulgarian territory.

RAW are processed in the Workshop for processing of radioactive waste of the Specialized Division of SERAW (Specialized Division "RAW-Kozloduy"), which is situated on the NPP "Kozloduy" site and is not a concern of the present EIA's report.

The present evaluation of the total volume of waste subject to disposal in the NDF indicates that most of waste will originate from NPP "Kozloduy". The amount of waste from future new nuclear capacity is less than 10% of the total volume of waste. Part of the waste from the nuclear applications, which are currently stored in the Specialized Division Permanent Repository for Radioactive Waste – Novi Han eligible for disposal in the NDF and undergo further processing in Specialized Division Radioactive Waste – Kozloduy (SDRAW Kozloduy) ", will also be disposed in the NDF. Their amount compared to the large volume of waste generated by the NPP "Kozloduy" amounts to less than 2%.

The RCC which arrive at the NDF will be with the following characteristics: overall dimensions 1950 x 1950 x 1950 mm; net volume of 5 m^3; total volume of 7.41 m^3; weight of the filled container not exceeding 20 t; a wall thickness of not less than 10 cm; the thickness of the substrate is not less than 14 cm; the thickness of the cover is not less than 8 cm; the equivalent dose rate of gamma radiation, on the surface ≤ 2 mSv/h; the equivalent dose rate gamma radiation at 1 m ≤ 0.1 mSv/h. RCC meet the requirements of the *Regulation on the terms and conditions for transportation of radioactive materials*.

It is not intended to be performed further processing and / or conditioning of incoming containers with radioactive waste on the site of the NDF.

The maximum annual productivity is 800 RCC and is determined on the basis of intake of RAW 200 days a year, taking into account that a shipment of RAW is carried out only on weekdays and transport will not be performed in adverse weather conditions. The staff of the NDF will work on a one-shift operation. The total number of employees amounts to 64 people.

1.4.2.4. CAPACITY

The preliminary assessment of the amount of radioactive waste subject to disposal in the NDF amounts to 18 615 packages of RAW (138 200[9] m^3 (345 500 t)). The maximum capacity of the facility is based on the PHARE assessment and is set on 19 008 packages of RAW (142 000 m^3).

[8] IAEA, Surveillance and monitoring of near surface disposal facilities for radioactive waste, Safety Reports Series No.35, Vienna, 2004

[9] The volume includes the volume of the radioactive waste and the volume of the reinforced concrete container

As stated above, the NDF is a modular facility that will be built in stages. In the first stage, according to[10] and the plans for decommissioning of units 1 ÷ 4 of NPP "Kozloduy" should be provided a disposal capacity for about 6336 RCCs.

1.4.2.5. STAGES OF CONSTRUCTION AND OPERATION. CLOSURE OF THE NDF.

The construction of the NDF will be done in stages also. The implementation of each stage will be in accordance with the operational needs of the facility and the requirements of the nuclear legislation in the country, the safety standards of IAEA and will be subject to licensing by the requirements of *Act on the safe use of nuclear energy* and Planning Act on the territory.

The operation of the NDF will continue for 60 years.

A **gradual closure** of the modules filled with RCCs is envisaged. It is planned that the final closure of the facility will last about 15 years and in accordance with the requirements of the nuclear legislation is subject to permit by the NRA and a new assessment of the environmental impact.

After closure, the NDF will be set to **300 years of institutional control** over part of which will be the implementation of programs for control on the condition of the facilities and radiation monitoring of the site, Precautionary action zone and surveillance zone, security and access control. Throughout the period of institutional control there will be applied administrative measures to control land use of the site. After the period of institutional control the site is released for unrestricted use.

The proposed concept is in line with the strict requirements in the field of nuclear energy concerning safety and economic efficiency in the management of RAW. It is based on the requirements of a maximum possible protection of personnel, population and environment during the operation of the NDF in normal and emergency situations.

1.5. TYPES AND QUANTITY OF THE MATERIALS AND RAW MATERIALS USED

During the **construction of the NDF** there will be used standard construction materials (concrete, rebar, bricks, paint, etc.). Other materials will also be used - liquid fuels, oils and grease in different in types and quantities, etc.

During the **operation of the NDF** there will also be needed water for drinking and domestic use for the service personnel and for technical purposes. Consumption of drinking water in the NDF for drinking and construction needs will be about 3.90l / s. For outdoor firefighting, water will be supplied through a pump station located in the Technical Building.

During the operation of the NDF is expected the use of the following substances and mixtures:

Liquid fuels for the operation of the diesel generators. Certain amounts of diesel fuel, gasoline and more will be required.

Fuel lubricants – The use of different types and amounts of oils and lubricants - mechanical and compressor oil, motor oil, various types of lubricants is estimated. They will be accompanied by the relevant certificates and other documents such as Safety data sheets indicating the correct method of storage, use, treatment.

Chemical substances and mixtures - to ensure the operation of the laboratory, different types of chemical hazardous substances and mixtures will be used and delivered - sulphuric acid, hydrochloric acid, nitric acid, sodium hydroxide, etc., but they will be in very limited quantities.

[10] Strategy on Spent Fuel and Radioactive Waste Management up to the year 2030, approved by the Council of Ministers on 5 January 2011

During Storage and use of raw materials, including those classified as hazardous there is no risk in an emergency situation to burst emissions of hazardous toxic substances in the workplace and in the environment. Upon delivery of the substances and mixtures, they will be accompanied by Material Safety Data Sheets, which is a prerequisite for environmentally safe storage and use.

When closing the NDF free spaces between the RCCs will be filled with natural materials - gravel and others.

1.6. TYPE AND QUANTITY OF THE ESTIMATED WASTE AND EMISSIONS (CONTAMINATION OF WATER, AIR AND SOIL; NOISE, VIBRATIONS; RADIATION – LIGHT, TEMPERATURE, IONIZING, NON-IONIZING, ETC.) IN RESULT OF THE OPERATION OF THE INVESTMENT PROPOSAL

1.6.1. WASTE

1.6.1.1. NON-RADIOACTIVE WASTE GENERATED

During operation of the NDF is expected to generate predominantly **domestic waste** which will be collected in containers or standard buckets and transported to the landfill for solid waste by a company with scope of activity - collection, transportation, disposal and disposal of solid waste. Furthermore **construction, industrial and hazardous waste** are periodically generated, mainly due to repair works.

The hazardous waste as GSM based garbage, paint and varnish, burned out mercury and fluorescent lamps, equipment batteries, chemicals and laboratory chemicals from the tests will be collected and temporarystored on the site in accordance with regulatory requirements and submitted to licensed disposal companies. The EIA Report provides specific measures that ensure the environmentally-friendly management of the generated waste.

1.6.1.2. RADIOACTIVE WASTE

The proposed disposal technology may cause the generation of secondary RAW from drainage water, working clothes, laboratories, etc. Throughout the period of operation of the facility the radioactive waste enters in a solid form - conditioned in cement matrix and packed in RCC. The proposed disposal technology may cause the generation of secondary RAW from drainage water, working clothes, laboratories, etc.

Minimum amounts of potentially contaminated radioactive materials result from operations on entry control and monitoring of the engineering barriers of disposal facility.

According to the preliminary assessment, are expected **limited amounts of the following solid radioactive waste:**

- Personal protective equipment (protective clothing, shoes, gloves) – they will be in rather small quantities – not more than 40 pairs a year, round 0.05 m^3/y. of maximum. PPE will be treated as radioactive waste only if they are contaminated after dosimetric control.
- cotton, filter paper, laboratory samples, glassware, tools – will not exceed 1.5-2 m^3/a.

They will be transported for further treatment to the specialized division SE "RAW" – SD "RAW-Kozloduy" which is located in close proximity to the NPP Kozloduy site.

RAW is collected in plastic bags and transported on a particular route in shipping containers on a vehicle, accompanied by a vehicle with equipment for radiation monitoring, personal protective equipment, decontamination and fire extinguishing and other resources necessary for emergency

response. For each activity with RAW there are stipulated instructions, compliance with which is essential for radiation safety and protection of the personnel.

Liquid radioactive waste is not generated under normal operation. Radioactively contaminated water can be generated in laboratories during laboratory tests and analyses. Expected quantity will amount to no more than 300 dm^3 per month. In accordance with the requirements of nuclear legislation, water from the internal drainage system of the modules for disposal will be considered as potentially radioactive. They undergo radiation control. In case of presence of radioactive isotopes in concentrations exceeding limit values, they undergo purification in the facilities of SE RAW at NPP "Kozloduy" site.

The solid from of waste and its packaging in reinforced concrete containers do not imply generating of aerosol emissions in the atmosphere. Pollution of water and soil is prevented by a multi barrier system, collection and control of drainage water in the internal drainage system, the radiation monitoring of the site, the Area for Precautionary action zone and a surveillance zone.

The IP and the EIA Report will provide measures to prevent / limit and minimize their impact on the environment and work environment.

1.6.2. EMISSIONS TO THE ATMOSPHERE

1.6.2.1. NON-RADIOACTIVE EMISSIONS

During normal operation gas emissions of the transport activities related to the operation of the NDF are expected on the national road network. The impact of the transport plan for delivery (equipment) and waste disposal will only affect the servitudes of road sections used for transport. They are a linear source of pollutants. The assessment of emission levels for the different pollutants from road transport on the national road network will be made according Level 2 (Tier 2)[11] of the European Guide emission inventory - EMEP / EEA air pollutant emission inventory guidebook 2013 for key pollutants from: (a) passenger cars (NFR[12] code 1.A.3.b.i), (b) light duty vehicles under 3.5 t (1.A.3.b.ii), (c) heavy duty vehicles over 3.5 t and (d) buses (1.A.3.b.iii), section Transportation.

Emissions for the following pollutants are evaluated: Ozone precursors - carbon monoxide (CO), nitrogen oxides (NO_X) and non-methane volatile organic compounds (NMVOC); Greenhouse gases (CO_2, CH_4, N_2O); Acidifying substances (NH_3, NO_X, SO_2); Fine Particulate Matter (PM) - only a fraction of PM2.5, since the higher fraction $PM_{2.5 \div 10}$ is negligibly small in the soot of the exhaust gases. Carcinogenic compounds: PAH - polycyclic aromatic hydrocarbons (Benzo (α) pyrene, Benzo (b) fluoranthene + Benzo (k) fluoranthene, indeno (1,2,3-cd) pyrene - for unleaded petrol)); POP - Persistent Organic Pollutants; Toxicity substances (DIOX - Dioxins and furans (unleaded petrol)); Heavy metals.

1.6.2.2. EMISSIONS OF RADIOACTIVE PRODUCTS

Sources of organized gaseous radioactive discharges into the atmosphere are not expected.

[11] **EMEP/EEAair pollutant emission inventory guidebook** is a methodology for estimating the emission levels, where methods with different complexity are used, which describe the main activities during inventory control of emissions. The level of complexity is noted as Tier X, i.e. the bigger number X is, the more complex and precise the method is.

[12] **NFR** (Nomenclature for Reporting) – a nomenclature for reporting of the emission-generating processes, which allows complete combination and correspondence of all national reports under the Convention on Long-Range Transboundary Air Pollution (CLRTAP);to the Secretariat of the United Nations Framework Convention on Climate Change (UNFCCC) and to the European Environmental Agency (EEA).

1.6.3. EMISSIONS TO WATER

It is envisaged that the main reciever of all kinds of non-radioactive contaminated waste water from the NDF (domestic and controlled rainwater) through sewage and treatment facilities of the NPP "Kozloduy" to be in the Danube river.

Sewerage network of the national disposal facility for radioactive waste will be divided for the different types of wastewater.

1.6.3.1. NON-RADIOACTIVE POLLUTED WASTE WATER

1.6.3.1.1. DOMESTIC WASTEWATER

Will be formed by all administrative, main and auxiliary buildings, and they will pass through the sewage canal network of the NDF to be discharged into the sewer for waste water of NPP "Kozloduy".

1.6.3.1.2. RAIN WATER

On the site of the NDF will be established a system for collection and control of rainwater, the surface runoff of the site and the protective runoff trenches. A rainwater collection pond will be built where all the rainwater and drainage water will be collected and monitored. Waters will pass through a collection reservoir-pond for rain water, which is designed to collect water from maximum precipitation. Then, after being subject to control, the water will be released at doses to the receptor. The discharge area will be specified in the following stage of design in accordance with the legal requirements.

1.6.3.2. RADIOACTIVELY CONTAMINATED INDUSTRIAL WASTEWATER

During normal operation of the NDF no radioactively contaminated waste water is expected to arise.

All potentially contaminated water streams are collected by specialized sewage in special volumes, they are measured and if contamination above the permissible limits is detected they will be submitted for processing to SD "RAW-Kozloduy"

Minimal amounts of radioactive waste water are generated (liquid radioactive waste) – from laboratories and other sources they are a maximum of 300 dm^3 per month.

Potentially contaminated water from the drainage of the trenches is not normally expected regular amounts. There will be a reservoir for their collection. The treatment of such water is known - collection control and then draining or removing for processing outside the NDF. The maximum quantity of such water is less than the volume of the reservoir.

In the updated EIA Report for the implementation of the NDF will be recommended measures to minimize impacts on the environment and ensuring the safety of the aquatic ecosystem and the population in the area.

1.6.4. SOIL CONTAMINATION

The implementation of the investment proposal causes impacts on the **land usage** only **on the site**. The impact is **long-term** because the NDF is located on the site for long-term period. Even after the closure of the NDF (recultivation) the land usage of the site will be limited during the whole period of institutional control (300 years).

No impacts on the agricultural lands outside the territory of the NDF site are expected.

No impacts are expected in relation to the radiation status of the soils in the vicinity of the NDF Radiana site caused by the implementation of the IP during the operation period of the facility. The packaging of the conditioned RAW (RCC) and the rest engineering barriers of the NDF ensure that no radioactive compounds are spread and that the environment is protected from radioactive contamination. It isn't expected a change in the radiation indicators of the soils beyond the typical background levels for the regional resulting from the implementation of the NDF.

1.6.5. NOISE AND VIBRATIONS

A source of noise in the environment in connection with the project of construction and operation of the NDF will be the used construction equipment, primary and auxiliary equipment and and the transport servicing these activities. According to the design it is not expected the envisaged technological equipment to be a source of vibration in the environment. The used construction and assembly equipment will not be a source of vibration in the environment. Vibrations in industrial sites are a factor only in the work environment.

It is not expected for the transport vehicles servicing the operation of the NDF to be source of vibrations in the environment. They would travel on the national road network class II road II-11 consistent according to the design with the respective traffic category in which the vibrations of heavy vehicles subside over short distances around the road route.

1.6.6. RADIATION

1.6.6.1. IONIZING RADIATION

Ionizing radiation is radiation which, upon interaction with the substance / organic or inorganic matter / leads to the formation of electrical loads. It is:

1. Corpuscular – a stream of elementary particles of different mass, with or without an electric charge, basically these are the alpha, beta and neutron particles.
2. Electromagnetic / photon / radiation - gamma and X-rays.

Ionizing emissions are the result of nuclear interactions and/or fission of the nuclei of natural and artificial radionuclides. These emissions affect the living organisms through the ionization components. Upon its impact on matter, the ionizing radiation transfers part of its energy. The energy delivered to a unit of matter is designated as dosage. The unit for delivered energy or unit dose is the Gray [Gy] equal to one J/kg.

Ionizing radiation is a manifestation of the radioactivity of radioisotopes. Radioactivity is spontaneous fission of atomic nuclei of chemical elements, changing their physical and chemical properties and emission of ionizing radiation. Such elements are called radioactive – natural and artificial radionuclides. 80 natural and 2 000 artificial radionuclides are currently known. Each of these is with a constant half-life - T, which may vary from fractions of a second to millions of years.

The source of ionizing radiation in the present project are the packed solid low and intermediate level radioactive waste to arrive for final disposal in the national disposal facility. The sources of irradiation or ionizing radiation are generally classified as:

- Closed, which preclude the possibility radioactive substances to be released into the environment under normal (failsafe) conditions
- Open, where the possibility is real.

The source of ionizing radiation in the National Disposal Facility is closed and the type of radiation is gamma because the package eliminates the spread of alpha and beta particles beyond it.

1.6.6.2. NON-IONIZING RADIATION

The main sources of ELF electric and magnetic fields (with industrial frequency 50 Hz) in the working environment are the transformer systems, busbar systems, switches and power lines. Sources of ELF fields (mainly magnetic) can be rectifiers, power supply systems with low voltage, etc.

Sources of radio frequency and microwave (SHF) electromagnetic radiation in the NDF are in: Security systems; Mobile connection systems; Emergency warning systems.

1.7. JUSTIFICATION OF THE NEED OF INVESTMENT PROPOSAL FOR REALIZATION OF NDF

Management and disposal of radioactive waste generated by nuclear facilities in the energy, industry, medicine and scientific research for the purpose of protecting the environment and care for the health and safety of the people is the rationale of the investment proposal as successfully using the existing infrastructure and experienced and highly qualified personnel of SE "RAW".

The need to construct the NDF on the site "Radiana" is based on the following:

- The construction of the NDF ensures the safe disposal of low and intermediate level radioactive waste type 2a and their sustained and permanent isolation from the environment and people and the lack of such a facility to date.
- Securing the necessary capacity for safe disposal of conditioned and packaged low and intermediate level waste category 2a that resulted from the operation of NPP "Kozloduy", decommissioning of units 1 ÷ 4 of NPP "Kozloduy" and decommissioning of old and possible new nuclear capacities of NPP "Kozloduy". In the NDF will also be disposed RAW category 2a generated using radioactive sources of ionizing radiation in industry, medicine, agriculture and research.
- Effective management of low and intermediate level radioactive waste by closing the cycle in accordance with the requirements of national legislation *Joint convention on the safety of spent fuel management and on the safety of Radioactive waste management* (ratified by an Act of the 38th National Assembly of 10.05.2000 SG No.42 / 23.05.2000),
- Obligation of Republic of Bulgaria under Directive 2011/70 / Euratom of 19 July 2011 for establishing a Community framework for the responsible and safe management of spent fuel and radioactive waste.
- Safety standards of the International Atomic Energy Agency (IAEA), as well as the best practices in the management of radioactive waste in the EU.

For the construction of the NDF, Bulgaria has made commitment to the European Commission. Construction of the first stage, which should ensure safe disposal of the radioactive waste from the decommissioning of units 1 ÷ 4 of NPP "Kozloduy" is funded by the Kozloduy International Decommissioning Support Fund (KIDSF). The construction of national disposal facility for disposal of low and intermediate level radioactive waste has the highest priority under the *Strategy for management of spent nuclear fuel and radioactive waste* until 2030.

1.7.1. JUSTIFICATION OF IMPLEMENTATION OF THE INVESTMENT PROPOSAL ON RADIANA SITE

All activities related to the implementation of the investment proposal (site selection, design, construction, commissioning, operation, closure) are subject to authorization by the Nuclear Regulatory Agency in accordance with the requirements of the *Act on the safe use of nuclear energy* and the *Regulation on the procedure for issuing licenses and permits for safe use of nuclear energy*.

The process of site selection passes through four phases, in accordance with Art. 25, paragraph 1 of the *Regulation for safe management of radioactive waste*, the recommendations of the International

Atomic Energy Agency (IAEA) and the best practices in waste management in the developed European countries:

→ **Develop a concept** for disposal and planning of the activities for site selection;

→ Data collection and analysis of areas, including:

a. **analysis of the regions** – doing analysis and evaluation on the territory of the entire country, except large areas with adverse conditions for locating facility for radioactive waste disposal and determine the areas for analysis, which are large areas with favourable geological and tectonic, geomorphological (topographic), hydro geological, geotechnical, hydrological, climatic and other characteristics
b. **selection of prospective sites -** in *the areas for analysis* are localized potential sites that meet the criteria for setting a facility for radioactive waste disposal, and identify promising sites for a thorough examination.

→ **Site characterization** – the promising sites are examined thoroughly and one of them is selected;

→ Site confirmation.

The activities on the listed four phases at the stage of site selection are subject to scrutiny by the NRA. This includes:

(1) SE "RAW" is developing a plan to implement the activities under each of the 4 phases, including a description of the objectives; description of the main activities in their sequence; description of the requirements and recommendations of national and international documents, which will be implemented during the activities; list and description of the elaborated procedures to ensure the practical implementation of the requirements and recommendations of national and international documents; detailed timetable for implementation of the activities, evaluation of the necessary financial resources and sources of funding and a program for quality assurance. The plan and program of quality assurance are approved by NRA before the implementation of the activities.

(2) For each of the phases SE "RAW" develops a report on the implementation of the planned activities. The implementation activities of each phase will be considered as finished upon approval of the report on their execution by the NRA.

On phase "Data collection and analysis of areas" of the process of site selection SE "RAW" initially determined 78 sites that dropped to 12 prospective sites for the construction of the NDF[13]. The characteristics of these 12 potential sites were compared and 4 were identified as prospective sites for further study (**Figure 1.7-1**) on phase "Site characterization". These sites are:

- **Site "Radiana",** located on the land of the village of Harlets, municipality of Kozloduy, near the NPP "Kozloduy" (within 2km PAZ).
- **Site "Marichin valog"** located near the town of Kozloduy, Kozloduy municipality 2.5-3 km away from the biggest producer of radioactive waste NPP "Kozloduy" and beyond the 2 km zone for precautionary measures but within 30km of the NPP "Kozloduy" Surveillance zone.
- **Site "Brestova padina",** located in the land of village Bhutan, municipality of Kozloduy, on distance of 20 km from the NPP "Kozloduy" and outside the 2km PAZ, but within the 30km Surveillance zone of NPP "Kozloduy".

[13] Report on Completion of Data Acquisition and Regions Analysing Phase, SE RAW, 2007

- **Site "Varbitsa"** located on the land of village Varbitsa, Vratsa municipality 52 km in a straight line from NPP "Kozloduy" (over 90 km by road) outside the 2 km PAZ and outside the 30km Surveillance zone of NPP "Kozloduy ".

On phase "Site characterization" SE "RAW" were conducted detailed field and laboratory studies of these sites, in the course of this phase site "Varbitsa" dropped from further consideration. Reason for the decision is the great distance of the site from the main generator of radioactive waste - NPP "Kozloduy" and minimization of potential danger to the population during the transport of conditioned radioactive waste to the site of the NDF. According to Article 55 Ph. 1, P. 1 of the *Regulation for safe management of radioactive waste* the location of the site for surface disposal of radioactive waste must provide transportation of waste to the facility, with minimal risk for the population. Researches on phase, "Characterization of sites for the NDF" shows that the shortest way from NPP "Kozloduy" to Varbitsa site is longer than 90 km as 68 km of them pass through a second class road № 4 from Kozloduy to Vratsa and 22 km more on a third grade road №1306, which needs repair and a 4 km new road link. This is considerably greater distance in comparison with site "Radiana" (located next to the NPP "Kozloduy" where the transport is carried out on an internal road), site "Marichin valog" (maximum distance over a new road network 2,5-3 km), and site "Brestova padina" (20 km distance, of which 6-7 km new road). The carriage to site Varbitsa will pass through 14 villages, the largest of which is Borovan. This way the transport operations expose the population at risk. In comparison, the transportation route of RAW from NPP "Kozloduy" to site "Marichin Valog" and site "Radiana" do not cross any populated areas, and especially to site "Radiana" public road network is not used. 3 populated areas are crossed during transportation of RAW from NPP "Kozloduy" to site "Brestova padina". Evidently site "Varbitsa" does not meet the requirements of the normative framework for minimum risk for the population during transport of RAW.

The EIA Report will describe all favourable comparative characteristics that favour the choice made at stage of selecting an appropriate site (geological, hydrogeological, tectonic, neo-tectonic seismic conditions, geochemical and other environmental conditions).

FIGURE 1.7-1 LOCATION OF THE MAIN SITE AND THE INVESTIGATED ALTERNATIVE SITES

1.7.1.1. RADIANA SITE

Site "Radiana" is located in immediate proximity to NPP "Kozloduy" and falls in the 2-km zone of precautionary measures (PAZ) of NPP "Kozloduy". It is 3,3 km southeast of the border of town Kozloduy, 4.3 km northwest of the construction borders of village Harlets and about 4.2 km southwest of the right bank of the Danube.

The site is located outside the "Zlatiata" area, one of the most fertile parts of the Danube plain and does not fall within the scope of protected areas by "Natura 2000"[14].

On **Figure 1.7-2** are the boundaries of site "Radiana".

[14] Letter from the MoEW , Outgoing No 48-00-566/13.07.2009 г

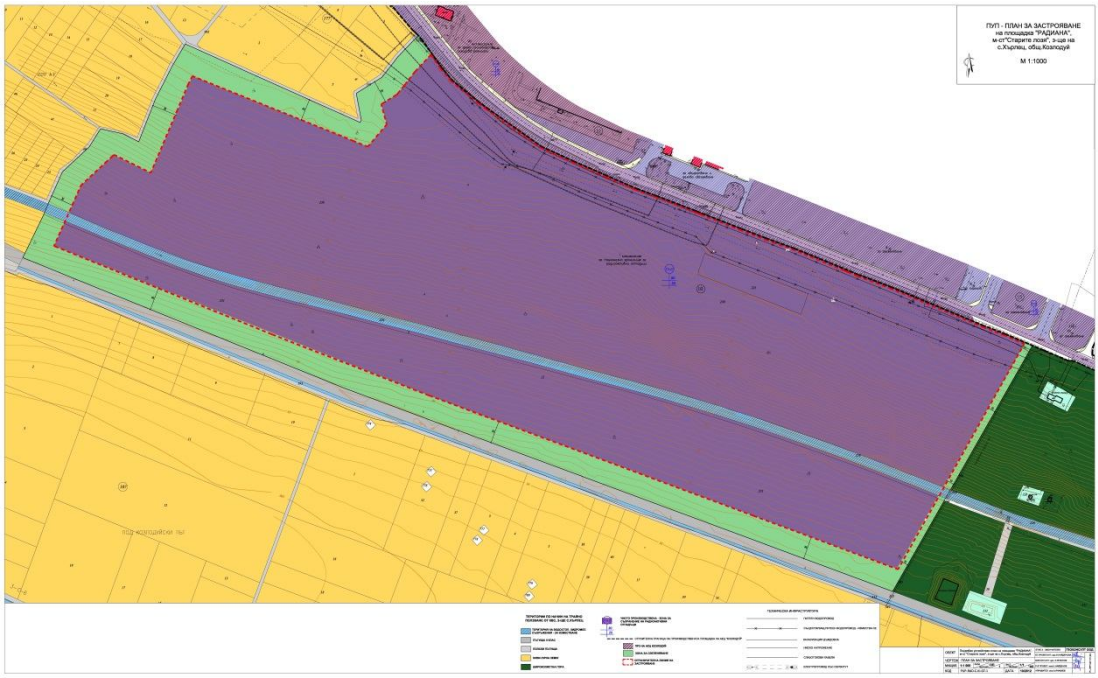


FIGURE 1.7-2 PLAN OF THE REGION OF THE RADIANA SITE, BOUNDARIES OF THE SITE

1.7.1.2. BRESTOVA PADINA SITE

The site is located 12 km from the Kozloduy NPP, 6,0 km from the Kriva bara village and 7,5 km from the Butan village. Its altitude above sea level is 100-120 m.

The site falls within the eastern edge of the protected area BG0002009 "Zlatiata" for conservation of wild birds, declared by Order № RD-548 / 05.09.2008 of the Minister of Environment and Water (Official Gazette No 83/23.09.2008.), the granary of Northwest Bulgaria. In the 5-km zone the carbonaceous black soils are dominating. The conditions for growing crops are very good. In the 10-km zone farmland is over 85%. These are some of the justified reasons not to select the site for the implementation of NDF.

1.7.1.3. MARICHIN VALOG SITE

The site is located about 3.5 km from the town of Kozloduy and 2.5 km west-northwest of NPP "Kozloduy".

The site is located in the "Zlatiata" area - one of the most fertile parts of the Danube plain and falls under the "Natura 2000" in the protected area BG0002009, area for conservation of wild birds, proclaimed by Order № RD - 548 / 05.09.2008 by the Minister of Environment and Water (SG No 83 / 23.09.2008) . This is one of the reasons why the site is not suited for the implementation of the NDF.

1.7.1.4. VARBITSA SITE

In the phase "Site characterization ", the site Varbitsa was eliminated from further consideration. The reason for the decision was the great distance of the main source of radioactive waste - NPP "Kozloduy" to the site of the NDF - about 90 km, which is unacceptable for the transportation of the conditioned radioactive waste to the NDF site.

The site does not fall within the territory of the protected areas "Natura 2000".

1.7.1.5. MOTIVES FOR THE CHOICE MADE

The detailed field and laboratory studies of the sites were done in Phase 3 "Characterization of sites for NDF." During the implementation of the Phase 3 the "Varbitsa" site was dropped from further consideration based on the reasons described above. The results from the research done on each of the sites are summarized and analyzed in a uniform manner and laid-out in the report on Phase 3 implementation, which is approved by the Nuclear Regulatory Agency[15]. The description include: location , lithostratigraphic structure, tectonic and neo-tectonic conditions , geotechnical conditions , geochemical characteristics , hydrological conditions, migration of radionuclides, seismic characteristics, flood impacts , meteorological processes and phenomena, hazards from technogenic nature, water and mineral resources, land use of the land and land ownership, transport of radioactive waste, population and populated areas, flora and fauna, national cultural and historical values, nuclear-related experience/education of the population and proximity to NPP, infrastructure, proximity to a state border, public tolerance.

In accordance with the *Regulation for safe management of radioactive waste* [16]*, Regulation on ensuring the safety of nuclear power plants*[17] and the recommendations of the IAEA[18,19] criteria for assessing the acceptability of the sites are defined.

The criteria include:

→ safety based on lithostratigraphical structure;

→ safety based on tectonic and tectonic conditions;

→ safety based on geomorphological conditions;

→ safety based on the geotechnical conditions;

→ safety based on hydrogeological conditions and qualities impeding the migration of radionuclides;

→ safety based on the geochemical characteristics (geochemistry of underground waters and sorbing minerals in the geological environment);

→ seismic safety;

→ safety as defined by the low potential for the development of exo-geodynamic

→ processes;

→ safety considering the meteorological processes and phenomena;

→ safety defined by the absence of hazards of technogenic character;

→ impact on the environment and population;

→ presence of water and mineral resources in the area of NDF's impact;

→ land use of land and land ownership;

→ transport of RAW (distance to the NDF, the presence of well-established road network), number of populated areas along the route;

[15] Report on Completion of Sites Characterisation Phase 3, SE RAW, 2011

[16] Regulation on Safe Management of Radioactive Waste, approved by the Council of Ministers on 23.08.2013, promulgated SG No 76/30.08.2013

[17] Regulation on Ensuring Safety of Nuclear Power Plants, SG No 66/30.07.2004

[18] IAEA, Siting of Near Surface Disposal Facilities, Safety Series No.111-G-3.1, Vienna, 1994

[19] IAEA, Near surface disposal of radioactive waste, Safety Requirements No. WS-R-1, Vienna, 1999

→ presence of environmentally or culturally protected areas in the zone of impact of the NDF;

→ socio- economic acceptability (social tolerance);

→ need for construction of a new infrastructure;

→ adverse effect on business activities.

Based on this multi-criteria analysis, which is described in detail in the EIA Report, the site „Radiana" was identified as the site that offers the most favorable conditions for the construction of the NDF. The appropriateness of the choice is evidenced by the results of the preliminary safety analysis report completed, in accordance with the requirements of the *Regulation on the procedure for issuing licenses and permits for safe use of nuclear energy*[20], at the "site selection" stage.

During the "Confirmation site" stage, further in-depth studies of the site „Radiana" were carried-out, confirming the correctness of the choice made.[21]

In addition to the favorable geological, hydrogeological, tectonic, seismic and neo-tectonic conditions, geochemical and other natural conditions, the advantages of the site are further defined by these conditions:

→ The site "Radiana" does not affect the protected areas under the Protected Areas Act,

→ The site "Radiana" does not fall within the protected areas as defined in the Zones of Biodiversity Act. The north-eastern border of the protected area BG0002009 "Zlatiata" is at a distance of about 400m. from the site of the NDF. It is not deemed likely for the NDF to have a significant negative impact on the natural habitats and the habitats of species subject to protection, or to the loss or fragmentation of important bio-corridors during the periods of construction , normal operation and after the decommissioning of the NDF,

→ The site is not located on agricultural lands and is away from populated areas.

→ The site "Radiana" is located next to the NPP „Kozloduy" within the 2 km zone for precautionary measures of NPP "Kozloduy ", which is one of the most significant advantages over the other sites considered. This allows for the use of the infrastructure of NPP "Kozloduy", including its resources and experience as related to the operation of nuclear facilitys requiring strict control in order to ensure the safety of the workers at the facility, the population in the area, and to prevent possible negative impact on the individual components and factors of the environment. Additionally there is no need to introduce restrictions on new territories.

1.7.2. RATIONALE FOR SELECTING NEAR-SURFACE DISPOSAL FACILITY FOR THE DISPOSAL OF LOW AND INTERMEDIATE LEVEL RADIOACTIVE WASTE

1.7.2.1. SURFACE DISPOSAL FACILITY

The selected option for the disposal of low and intermediate-active level short-lived radioactive waste is the **near-surface multi barrier engineering facility.** The choice of near-surface multi barrier engineering facility is based on the nuclear legislation[22] according to which **"radioactive**

[20] Regulation on the Procedure for Issuing Licenses and Permits for Safe Use of Nuclear Energy, SG No 41/18.05.2004, last amended in SG No 76/5.10.2012

[21] Report on the Results from Geological, Geophysical, Engineering and Geological, Hydrological and geological, Hydrological and Laboratory Studies, MGU-Engineering, 2009

[22] Regulation on Safe Management of Radioactive Waste, approved by the Council of Ministers on 23.08.2013, promulgated SG No 76/30.08.2013

waste category 2a should be disposed in surface engineered structures for RAW disposal" (Article 18, section 4 of the *Regulation on Safe Management of Radioactive Waste*). The decision of the legislator, which is the basis for the choice of SE RAW, is in accordance to the legislation of the European Union. In addition this decision was supported by the European Union Directive 2011/70 / Euratom of 29 July 2011, regarding the establishment of a framework for the European Community providing guidelines for the responsible and safe management of spent fuel and radioactive waste disposal, wherein the close to the surface i.e. in surface repositories, is regarded as the typical concept for disposal of low and intermediate level waste. The Strategy on the management of spent nuclear fuel and radioactive waste[23] is an administrative and not a normative act, but it also defines NDF as a near-surface facility.

The analysis of a number of documents of the International Agency for Atomic Energy (IAAE), including the recommendations of the IAAE safety standards prove that the disposal in near-surface facilities is a proven and confirmed method of RAW disposal that have proven the safety isolation of RAW from the environment and people during the tens of years of operation of such facilities.

The analysis of the experience of leading countries in the European union confirms the choice made for the disposal of low and intermediate level radioactive waste category 2a in near-surface engineering facilities for RAW disposal.

1.7.2.2. LONG-TERM STORAGE IN A STORAGE FACILITY

Long-term storage of conditioned low and intermediate level radioactive waste in storages similar to the existing one at the SD RAW - Kozloduy is not deemed a preferred option as a result of the experience in waste management in the world's leading countries, and as postulated in the documents of the International Agency for Atomic Energy in Vienna. The reasons include the inability to provide long-term safety of the facilities, transfer of responsibility for the safety RAW management and disposal to the future generations, the much higher cost of the storage until the waste could be exempt from institutional control, in other words untill the activity of the radionuclide fall below the levels dangerous to humans and the environment.

(1). the inability to provide long-term safety of the facilities

(2). actually, the long-term storage is storage facilities is delegation of the responsibility for the safety RAW management and disposal to the future generations, which contradicts to the main principles of the IAAE according to which this responsibility should not be delegated to future generations;

(3). at last, the cost of RAW management, including long-term storage and following disposal, will be significantly higher, which is unjustified under the condition that it is not ensured long-term safety of the facilities

According to the Directive 2011/70/Euratom of 29 July 2011, establishing a Community framework for the responsible and safe management of spent fuel and radioactive waste, "storage of radioactive waste, including long-term storage is a temporary solution and not an alternative to its disposal".

1.7.2.3. DISPOSAL IN A GEOLOGICAL REPOSITORY

Deep geological repository is not an option for the disposal of low and intermediate level radioactive waste category 2a. It is intended for the disposal of highly radioactive and long-lived waste (HLW) from the reprocessing of SNF. On the other hand - the price of such disposal per unit volume of conditioned waste is disproportionately high and economically unjustified. The international experience in the field demonstrates that surface repositories are sufficiently reliable

[23] Strategy on Spent Fuel and Radioactive Waste Management up to the year 2030, approved by the Council of Ministers on 5 January 2011, amended by protocol decision of the Council of Ministers of 25.06.2014

for the disposal of low and intermediate level waste with predominantly short-lived radionuclides. Under the Bulgarian nuclear legislation[24] disposal in geological repositories is appropriate for radioactive waste category 2b and category 3. These guidelines are supported by the European Union Directive 2011/70 / Euratom of 29 July 2011, establishing a Community framework for the responsible and safe management of spent fuel and radioactive waste[25], according to which the geological repository is intended for the disposal of high level waste and spent nuclear fuel.

1.7.3. MAIN OBJECTIVES, PRINCIPLES AND CRITERIA FOR SAFETY

The purpose of the realization of this investment proposal for construction of NDF is to provide safety and effective protection for the operating personnel, the population and the environment from the potential impact of the disposed waste during the operational and post-operational periods. The safety insuring measures are applied throughout the whole life cycle of the NDF - the stages of site selection, design, construction, operation, closure after reaching capacity and the period of institutional control.

In accordance with the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management, the requirements of the Bulgarian legislation, the safety standards of the IAEA[26,27,28,29,30], and the recommendations of the International Comity on Radiological Protection (ICRP)[31,32] the basic safety principles employed by SERAW in the construction of the NDF are as follows:

1. NDF should be located, designed, constructed, operated and closed in such a way that the exposure of workers and the public should not exceed the limits specified in the *Regulation on basic norms of radiation protection,* 2012 and the *Regulation for safe management of radioactive waste,* 2004*;*
2. The exposure of the workers and the public should be kept as low as reasonably achievable;
3. The measures that ensure radiation protection should be optimized in a way to guarantee achievement of the highest reasonable level of protection;
4. The level of protection of the population beyond the national borders should not be lower than the level of protection of the population in the country;
5. The level of protection of the future generations should not be lower than the level of protection of the current generation;
6. Future generations shall not be burdened by the existence of the NDF, including having to make efforts to restore or maintain the necessary level of safety of the facility;

[24] Regulation on Safe Management of Radioactive Waste, approved by the Council of Ministers on 23.08.2013, promulgated SG No 76/30.08.2013

[25] Council Directive 2011/70/EURATOM of 19 July 2011 establishing a Community framework for the responsible and safe management of spent fuel and radioactive waste

[26] IAEA, The principles of radioactive waste management, Safety Fundamentals, Safety Series No.111-F, Vienna, 1995

[27] AEA, Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards (Interim Edition). Safety Standards Series No. GSR Part 3 (Interim), Vienna, 2011

[28] IAEA, Fundamental safety principles, Safety Standards, No.SF-1, Vienna, 2006

[29] IAEA, Siting of Near Surface Disposal Facilities, Safety Series No.111-G-3.1, Vienna, 1994

[30] IAEA, Near surface disposal of radioactive waste, Safety Requirements No. WS-R-1, Vienna, 1999

[31] ICRP, Radiological Protection Policy for the Disposal of Radioactive Waste, Publication No. 77, Elsevier, Oxford, 1997

[32] ICRP, Radiation Protection Recommendations as Applied to the Disposal of Long-Lived Solid Radioactive Waste, Publication No. 81, Elsevier, Oxford, 1999

7. The NDF should be located, designed, constructed, operated and closed in a way which ensures environmental protection in accordance with the requirements of *the Environmental protection Act,* 2002 and international requirements in the field of environmental protection[33,34,35,36,37,38,39];
8. For ensuring the safety of the NDF is applied the principle of retention and isolation;
9. The construction of the NDF must utilize the latest achievements in science and technology, and conform to the established international experience in the field;
10. After the closure of the facility, the NDF safety is ensured by passive engineering and natural barriers;
11. The NDF safety is based on the application of deep echelon protection, which is based on simultaneous application of a physical barriers system and administrative measures, which ensure the following levels of protection:
    - ⇒ System consisting of consecutive physical barriers along the way of distribution of radioactive substances in the environment;
    - ⇒ System consisting of technical and organizational measures for protection of the barriers and maintenance of their efficiency;
    - ⇒ System consisting of technical and organizational measures for protection of the operational personnel;
    - ⇒ System consisting of technical and organizational measures for protection of the population and environment.
12. The system of physical barriers is based on the multi barrier conception, and each barrier contributes to safety ensuring through its safety functions. The NDF safety should not depend mainly on each separate barrier. If a particular barrier cannot perform its safety functions, then the system as a whole should ensure the isolation of RAW in accordance with the safety criteria.
13. The construction of the disposal facilities should be such that the packages with radioactive waste can be extracted during the period of NDF operation;
14. The construction of the disposal facilities should ensure easy and effective operation, maintenance, control and monitoring;
15. The whole process of NDF construction should be transparent and an open dialogue with the public should be established. The requirements of the public should be taken into account during the site selection process and should be included in the facility design to an extent, which is feasible from technical and economical point of view;

[33] Convention on environmental impact assessment in transboundary aspect (ratified with Law, adopted by the 37-th National Assembly on 16.03.1995) SG 28/1995, effective as of 10.09.1997 (promulgated SG 86/01.10.11995)

[34] Convention of the access to information, participation of the public into the decision-making process and access to justice regarding the environment (ratified with Law, adopted by the XXXIX N.A. on 02.10.2003, SG 91/2003, effective as of 16.03.2004, promulgated SG 33/23.04.2004)

[35] Directive 2011/92/EU of the European Parliament and of the Council of 13 December 2011 on the assessment of the effects of certain public and private projects on the environment (Codified)

[36] European Directive 2001/42/EC on the assessment of the effects of certain plans and programmes on the environment, June 2001.

[37] Council Directive 92/43/EEC (1992) on the conservation of natural habitats and of wild fauna and flora (Natura 2000) – Habitats directive

[38] Council Directive 78/659/EEC of 18 July on the quality of fresh waters needing protection or improvement in order to support fish life

[39] Council Directive 79/409/EEC of 2 April 1979 on the conservation of wild birds

16. The main safety criteria are the **radiological criteria** set in the *Regulation on basic norms of radiation protection,* 2012 and in the *Regulation for safe management of radioactive waste* [40]:
    1. The annual total effective dose equivalent for the critical group members of the public after the closing of the NDF should not exceed 0.1 mSv;
    2. The annual total effective dose equivalent for the critical group members of the public in result of the operation of the NDF should not exceed 0.1 mSv;
    3. In cases of accidents the annual total effective dose equivalent for the relevant critical group members of the public on the boundaries of the site should not exceed 1 mSv;
    4. The effective dose limit for staff operating the NDF is 20 mSv for every single year;
    5. The annual total effective dose equivalent for personnel employed at the NDF is: 20 MS for the eye lens; 500 mSv for the skin and 500 mSv for the palm of the hand, under the elbows, the feet and the ankles.

The dose limits for the population during the operation of the NDF and after termination of operation (post- operative period) are to be lower than the limit of the annual effective dose for each individual in a population - 1 mSv/a, as defined by the *Regulation on basic norms of radiation protction*, 2012. Safety criteria conform to the safety standards of the IAEA, radiation protection and safety of radiation sources: International Basic Safety Standards – Radiation Protection and Safety of Radiation Sources[41] and the recommendations of the International Committee for Radiation Protection[42,43].

Important aspect of the ensuring the compliance with safety objectives, principles and criteria is the Integrated management system of SE RAW, which covers all safety, environmental and social aspects. At the same time SERAW maintains it's basic objectives in the area of health and safety for the workers (it's own personnel and the workers of the different contractors that implement different activities at Radiana site) to maintain appropriate working conditions.

1.8. SPECIAL STATUTORY AREAS

1.8.1. ZONES AROUND THE KOZLODUY NPP

The establishment of the special statutory areas around NPP "Kozloduy " necessitates the creation of a tool for planning and management of the site's territory in accordance with the laws and regulations of the country and the European standards for safety and security, as required by Article 104 , paragraph 1 of the Law for Safe use of Nuclear Energy (State Gazette No 63 2002 , last amend. SG 82 , 2012).

Based on the conducted safety analysis and in accordance with the Regulation for emergency planning and emergency preparedness in a nuclear and radiation accident (Prom. SG . 94 of 29.11.2011), the following emergency planning zones around the NPP "Kozloduy" have been determined:

→ **Emergency planning zone on the site** - *protected area* № 1 – the site " NPP Kozloduy"

[40]Наредба № 7 от 8.06.1998 г. за системите за физическа защита на строежите, ДВ, бр. 70 от 19.06.1998

[41] IAEA, Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards IAEA Safety Standards Series GSR Part 3, 2014

[42] ICRP, Radiation Protection Recommendations as Applied to the Disposal of Long-Lived Solid Radioactive Waste, Publication No. 81, Elsevier, Oxford, 1999

[43] ICRP, Radiological Protection Policy for the Disposal of Radioactive Waste, Publication No. 77, Elsevier, Oxford, 1997

→ **Precautionary action zone (PAZ) - Zone № 2**, a zone with 2 km radius zone with geometric center between the vent pipes of units 5 and 6. The area of the zone is occupied by the production site of NPP "Kozloduy ", on-site storage and processing of radioactive waste area of SD " RAW Kozloduy " and the site " Radiana" . Its purpose is to limit exposure in case of radiation accidents.

→ **Urgent protective action planning zone (UPAPZ)**[44] **- zone № 3** with a provisory radius of 30 km radius around "NPP Kozloduy". Its role is to facilitate the control as necessary for radiation protection purposes.

Emergency planning zones are divided into 16 sectors – **Figure 1.8-1**. Depending on the emergency situation there would be different measures and procedures held in the zones, in order to protect the personnel and the public.

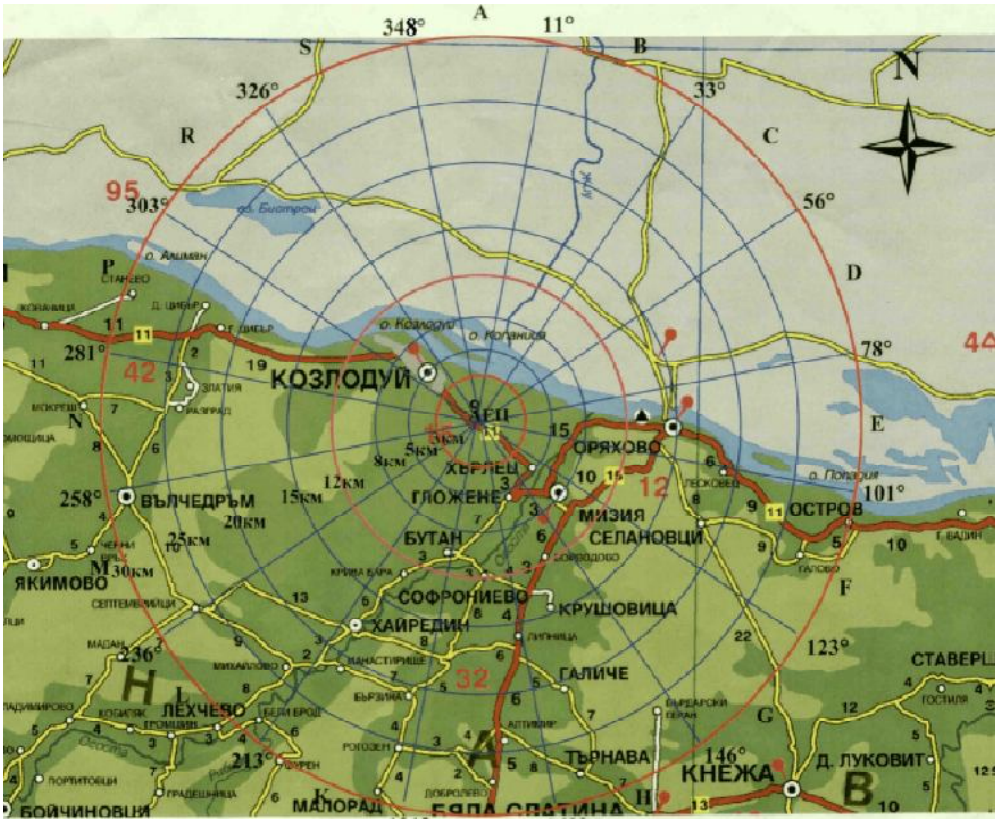


FIGURE 1.8-1 ZONES FOR EMERGENCY PLANNING – UPAPZ ZONE WITH A RADIUS OF 30 KM

On the territory of the Republic of Bulgaria Zone 3 includes the entire municipalities: Kozloduy, Valchedram, Hayredin, Mizia and partially the municipalities of Lom, Byala Slatina, Oryahovo, Boychinovtsi, Krivodol and Borovan. There are no major Bulgarian industrial and military sites within the zone.

On the territory of Romania, the zone covers a total of 23 villages in the counties of Dolj and Olt: Bechet, Nedeia, Gighera, Zaval, Ostroveni, Sarata, Călăraşi, Dabuleni, Listeava, Piscu Sadovei,

[44] The 30-km UPAPZ is defined for the purposes of emergency planning. The same 30-km zone is called „Supervised zone" (SZ) for the purposes of radiological monitoring

Sadova, Gângiova, Măceşu de Jos, Măceşu de Su, Sapata, Plosca, Bistret, Brandusa, Goicea, Barca, Horezu Poenari, Toceni, Valea Stanciului.

1.8.2. RADIO-ECOLOGICAL MONITORING

In the zones around NPP "Kozloduy" is conducted radiological monitoring which includes all major components of the environment (air, water, soil, vegetation, food, agricultural products, etc.), within radius of 100 km around the plant on Bulgarian territory.

The magnitude, scope and monitored parameters are regulated by a long-term program for radiological and ecological monitoring during normal operation of KNPP, which is approved by the control and supervisory authorities in the country - the NRA, the National Centre of Radiobiology and Radiation Protection (NCRRP) at the Ministry of Health (MoH) and the Executive Environment Agency (EEA) to the Ministry of Environment and Water (MoEW). The program fully complies with the national and EU regulations in this field, including art. 35 of the Euratom Treaty, the EU Recommendation 2000/473/Euratom and 2004/2/Euratom.

The area for monitoring includes benchmarking points within a 100 km radius around the nuclear plant, with the control being carried out mainly at 36 control points. Beyond these places, there will be monitoring of the Danube River and other inland waters, control of the ground water and drinking water as well as the local food - fish from the Danube River, milk from farms, etc.

1.8.3. ZONES AND PREDISPOSAL MONITORING OF THE RADIANA SITE

According to the analysis of ISAR, due to radiation risk, the NDF should be classified in risk category 3 which is the category with the lowest risk for nuclear facilities. As is known, the special statutory areas are created together with the design of the nuclear facility and are justified with the report for interim safety assessment. Considering the fact that the NDF falls into the lowest risk category, two zones with special status will be created around it:

1. Precautionary action zone (PAZ)
2. Surveillance zone (SZ).

In accordance with the requirements of article 104, section 2 of the Act on safe use of nuclear energy and based on the criteria defined on the Regulation on emergency planning and emergency preparedness in cases of nuclear and radiation accident (promulgated, SG, 94/29.11.2011) the parameters of the special status zones around the NDF are estimated and defined. The precautionary action zone (PAZ) of the NDF is limited within the boundaries of the site (within the boundaries of its fence) and the surveillance zone of the NDF is below 4 km.

Pre-operation radiation monitoring is conducted on the site of the IP and in the surveillance zone, and it will continue in the future and during the NDF operation. The pre-operation monitoring (the monitoring before and during the construction of the NDF) is regulated by the Program for pre-operation radiological monitoring on site "Radiana " (№ TK.D -142 -D3/2012, HX - PEM - AF - 001), which comply with the requirements of the Nuclear Regulatory Agency[45,46]. The radiation monitoring consists of determining the gamma-ray background, checking for the presence of radionuclides from the inventory of the NDF in the surface air , precipitation, ground surface and the underground water , water-sources, soil, vegetation and agricultural products.

[45] Monitoring and Surveillance of Radioactive Waste Disposal Facilities IAEA Safety Standards Series SSG-31, 2014
[46] Surveillance and Monitoring of Near Surface Disposal Facilities for Radioactive Waste, IAEA Safety Reports Series No 35, 2004

The program includes the following zones:

- Site " Radiana" - approximate size 46 hectares - (about 1200x400 m); it is the PAZ;
- Areas in SZ and PAZ around the site " Radiana" – aquifer catchments - the River Danube, wells for drinking water, agricultural land, farms and others.

Object of monitoring on "Radiana" site and the area around it are:

- Radiation gamma background (thermoluminescent dosimeters (TLD) of the control points and field (*in situ*) measurements)
- Specific, or volume radioactivity of key radionuclides in environmental components:
    - soils - control posts on the site " Radiana" site,
    - waters:
        - natural waterways - the Danube River, downstream from the NPP "Kozloduy"
        - drinking water - the network of the town of Kozloduy,
        - ground water - from available piezometers,
        - sediments – the Danube River, in the places for taking water samples.
    - atmospheric air (aerosols and atmospheric depositions)
    - flora (grass, foliage and plants - from the site)
    - algae - the Danube River, in the places for taking water samples.
- Radioactivity in food and agricultural crops (fish, milk and seed crops) in areas around the site.

An institution-independent monitoring of the main parameters of the environment - air, water and soil is conducted in PAZ and SZ by the control and supervisory authorities in the country - the Executive Environment Agency EEA/MoEW and the National Centre of Radiobiology and Radiation Protection NCRRP/MH.

1.9. DESCRIPTION OF THE LICENSING PROCESS AND RESPONSIBILITIES OF VARIOUS INSTITUTIONS

The description of the licensing process, including the responsibilities of the various institutions to ensure the safety, physical protection and funding of the NDF was brought-up in response to the recommendations of the Romanian side – a letter from the Romanian Ministry of Environment, outgoing №7439/EGU/16.11.2009.

The activities involved in the construction of the NDF are subject to licensing by the Nuclear Regulatory Agency in accordance with the *Regulation on the procedure for issuing licenses and permits for safe use of nuclear energy*, and they include:

⇒ Site selection permit (defining the location);

⇒ design permit

⇒ construction permit

⇒ permit for commissioning;

⇒ license for operation;

⇒ license for closure.

In accordance with the Strategy for the management of the spent nuclear fuel and radioactive waste, the governmental policies in the field of RAW management are being implemented by the Ministry of the Economy and Energy. The control of the nuclear and radiation safety is implemented by the Nuclear Regulatory Agency. Physical protection of the facilities for RAW management is carried-out according to the *Regulation on physical protection of nuclear facilitie , nuclear material and radioactive substances*, and is controlled by both the NRA and the specialized bodies of the Ministry of Interior.

2. ALTERNATIVES FOR THE REALIZATION OF THE NDF

2.1. ZERO ALTERNATIVE

"Zero" option would be the decision to not go ahead with the realization of this investment proposal, in other words the denial of approval for construction of an NDF in the foreseeable future in the country.

At present, the radioactive waste from the normal operation of Units 5 and 6 of the NPP "Kozloduy" and the historically accumulated radioactive waste are being processed at the appropriate facilities of "SD RAW - Kozloduy" and the conditioned waste is then stored in a specialized waste-storage warehouse with the capacity of 1920 units of the reinforced concrete container (RCC). The conditioned radioactive waste from the decommissioning of units 1 ÷ 4 of NPP "Kozloduy" will be stored at the very same facility.

The capacity of the storage facility is calculated taking into consideration the role of the facility as an intermediate link in the overall system for radioactive waste management, and in accordance with the requirements of the Bulgarian nuclear legislation[47,48], the safety standards of the IAEA[49,50,51,52] and the European Union Directive 2011/70/Euratom of 29 July 2011, establishing the European framework on the responsible and safe management of spent fuel and radioactive waste[53].

The warehouse is a facility for temporary storage of RAW before their disposal in the NDF with foreseen life cycle of 50 years. Currently stored in the storage facility are stored 1368 RCC. With the current rate of filling-in with conditioned radioactive waste, future rate as calculated and determined by production requirements ensuring the normal operation of Units 5 and 6 of NPP "Kozloduy ", and the expected waste resulting from the due process of decommissioning of units 1 ÷ 4 of NPP "Kozloduy ", the storage capacity will be exhausted in less than four years.

The zero alternative, i.e. the denial of approval for the construction of the NDF, is directly overthrown because:

- → **it is not in accordance with** the nuclear legislation according to which the radioactive waste should be disposed within the shortest possible period of time after they are generated;
- → **it is not in accordance with** the requirements of the Joint convention on the safety of spent fuel management and on the safety of radioactive waste management[54];
- → **it is not in accordance with** the legislation of the European Union - European Union Directive 2011/70/Euratom of 29 July 2011, establishing the European framework on the responsible and safe management of spent fuel and radioactive waste[55], as well as with the

[47] Act on Safe Use of Nuclear Energy, SG No 63/28.06.2002, last amended in SG No 68/2.08.2013

[48] Regulation on Safe Management of Radioactive Waste, approved by the Council of Ministers on 23.08.2013, promulgated SG No 76/30.08.2013

[49] IAEA, Fundamental Safety Principles, Safety Fundamentals No.SF-1, IAEA, 2006

[50] IAEA, ThePrinciples of RadioactiveWasteManagement, Safety Standard SeriesNo.111-F, IAEA, 1995

[51] IAEA, Storage of RadioactiveWaste, Safety Standards, Safety GuideNo.WS-G-6.1, 2006

[52] IAEA, PredisposalManagement of RadioactiveWaste, Safety Standards, No. GSR part 5, 2009

[53] Council Directive 2011/70/EURATOM of 19 July 2011 establishing a Community framework for the responsible and safe management of spent fuel and radioactive waste

[54] Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management. Ratified by an Act passed by the 38th National Assembly on 10 May 2000, SG No 42/23.05.2000

[55] Council Directive 2011/70/EURATOM of 19 July 2011 establishing a Community framework for the responsible and safe management of spent fuel and radioactive waste

Law on safety use of nuclear energy[56] and the Strategy for management of spent nuclear fuel and radioactive waste[57];

→ **it is not in accordance with** the decisions of the Bulgarian government:

- → Strategy for management of spent nuclear fuel and radioactive waste until 2030, accepted with a protocol decisions of the Council of Ministers on 5.01.2011, according to which the construction of the NDF is of first priority.
- → SE RAW is authorized to build a National Disposal Facility for Radioactive Waste with Decision of the Council of Ministers № 683 from 25th July 2005[58];
- → With a Decision of the Council of Ministers № 898 from 8th December 2011 the National disposal facility, for whose construction as part of the procedure for selection of the nuclear facility's location is chosen the Radiana site, is defined as a national object under the State Property Act and as an object of national importance under the Law on Territory Planning[59];
- → Government decree № 3 from 10th January 2013 defines the national disposal facility as a strategic object for the national security[60].

This has the following negative consequences:

(1) **Termination of the process of conditioning of RAW from the normal operation of Units 5 and 6** of NPP "Kozloduy". In this case, the available space for the temporary placement of not yet processed RAW would be exhausted, resulting practically in the termination of operation of the NPP "Kozloduy" units 5 and 6. This scenario would have significant socio-economic consequences for the population and industry of the country, by resulting in a significant increase in the price of electricity due to unavailability of cheap electricity from NPP "Kozloduy" for the country's energy mix.

(2) **The planned extension of service life for the Units 5 and 6** of NPP" Kozloduy" **cannot be implemented** due to failure to secure means for a long-term management of the radioactive waste generated during the Units' future operation. Socio-economic effects are similar to the described above.

(3) **Termination of the process of decommissioning of units 1 ÷ 4** of NPP "Kozloduy " due to lack of capacity for temporary storage of the conditioned radioactive waste and lack of capacity for their disposal. It should be stressed here that the decommissioning of units 1 ÷ 4 of NPP "Kozloduy" is a part of the Treaty of Accession of Bulgaria to the European Union. The realization of the process of decommissioning is funded by the International Fund "Kozloduy". Any default on this process will lead to significant financial penalties.

(4) **Inability to build new nuclear facilities**. The construction of new nuclear facilities is a subject to approval by the European Commission. Imperative condition is the existence of a disposal facility for the disposal of radioactive waste that will be generated during the operation of a new nuclear facility.

[56] Act on Safe Use of Nuclear Energy, SG No 63/28.06.2002, last amended in SG No 68/2.08.2013

[57] Strategy on Spent Fuel and Radioactive Waste Management up to the year 2030, approved by the Council of Ministers on 5 January 2011, amended by protocol decision of the Council of Ministers of 25.06.2014

[58] Decision of the Council of Ministers No 683/25.07.2005 for implementation of a national disposal facility for radioactive waste

[59] Decision of the Council of Ministers №898/08.12.2011 for designating NDF as a national site and site of national significance

[60] Decree of the Council of Ministers №3/10.01.2013 for amendment of Decree № 181 of the Council of Ministers of the year 2009 for designation of strategic sites and activities, which are of significance to the national security

If the investment proposal is not realized, this **causes significant risks** for:

- **the health of the personnel** of the Kozloduy NPP, the personnel of the SE RAW and the population of the nearby settlements – the town of Kozloduy, the town of Mizia, the villages of Harlets, Glojene, Butan, Kriva bara, etc.
- **the state of the environment** which may be expressed in pollution with radionuclides of the soils and near-surface zone of the earth's depths, as well as of the underground water, mainly of the underground water body "Porous waters in the Quarternary – Kozloduy valley" with a code BG1G0000Qal005, which is a source of water supply through built water supply facilities and it a protection zone for the water used for drinking and domestic use.

On the basis of the above-mentioned, the zero alternative is overthrown.

2.2. ALTERNATIVES IN TECHNOLOGY

Two technologies for the disposal of low and intermediate level RAW category 2a in a modular surface disposal facility are being considered: trench type[61] and tunnel type[62]. Within the frame of the EIA Report both technologies for the disposal of radioactive waste are analyzed and a preference to one of them is justified in the light of safety and potential environmental impact.

2.2.1. TECHNOLOGY FOR DISPOSAL OF LOW AND INTERMEDIATE LEVEL RADIOACTIVE WASTE IN TRENCHES

Modern trench type disposal facilities are realized in Centre d'Aube- France , El Cabril – Spain, Mochovce in Slovakia , Dukovany in the Czech Republic and others. Our developed technology for disposal in trenches is based on the French and Spanish technology in use. The same technology will be implemented in a Belgian facility which is currently under construction.

Figure 2.2-1 shows the location of trench type disposal facility at Radiana site.

The repository consists of 66 disposal cells, situated on three identical platforms, each of which has 22 cells capacity. The cells are arranged in two rows, 11 cells each. The capacity of each disposal platform is 6336 packages of radioactive waste (containers made of reinforced concrete) and the total capacity of the facility is 19 008 packages. The disposal cells are solid rectangular boxes with the following external dimensions: length – 20.15 m, width – 17.05 m and height – 9.45 m to the covering slab. Each cell is divided into two sections by two interior walls of the reinforced concrete, which consist of three chambers where the containers are arranged into four rows.

[61] Conceptual Design of the National Disposal Facility for Low and Intermediate Level Waste, Report on Task 4.1 of the PHARE Project No EUROPEAID/122568/D/SV/BG, 2008

[62] Pre-design Study for the NDF Implementation, a Tunnel Type Repository, Minproekt Plc., 2009

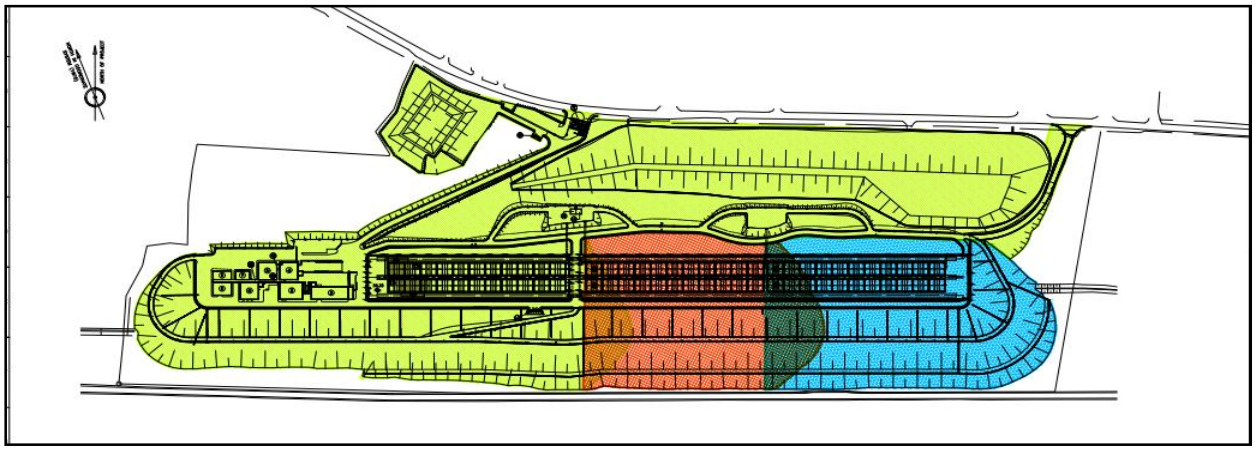


FIGURE 2.2-1 LAYOUT OF THE TRENCH TYPE STORAGE

After filling-in with packages, the space between the containers is filled with an inert material that ensures mechanical stability of the construction, 50cm thick concrete panels are placed and a covering slab is built. In accordance with the best practices, the cells are constructively independent. They are constructed on a loess-concrete pillow which is 5 m thick. The thickness of the fundamental and covering slabs is 60 cm, and the external and internal walls are 50 cm thick. An inspection gallery is construction in the loess-concrete pillow under each row of cells, in which a system for control and infiltration is located. The system includes a pipe link of the pipes coming from each cells and they are gathered in a collective reservoir. A possibility for debit and sample taking control is ensured. The system for control of the infiltrate allows control of the condition of the disposed waste and the facility during its complete life cycle – during the operation, upon closure and during the period of institutional control.

The fundamental slab is 0.60 m thick. The exterior and interior walls are 0.50 m thick and the covering slab is 0.60 m thick. The life cycle of the reinforced concrete construction of the facility is 375 year and it includes the operation, closure and the institutional control of the facility.

On the Radiana site, the modules for disposal are placed on Pliocene deposits which are stable from a geo-technical point of view.

The packages that are subjected to disposal are delivered with specialized vehicles and are placed in the facility with a travel crane. While the cells are filled in, there is a mobile roof over the cells, which protects them from atmospheric and meteorological effects – **Figure 2.2-2.**

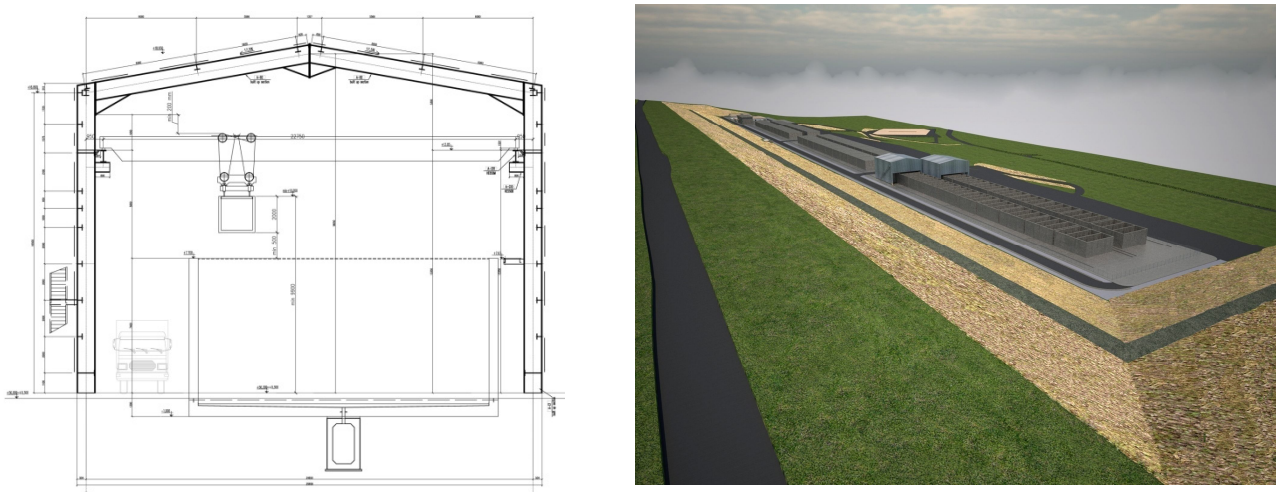
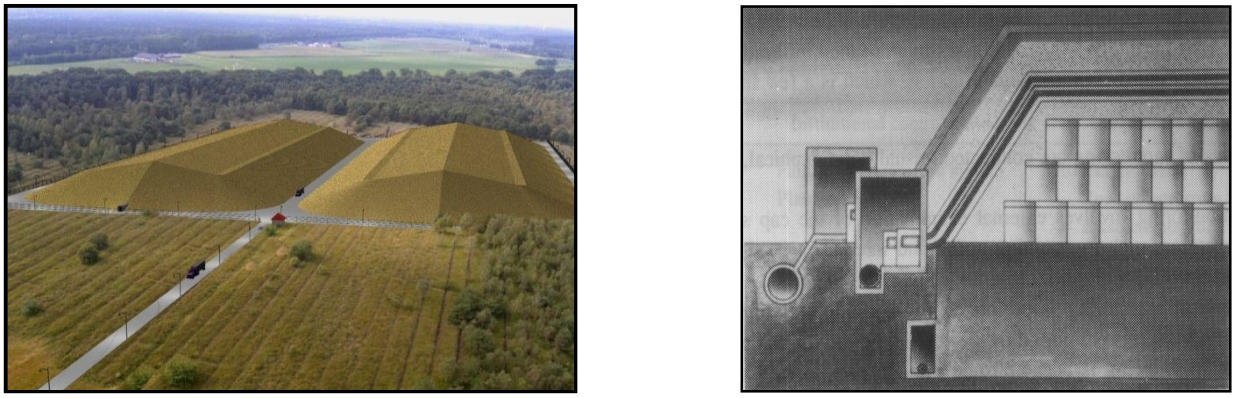


FIGURE 2.2-2 CROSS SECTION OF A MODULE FOR DISPOSAL WITH GANTRY CRANE AND PROTECTIVE COMPARTMENT

Over the filled modules a protective multi-laver cover is built (**Figure 2.2-3**), isolating the disposal facility from surface waters protecting from erosion and denying penetration by animals, and plant roots. The multilayer cover will be constructed of natural materials, once their insulating and protective properties are proven by observation in experimental tests.



APPEARANCE DETAILS OF THE PROTECTIVE COVER

FIGURE 2.2-3 CLOSED MODULAR TRENCH REPOSITORY WITH A MULTI BARRIER PROTECTIVE COVER

The radioactive waste will not be treated and/or conditioned on the NDF site. The low-and intermediate level radioactive waste are delivered to the site conditioned (included in a cement matrix) and packed in reinforced concrete containers (RCC) with external dimensions 1.95 x 1.95 x 1.95 m that are shown on **Figure 2.2-4.**

Presently these containers are stored on the site of the NPP Kozloduy in the Storage facility for storage of conditioned radioactive waste of the State Enterprise "Radioactive Waste" **(Figure 2.2-5).**

FIGURE 2.2-4 REINFORCED CONCRETE CONTAINERS FOR DISPOSAL OF RAW IN NDF

FIGURE 2.2-5 TEMPORARY STORAGE IN THE STORAGE FACILITY FOR STORAGE OF CONDITIONED RAW ON THE SITE OF NPP KOZLODUY

The proposed construction ensures the safety of the disposal facilities with a multi barrier method for deep echelon protection. The multi barrier system for isolation of NDF consists of the following parts:

- **The first engineering barrier** is the waste form which represents a cemented radioactive waste, some of which have been preliminary placed in steel barrels with or without super-pressing. The safety function of the waste's shape (cement matrix in which the waste are placed) is related to the placement of the radionuclides in the solid phase of the matrix, as well as to their detention through adsorption and settling in the highly alkaline cement. The cement matrix is considered a chemical barrier and its safety function continues for thousands of years.
- **The second engineering barrier** is the reinforced concrete container with thick walls, a bottom slab and a covering, in which the cemented radioactive waste is placed, so that the free space between the cement matrix of the waste and the lid of the reinforced concrete container is filled with cement solution, forming a monolithic block. The reinforced concrete container should provide for opportunity for retrieval of the waste until the final closure of the NDF. The safety function is to ensure complete retention through maintaining its mechanical integrity, including the integrity of the holds during the operation of the facility which will continue approximately 60 years. The reinforced concrete container keeps its functions as a chemical barrier for thousands of years.
- **The third engineering barrier** of the facility comprises of is the disposal walls, the bottom slabs and the upper slabs which are made of reinforced concrete. The safety function is to ensure the retention of potentially spread radionuclides from the RAW packages by maintaining the integrity of the cells during the operation of the facility (which continues 60 years), during the period of closure (which continues 15 years) and during the institutional control (which continues 300 years). As mentioned above, the designed life of the facility's constructions is 375 years. The concrete will preserve its functions as a chemical barrier for thousands of years.
- **The fourth engineering barrier** includes external loess-concrete foundation (cushion) and the multi-layer cover. The foundation is not only a barrier against the migration of radionuclides but is also increased the thickness of the unsaturated zone and improves the overall condition of the foundation. The multi-layer protective cover should be made of natural materials (clay, sand, gravel, etc) and its construction should ensure a variety of important safety functions, the main of which include:

→ To optimally minimize the infiltration flow from rain water through the facility's system by making sure the infiltrating hydraulic flow is below 1.5 L/m^2 per year through the modules of the facility;

→ To act like a barrier against external damage of the barrier system from people, animals or plants;

→ To provide protection against continuous erosive agents, such as rain and wind.

- **The fifth (natural) barrier** is carried out by the favourable characteristics of the site.

The proposed approach is similar to the best practices in the EU recommended by the International Atomic Energy Agency (IAEA). The comparative analysis of the repositories around the world and particularly those in the developed countries proves the applicability of this technology. According to data provided by the IAEA the disposal of radioactive waste in repositories of such type is a technology which has proven its qualities – its ability to isolate the radioactive waste from the environment, the safety in terms of people and it will continue being widely used. The technology has proven its applicability on the basis of the operation of a significant number of repositories (over 75), as well as on the basis of the results from the monitoring of repositories which have already exhausted their capacity and have been closed. Thus, many countries plan to construct such type of a repository.

The design of the trench type near surface repository at the Radiana site has been elaborated using the experience gathered during the operation of such repositories, and especially the experience of France, which operates a significant number of nuclear power plants (58 NPPs) and produces electricity mainly by nuclear reactors (over 75% of the produced electricity is due to the operation of NPP) as well as the experience of other developed European countries.

France constructed its first disposal facility for low and intermediate level waste – La Manche – in 1969. The capacity of the disposal facility is 530 000 m^3 of conditioned radioactive waste and between 20 and 25 000 m^3 have been disposed annually. The capacity was exhausted in 1994, the waste disposal was discontinued and a program for its closure, which continued a few years, was implemented. A multi-barrier cover was constructed and now the depository is subjected to institutional control. The long-term monitoring of the disposal facility during its operation and after its closure has proven its safety and the lack of any negative impacts on the environment and people. The disposal facility is located in a wine region famous for its vines that are adjacent to the fence of the facility. The presence of the facility has not affected the production of wine and the tourism in the region. The nearby city of Cherbourg (16 km away) is a historical city and a large number of tourists visit it each year. The presence of the disposal facility has not affected the trade with oysters – there are numerous famous oyster farms located at the Atlantic shore, which export oysters throughout Europe.

The experience gained during the construction and operation of the La Manche depository has been applied to improve the technology used by the new French disposal facility in Centred'Obe which is in operation since 1992. The disposal facility is located in the Champagne-Ardenne area which is famous for its wine production. One of the largest artificial lakes in Europe is located just 20 km away from the facility. Its coast line is 77 km and the lake is a habitat of over 200 species of birds, some of which are extremely rare and endangered. The capacity of the depository is 1 000 000 m^3 and it is designed to dispose about 20 000 m^3 of waste annually for a period of 50 years. Its operation is foreseen to continue until the year 2040. The disposal facility is of a module type and the reinforced concrete cells, which are illustrated in **Figure 2.2-6**, are constructed and closed sequentially. The dimensions of the cells are 25 m x 21 m, their height is 8,5 m and the thickness of the walls is 40 cm. The capacity of each cell is 2 200 m^3 of waste. During the process of filling of the cells they are covered with a mobile roof construction and they will be covered by a protective

multi-barrier cover after the closure of the facility. There is a drainage system below the disposal facility intended to catch the eventual ingress of water. The closure of the filled cells prior to the final construction of the protective cover is conducted through construction of a hydro-isolated reinforced concrete upper slab. A total of 123 cells have been consecutively constructed and closed until the end of the year 2013. The 20-year operation shows that the disposal facility is operated in a safe way which is proven by the fact that the production and trade with agricultural products have not been changed and affected, as well as the visits to the artificial lake.

The technology has been significantly improved during the construction of the Spanish repository El Cabril which is considered a reference technology for a trench type national disposal facility. It was constructed in the 1990s by the Spanish agency for radioactive waste management, called Enresa. The capacity of the disposal facility is 200 000 m^3 and about 3 000 m^3 of waste can be disposed there annually. The area of the depository is 120 hectares. It is located near the city of El Cabril in the Cordoba province, which is a famous tourist destination. The disposal facility is located within the boundaries of hunting and farming reserve. The region in its vicinity is characterized by the production of organic honey and by the olive plantations used for the production of high quality olive oil. A large pig farm is located next to the deposit and it grows pigs and produces the famous Spanish jamón. The jamón production factory is also located near the disposal facility – next to the pig farm. The waste is disposed in reinforced concrete containers with external dimensions of 2.25 m x 2.25 m x 2 m and maximum weight of 24 tones. The disposal facility is modular and during the first stage have been constructed two platforms with a total of 28 cells, each of which has the capacity to hold 320 containers, as shown in Figure 2-2.6. During the operation the cells are protected by a mobile protective roof and a protective multi-barrier cover will be constructed after the closure of the repository. A drainage system to catch eventually infiltrated water has been constructed under the repository. The closure of the filled cells prior to the final construction of the protective cover is conducted through construction of a hydro-isolated upper slab made of reinforced concrete. The disposal facility is operated in a safe way which is proven by the fact that the production and trade with agricultural products in the region (honey, olive oil, the famous local delicacy known as jamón) are further expanded and the production is exported to other countries.

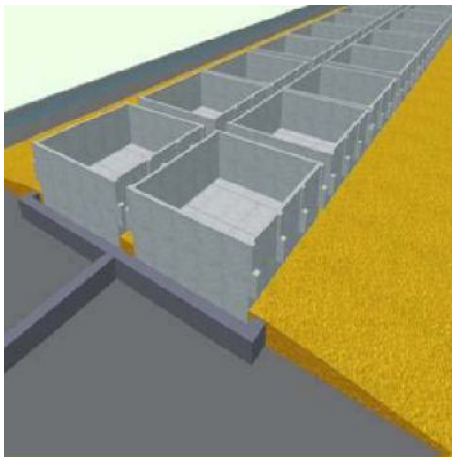
The same technology has been used in the disposal facility in the Czech Republic and in the disposal facility in Slovakia which is currently expanded with funding from the European commission, as well as in the construction of the disposal facility for radioactive waste produced by the Ignalina NPP funded by the European commission and in the construction of the Belgian disposal facility, shown in **Figure 2.2-7.**

Centred'Obe repository, France

El Cabril repository, Spain

FIGURE 2.2-6 CONTEMPORARY FACILITIES OF TRENCH TYPE THAT ARE CURRENTLY IN OPERATION

Appearance of the facility after its closure, according to the design



Appearance of the cells for RAW disposal, according to the design

FIGURE 2.2-7 CONTEMPORARY FACILITIES OF TRENCH TYPE THAT ARE CURRENTLY IN CONSTRUCTION, DIZEL, BELGIUM

The closure of the facility of trench type and the construction of a protective multi barrier cover is also a technology that has been tested in practice and has proven its efficiency, as shown on **Figure 2.2-3** – an example with the closed facility La Manche, France.

2.2.2. TECHNOLOGY FOR THE DISPOSAL OF LOW AND INTERMEDIATE LEVEL RADIOACTIVE WASTE IN TUNNELS

The technology of a tunnel type facility is based on underground parallel tunnel constructions (galleries) with large diameter (6.5 m) and length of 1130 m, the access to which is ensured through horizontal shafts with a small diameter (3.7 m).

The disposal facility consists of 8 parallel tunnel constructions where the RAW reinforced concrete containers (RCC) are placed; each of the tunnels is 1130 m long and has a diameter of 6.5 m. The tunnel constructions for the RCC are placed along the length of the Radiana site, parallel to the road. The tunnel constructions for the RCC are serviced through 3 perpendicular service galleries – transport shaft, service gallery and a ventilation shaft with a diameter of 3.7 m. An experimental shaft is also built. The total length of the mine constructions is 9770 m.

The tunnel constructions are place in a single plane at a depth of 25-30 m under the surface of the terrain in the loess clays at a distance not less than 9 m to the Pliocene clays.

The tunnels for radioactive waste are equipped with hydroisolated multi-layer reinforced concrete lining with a total thickness of 0.45 m. The boy is further consolidated through micro piles and injection silicatization or cementation. The depth of the consolidation is 40 cm according to the authors of the design.

In the bottom part of the tunnel constructions is built a 40 cm concrete slab with drainage ditches for disposal of the potentially polluted waters. The waters are discharged into receivers that are equipped with sample-testing devices. This system for infiltration control functions only during the placement of the containers in the galleries. It is eliminated before the free space is filled in and before the filed-in galleries are closed.

Ventilation is compulsory for the tunnel type repository. Ventilation is provided through the perpendicular ventilation shaft.

The radioactive waste is placed in the disposal galleries through the transport shaft and is delivered to the placement spot in the tunnel construction. The transportation and placements are carried out with a remote-controlled transportation and unloading machine (heavy capacity accumulator car) on a railway. The transportation and unloading machine travels on rails that are dug in the concrete fundament of the transport shaft and in the cement fundament of the galleries for radioactive waste.

The radioactive waste is placed in two rows. The capacity of each tunnel construction is 2150 packages with radioactive waste and the total capacity of the repository is 17200 packages.

The galleries are dug in the ground using the standard mine construction method with tunnel-boring machines. After a period of time allowed for the development of inelastic deformation in the contour of the bored tunnel, the ground shaping it is reinforced by cementation and silicate based treatment.

According to the authors of the project the closure of the disposal facility is done at staged by consecutive filling with fill-in material and sealing of the entrances with standard pneumo- and hydro-transport mechanisation. The drainage pipes of the system for control of the infiltrate are disassembled before the filling-in actions begin.

The filling-in is carried out in two stages. Initially, the whole space is filled in with the main filling material (loess cement or inert material). It is waited for a certain period of time, so that the processes of self-sealing and settling take place, and then the remaining space is filled in with clay

material. This process is carried out through a pipeline which is preliminary mounted in the upper part of the gallery's arch. The pipeline travels on a single rail and consists of sectors that are 2 m long. During the filling in the pipeline is drawn out of the gallery

Figure 2.2-8 shows a cross section of the filled—in disposal module (tunnel) and **Figure 2.2-9** shows the placements of the tunnel galleries and shafts on the Radiana site.

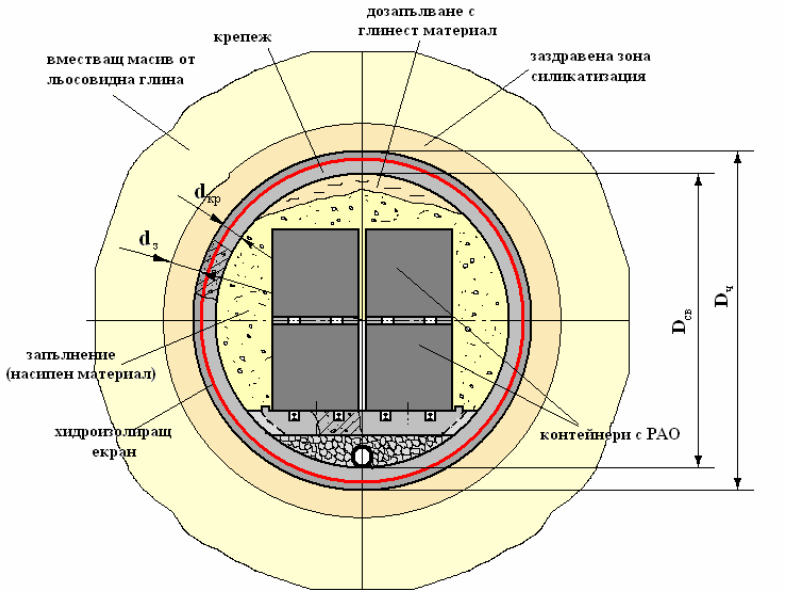


FIGURE 2.2-8 CROSS SECTION OF A TUNNEL TYPE REPOSITORY

The entrances of the tunnel constructions where the radioactive waste are disposed are sealed with clay „plug" and concrete walls. The clay plugs are 30 m construction limited on the two sides with reinforced concrete barriers that are 35 cm thick. Inside, there are 2 such reinforced concrete barriers with thickness of 35 cm that are located at a distance of 10 m each. The space between the barriers is filled in with clay pulp by pumping.

The passive safety systems are the elements of the multi barrier system. The authors of the project mention the following elements as part of the multi barrier system:

- **The first engineering barrier** is the waste form which is cemented radioactive waste, some of which have been preliminary placed in steel barrels with or without super-pressing. The safety function of the waste form (cement matrix in which the waste are incorporated is related to the incorporation of the radionuclides in the solid phase of the matrix, as well as to their retention through adsorption and settling in the highly alkaline cement. The cement matrix is considered a chemical barrier which remains its safety function continues for thousands of years.

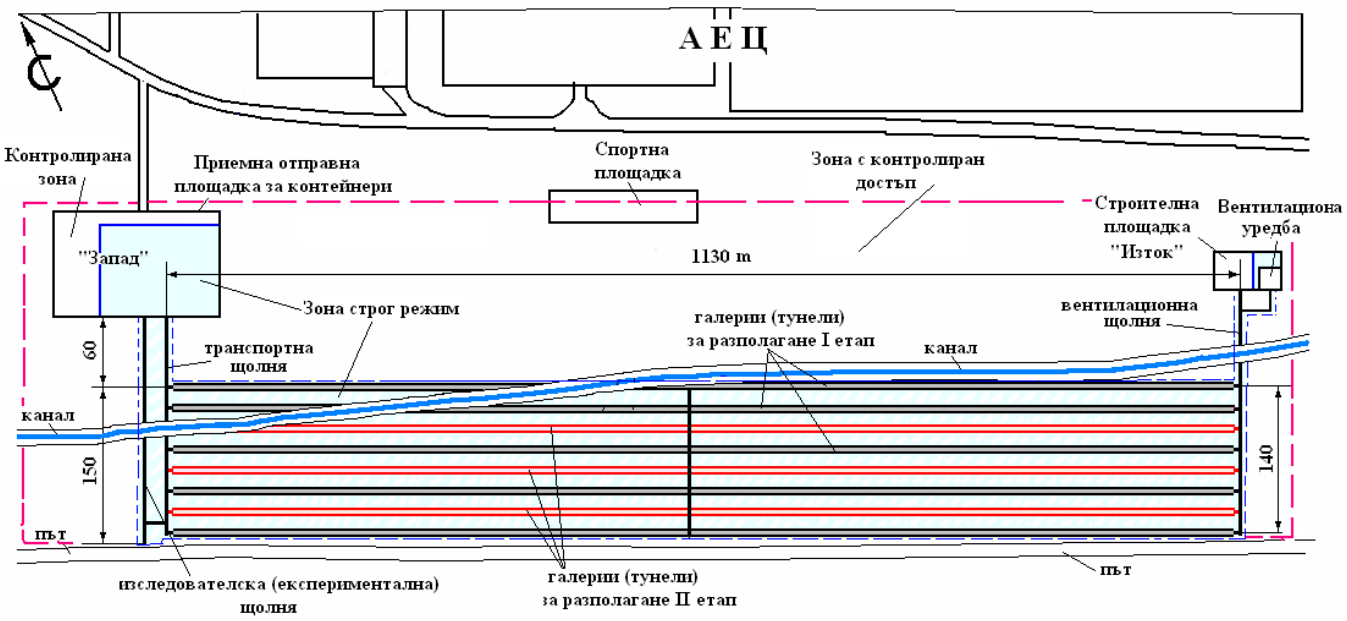


FIGURE 2.2-9 LAYOUT OF A TUNNEL TYPE REPOSITORY

- **The second engineering barrier** is the reinforced concrete container with thick walls, a bottom slab and upper slab, in which the cemented radioactive waste is placed, so that the free space between the cement matrix of the waste and the lid of the reinforced concrete container is filled with cement solution, forming a monolithic block. The reinforced concrete container should provide possibility for retrieval of the waste until the final closure of the NDF. The safety function is to ensure full retention through maintaining its mechanical integrity, including the integrity of the container holds during the operation of the facility which will continue approximately 60 years. The reinforced concrete container keeps its safety function as a chemical barrier for thousands of years.
- **The third engineering barrier** is the lining of the tunnel construction which is made of 40 cm hydroisolated concrete, filling material around the containers and the consolidated zone around the placement gallery which is 40 cm thick. The safety function is to maintain the mechanical integrity of the system for a minimum of 150 years, according to the authors of the project.
- **The fourth (natural) barrier** is carried out by the favourable characteristics of the site. The natural barrier has a filtration coefficient in the range $10^{-5} \div 10^{-6}$ m/s, which is high enough to allow an infiltration hydraulic flow of minimum 50 L/m^2 per year, which corresponds to vertical infiltration of 8.7% average annual rainfall.

The proposed technological solution is a new technology that has not been used so far for disposal of radioactive waste.

On a world scale, there is a limited number of designed or constructed tunnel type repositories for disposal of radioactive waste generated by the operation and closure of nuclear power plants. All tunnel type repositories are built in solid rocks, at a significantly greater depth and with a different type of construction. The radioactive waste are placed in silos with limited volume that are dug from tunnel constructions or in short tunnels that are 50-100 m long which are also built from tunnel constructions.

Auxiliary buildings, described above, will be constructed for the two types of repositories because they are required for the proper functioning of the disposal facility.

The EIA Report presents a comparative analysis of the projects from a structural point of view, justifying the selection of the preferred option for construction of the disposal facility with the aim to guarantee nuclear safety, security and radiation protection, provide information regarding durability and rate of attrition and degradation and aging of materials and structures while in operation, and specifically address the preservation of the mechanical integrity of "RCC" after the closing of the facility.

The EIA Report examines in detail the two alternatives for the realization of the NDF - tunnel and trench type. It provides a side by side comparison of their main characteristics with considerations given to the advantages and disadvantages they each pose in terms of impact on the individual environmental factors and components, and with highest priority placed on safety and minimizing the risk for the public and on-site workers, both during the normal operation of the chosen facility, and in a possible case of accidents.

3. DESCRIPTION, ANALYSIS AND ASSESSMENT OF THE PRESUMED SIGNIFICANT IMPACTS ON THE POPULATION AND THE ENVIRONMENT, IN A RADIATION AND NON-RADIATION ASPECT, RESULTING FROM THE REALIZATION OF NDF, THE USE OF NATURAL RESOURCES, EMISSIONS OF HARMFUL SUBSTANCE DURING NORMAL OPERATION AND IN CASE OF ACCIDENTS, WASTE GENERATION AND DISCOMFORT CREATION

3.1. ATMOSPHERIC AIR

3.1.1. CLIMATE AND METEOROLOGICAL CHARACTERISTICS

The site is located within the moderate continental climate zone characterized by hot summer and cold winter, large annual amplitudes of air temperatures, with rainfall highest in spring and summer and lowest in winter.

The EIA Report contains a detailed analysis of the climate conditions.

3.1.2. ATMOSPHERIC AIR QUALITY

3.1.2.1. NON-RADIOACTIVE POLLUTANTS

3.1.2.1.1. CURRENT SITUATION

According to the Environmental Protection Programme of Kozloduy Municipality for the period 2010–2013 the atmospheric air pollution with dust and non-radioactive harmful gases has been insignificant. The impact of the road transport appears to be sporadic and local. The major source of air pollution is the road transport, and the concrete plants are a potential local source of dust pollution. The concentrations of dust and basic gas pollutants (SO2, CO2, NO2, H2S, methane and non-methane components, O3 and NH3) are far below the allowable concentrations according to the Ambient Air Quality Standards (AAQS). The emissions of dust and non-radioactive harmful gases (except for ozone) is far lower in the village of Harlets – on the land where the Radiana site is located – as compared to the urban areas of the town of Kozloduy.

In the determined areas around the Kozloduy NPP, parallel to the radioecological monitoring, a non-radioecological monitoring is also performed, which covers all major environmental components (atmospheric air, water, etc.) within a 100-kilometer radius of the plant on the Bulgarian territory.

3.1.2.1.2. POTENTIAL IMPACT

The EIA report contains an accurate impact assessment of the investment proposal on the atmospheric air condition during construction, normal operation and closure. During the *construction* period no excessive pollution of the atmospheric air in the region is expected in case the proposed measures are implemented. During the *operation*: NDF does not affect the quality of atmospheric air. During the *closure* period no excessive pollution of the atmospheric air in the region is expected in case the proposed measures are implemented. No significant changes in the microclimate at the territory are expected (this is one of the main factors that determine the biodiversity in the region).

3.1.2.2. ATMOSPHERIC AIR RADIOACTIVITY

3.1.2.2.1. CURRENT SITUATION

Aerosols – the atmospheric air radioactivity is regularly measured at 11 radiation control posts within the 30 km surveillance zone (SZ) and at benchmarking posts within the 100-km zone of the Kozloduy NPP and respectively the NDF site. The summarized data from the performed aerosol monitoring for the period 2009-2013 (Results of the radiological monitoring of the Kozloduy NPP, Annual Report 2013) indicate that the results are within the normal levels **without a change in the gamma background radiation levels** and in the atmospheric radioactivity.

Atmospheric deposition **-** atmospheric deposition is monitored monthly at 33control posts in the 100 km surveillance zone of the plant, the NDF site respectively.

It is generally recognized that the radioactivity of the atmospheric deposition in the area of the NDF site and in the 100 km zone is within the normal background levels.

Gamma ray radiation background **-** The monitoring of gamma-ray radiation background includes measurements of radiation background at the control posts and routes with portable dosimetry devices and fixed thermo-luminescent dosimeters (TLD) within the 2 km PAZ, the 30 km SZ and at benchmarking posts up to 100 km away.

The gamma-ray radiation background at the nearest station on the Romanian riverbank, which is monitored by the Romanian authorities, varies around 0,1 μSv/h according to the EIA Report of Dry Spent Fuel Storage Facility at the Kozloduy NPP site. The stations of the National Automated System for Environment Monitoring (NASEM) of MOEW are integrated in the control stations of the Automatic Information System for External Radiation Control (AISERC) in the 2 km PAZ of Kozloduy NPP and are part of the European Radiological Data Exchange Platform (EURODEP). On this platform the data from all other European countries is available in *on-line* mode and the data from all other European countries, including Romania with data from the stations in the 30-km SZ on the Romanian territory is also included.

The results are fully comparable within the natural background radiation in the area.

3.1.2.2.2. POTENTIAL IMPACT

No impacts are expected on the radio-ecological condition as a result of the IP implementation. No change in the radiation background is expected in the area due to the NDF implementation.

3.2. WATERS

3.2.1. SURFACE WATERS

3.2.1.1. NON-RADIOLOGICAL ASPECT

3.2.1.1.1. CURRENT SITUATION

There are no natural water bodies on the territory of the Radiana site. The nearest rivers are:

- → Danube River –It is in close proximity (4.2 km sought-west from the right bank of Danube river) and of greatest importance to the NPP and to the upcoming NDF construction, flows north of the site.
- → Ogosta River – at a distance of between 10 and 30 km south and southeast
- → Skat River- at a distance of between 10 and 30 km east and south
- → Tsibritsa River – At a distance of between 20 and 30 km west

The Danube River, named "Danube River RWB01"and identified by code BG1DU000R001, flows the north of the site. It is in close proximity to and of greatest importance to the NPP and to the upcoming NDF construction.

All the requirements of the River Basin Management Plan and of the measures established by it apply to these rivers.

In the region there are small dams managed by the municipalities and dams managed by ″Irrigation Systems″ Ltd. The main irrigation channel M-1 passes through the Radiana site which is part of the Shishmanov Val irrigation system. A relocation of the irrigation channel M-1 off the site, designated for the NDF implementation, is forthcoming, for which a project funded by SERAW has been prepared.

Due to the nature of Radiana site (situated on the north slope of the second non-flood plain of the Danube River) surface waters drain away north towards the Kozloduy NPP. In the region a system of drainage channels and facilities was constructed, into which the slope waters, descending the north slopes of the plateaus, are also included. These systems protect the area during heavy rains and prevent lowlands from swamping by being calculated in such a manner so that any surface water increase due to intense rainfall of varying duration. Systems of drainage channels include three types of channels: drainage channels, collector drains and main drainage channel. The waters from the main drainage channel are transferred into the Danube River through dikes by means of pump stations /PS/. These drainage facilities are essential for the adequate protection of the agricultural land in the area and of the existing infrastructure.

The Danube River plays the most important and key role in the existing Kozloduy NPP site as well as in the NDF.

There is no risk of increased underground waters for the Radiana site because it is located on a higher non-flood elevation that the non-flood elevation of the NPP Kozloduy site. This is demonstrated by the results of the hydrological monitoring in the region during a long period of time. The conclusion is also confirmed by the analyses from the stress tests carried out in 2012 in the region of the nuclear power plant site.

The rivers flowing through the territory supervised by the RIEW-Vratsa are subjected to a Program for national monitoring for major physical and chemical indicators, priority and specific pollutants and hydro-morphological elements per quality in accordance with the International Commission for the Protection of the Danube River /ICPDR/ which is included in the National System for Environment Monitoring /NSEM/ implemented by the Executive Environment Agency and the Regional laboratories. Control and operational hydro-biological monitoring is also carried out in accordance with the same program. Order No RD-182/ 26 February 2013, issued by the Minister of Environment and Water, came into effect and it refers to the execution of the monitoring programs in the Danube River as well as to the status monitoring of Ogosta River.

There is tendency towards maintenance and improvement of the quality contents of the water bodies in the territory.

Surface water pollution is widespread in rural and urban areas and is characterized by a complex pollution of nutrients (nitrogen and phosphorus), of some heavy metals, organic pollutants and of their breakdown products.

In general, there is an improvement of the water quality of the Ogosta River in the part of the river that passes through RIEW-Vratsa, and it complies with the project category.

➢ *DRINKING AND DOMESTIC WATER SUPPLY*

There is a public water-pipe going through the site which supplies NPP "Kozloduy" and is property of "Water and Sewage Service" Vratsa Ltd. The drinking water is provided from 3 wells – type "Ranei", situated on the ledge of Danube River prior to town of Kozloduy. They supply Harlets and Glojene villages. For those hydro-installations of Kozloduy municipality is granted a permit for water abstraction according to Water Act of the Basin Directorate for Water Management, Danube region. The build in system is with sufficient capacity of distributing drinking and domestic water to the NPP including the necessities for water with drinking quality during the construction, usage and closure of the NDF. The utilization of that water is going to be according to the legal requirements and contract conditions with „Water and Sewage Service" Ltd – Vratsa.

➢ *SEWAGE SYSTEM*

There is no constructed or existing sewage system on the "Radiana" site. The IP anticipates for its division: for domestic wastewater from the administrative area, for rain and drain water from the disposal cells of the repository which allows the collection of eventually infiltrated water to the containers with the conditioned RAW. The internal drainage system will be built is a way that allows to be accurately determined in which cell with disposed radioactive waste has infiltrated water and to determine the condition of the containers. Discharging of domestic wastewater will take place in the domestic wastewater sewage of NPP "Kozloduy" and on a next stage of the IP it will be determined whether the surface water will be directly led away in a main drain or indirectly through the sewage system of the Kozloduy NPP.

➢ *WASTEWATER – NON-RADIOACTIVE CONTAMINATED*

The Kozloduy NPP is a potential source of pollution of the major water body in this region - the Danube River because the river is used both as a source of industrial water supply and as a receiving water body of the Kozloduy NPP waste waters discharge. The non-radioactive wastewaters of the NPP Kozloduy site are domestic and sewage, industrial and rain water. It is provided that these waters are led away to the existing sewage system of the NPP Kozloduy through the sewage system of the disposal facility. One's own non-radioactive monitoring, a radio-ecological monitoring and control institutional monitoring of the environment have been implemented and is successfully used by the NPP Kozloduy Ltd. The aim of the non-radioactive monitoring is to maintain a correspondence with the normative requirements of the permits issued by the MOE, EEA, Basin Directorate for Water Management, Danube region and RIEW-Vratsa.

3.2.1.1.2. POTENTIAL IMPACT

No significant impact is expected on the receiving water body from the NDF wastewater in the non-radiation aspect, as well a cumulative and transboundary effects. The EIA Report will analyse and assesses the impact on the surface waters during the periods of construction, operation, and closure, and in cases of accidents.

3.2.1.2. RADIOACTIVE ASPECT

3.2.1.2.1. CURRENT SITUATION

According to the results of the radioecological monitoring of the NPP Kozloduy, the technogenic radioactivity in the surface water bodies in the region is within the standard limits, i.e. the values are typical for natural water reservoirs and substantially lower than the established norms. The radioactivity of waters of the Danube River Valley and internal rivers, reservoirs close to the nuclear power plant – Ogosta River, Tsibaritsa River and Kozloduy Dam is monitored. The River Danube is the receiver for the water discharge of the NPP and it is a boundary river, so it is subjected to great attention.

The data about the region show that the waters of the Danube River and the other natural water bodies in the region are not affected by the operation of the power plant. The results are within normal limits for the natural water bodies, i.e. they are significantly below the established norms. The results from the radiological status of the Danube River are also confirmed by the independent studies carried out by the Executive Environmental Agency (EEA) to the MOEW – Reports of RIEW-Vratsa, MOEW on the condition of the environment for the period 2009-2013.

3.2.1.2.2. POTENTIAL IMPACT

In radiological aspect no significant impact on the receiving water body is expected from the NDF waste waters.

3.2.1.2.3. RADIOACTIVE CONTAMINATED WASTEWATER

During the operation period waste waters, which after the radiometric measurements, are classified as radioactively contaminated, will be collected in a tank, will be measured once again in a radiometric laboratory and in the case of an abnormal specific activity they will be transported to the SERAW treatment facilities for radioactivity reduction below the permissible limits of the legislation in force. These quantities are expected to be minimal up to 1 m^3/y.

3.2.1.2.4. RADIOLOGICAL MONITORING

The radiological monitoring of the discharged waste waters from the Kozloduy NPP site is regulated by the program for radioecological monitoring of the plant. The object of monitoring are the waters discharged into the MDC, at control points along the channel until the drainage pumping station /DPS/. The samples are analyzed for technogenic activity concentration.

The results of the performed departmental radioecological monitoring throughout the years are within normal limits.

During the NDF operation the generated minimum quantities of radioactively contaminated waters around 1 m^3/y will be collected separately in a tank and will be transported to the NDF treatment facilities. They will not be discharged into the wastewater sewage network.

No impact is expected on the receiving body of NDF wastewater in a radioalogical aspect.

3.2.2. GROUND WATERS

3.2.2.1. CURRENT SITUATION

An aeration zone and part of the *groundwater body "Porous* groundwater in *Neogene - Lom-Pleven depression"* identified by code BG1G00000N2034 differentiate from the top to the bottom in the hydrogeological profile of the Radiana site. To the north and east–southeast of the site ground water bodies "Porous waters in the Quaternary – Kozloduy lowlands" identified by code BG1G0000Qal005 and *"Porous* groundwater in *Quaternary - between* the *rivers* of *Lom* and *Iskar*" identified by code BG1G0000Qpl023[63] are formed.

The characterization of the water bodies is a requirement of the Water Framework Directive 2000/60/EC on the basis of expert-adopted at national level criteria for the purpose of load and impact evaluation (IMPRESS review). They are borrowed from the criteria, developed by the International Commission for Protection of Danube River (ICPDR), and are adapted at national level. The assessment of the protective cover layers of the groundwater bodies was performed on the basis of an expert judgement of the characteristics of the geological units. The analysis is based on the detection rate of the groundwater body to the ground surface and *loads* caused by *human*

[63] Danube River Basin Directorate-Pleven /DRBD/. Pleven, 2010. Plan for river basins management 2010-2015 in the Danube region

activities on the excavated areas of the groundwater bodies (GWB).There are 3 types of GWBs - with favorable, moderate and adverse impact on the cover layers.

The groundwater body **"Porous groundwater in Neogene - Lom-Pleven depression"** identified by code BG1G00000N2034" consists of 2 layers – upper and lower. Sedimentary layers of the Brusarski Formation form the upper less permeable layer which is composed of clay in alteration with sandy clay, clayey sand and sand. At present the quantitative status of the GWB is **good**[64]. The chemical status of the GWB is **bad**, the one of the protection zone – **good**, according to the data of the performed monitoring in 2013[65], at 2 monitoring points in compliance with Order No 182/26.02.2013 of the Minister of the Environment and Water, namely: at point MP 189 SW near Septemvriytsi, Valchedrym municipality, Montana district – since 2012 the nitrate concentrations exceed the threshold limit values, at point MP 190 SW2 Podem PS near Byala Slatina, Byala Slatina municipality Vratsa region – the annual average nitrate concentration are on the upper limit of the threshold limit value. Regarding the rest of the parameters the water is in good chemical status.

Groundwater body "Porous groundwater of the Quaternary – between the rivers of Iskar and Lom" identified by code BG1G0000Qpl023" is formed at the base of *aeolian deposits* in the massifs between the rivers Lom-Tsibritsa, Tsibritsa-Ogosta and Ogosta – Iskar. At present the quantitative status of the groundwater body is **good**. The chemical status of the GWB and the protection zone is **good**, according to the data of the performed monitoring in 2013 at one monitoring point under Order No 182/26.02.2013 of the Minister of the Environment and Water, namely: at point MP 122 SW Gabrovnitsa PS near the village of Gabrovnitsa, Montana municipality, Montana district, the water is of good chemical status according to the quality standard.

The ground water body "Porous waters in Quaternary – Kozloduy lowlands" identified by code BG1G0000Qal005 is composed of alluvial deposits from the floodplain and the fluvial terrace of the Danube River on the Kozloduy lowland, which are mixed with the alluvium from the mouth section of the Ogosta River. The groundwater body BG1G0000Qal005 according to the Directive 2000/60/EC and art.119 of the Water Act, is designated as a potable water protection zone identified by code BG1DGW0000Qal005. At present the quantitative status of the groundwater body is **bad** (BDWMDR, 2014[2]). The chemical status of the GWB is **good**, the one of the protection zone is **bad**, according to the data of the performed monitoring in 2013, at one monitoring point under the Order No182/26.02.2013 of the Minister of the Environment and Water, namely: at point MP 027 SW P2 Kozloduy WSS near Kozloduy, Vratsa district, the water is of good chemical status according to the quality standard.

The ground water body BG1G0000Qal005 is not present in the hydrogeological cross section of the Radiana site, but due to the hydraulic connection with GWB BG1G0000N2034 it is a potential receiving body of eventually contaminants (non-radiation and radiological) generated at the site.

The described three ground water bodies in the body of the Radiana site and around it, due to their hydraulic connection, form a common ground filtration flow that goes south-southwest to the north-northeast towards the flood plain and the fluvial terrace of the Danube River.

The recharge of the ground waters is from the south, and also from above (through infiltration within the site). The drainage is realized fully into the first above floodplain terrace of the Danube River, which is within the range of the groundwater body "Porous waters in the Quaternary – Kozloduy lowlands" identified by code BG1G0000Qal005 and through it – into the main drainage

[64] DRBD, 2014. Free water quantities of the underground water bodies as of 01.05.2014

[65] DRBD, 2014. Condition of the underground waters at the territory of the Danube region in the year 2013

channel surrounding the Kozloduy lowland along its south periphery. Via this channel all waters entering the Kozloduy lowland from the south, along the low floodplain terrace, are discharged (by pumping) into the Danube River.

The level of the ground waters within the boundaries of the site is established in the range of 50÷30 m above sea level with a gradient of 0,036 in the slope part of the terrain and south of it up to 0,017 in the base of the slope, it is average of 0,028.

In the hydrogeological profile of Radiana site there are: unsaturated (aeration) zone and saturated zone - groundwater body "Porous waters in the Neogene – Lom-Pleven depression" identified by code BG1G00000N2034 with an upper layer in the Brusarski Formation and a bottom layer in the Archar Formation.

According to the information in the Directorate for Water Management, Danube region, at the territory of the Radiana site there are no water sources from ground waters, facilities for drinking and domestic water supply and sanitary protection zones around them.

At a distance of 2-13 km from the Radiana site there are 8 available *drinking-water sources*, for which establishment of sanitary protection zones is envisaged. At a distance of about 10 km are located the main water sources (shaft wells of Raney type) supplying water to the town of Kozloduy and to the Kozloduy NPP; the size of their design sanitary protection zones is planned to be 2500/1500 m.

Ground water bodies BG1G00000N2034, BG1G0000Qal023 and BG1G0000Qal005, which form a common underground filtration flow in the vicinity of the Radiana site and the NPP Kozloduy, are subjected to:

→ monitoring within the frames of the National program for monitoring carried out under Regulation № РД-182/26.02.2013 issued by the minister of environment and waters;
→ NPP Kozloduy's own non-radiation and radiation monitoring.

3.2.2.1.1. PRE-OPERATIONAL MONITORING OF THE GROUND WATER AT THE RADIANA SITE

According to the results of the Kozloduy NPP own non-radiological monitoring during the period 2009-2013 deviations from the quality standard are registered in the groundwater from GWB identified by code BG1G0000Qal005 for the indicators: fluoride - in two boreholes under observation, nitrates - in four boreholes, sulphates - in four boreholes, manganese - in two boreholes and selenium – in one borehole.
In 2013 samples from a total of 121 boreholes, as planned, were taken for a radioactivity study of the groundwater on the industrial site of the Kozloduy NPP. 26 of them are within the territory of Units 1-4, 30 within the EP-2 territory, 26 are in the region of RAWPP and storage facility for RAW, 31 in the area of SFS, DSFSF, RRAW, lime storage facility and temporary storage site for solid RAW outdoors and 5 in the landfill. Sampling and analysis of three newly drilled benchmarking boreholes located on the inlet and outlet of the aquifer in the close proximity to the industrial site began in August 2004.

Water samples from boreholes are analyzed four times a year for total beta activity and tritium content. In 2013, the results of the ^{3}H activity vary between the MDA range (up to 6.8 Bq/l) up to 13.7 kBq/l. The total beta activity is within the MDA range up to 2.71 Bq/l. According to the Program for radiological monitoring of the environment, the water from boreholes with total beta activity higher than 1.0 Bq/l is studied also for radionuclide composition by means of the gamma—spectrometric analysis. The results of the measurements show that technogenic activity of ^{60}Co (up

to 4.50 Bq/l) is recorded in only one drill. Traces of ^{54}Mn are not found. The results for technogenic activity of ^{137}Cs are below the MDA or near background levels, in range of 0.14 ÷ 0.52 Bq/l.

The registered higher activities are in a limited number of boreholes and are well localized. The radioactivity in the remaining boreholes on the site and benchmarking boreholes is very low (around MDA), indicating that there is no impact from the NPP operation on the aquifer in the area.

The quality of water used for drinking water supply must meet the requirements of *Regulation № 9 of 16.03.2009 on the quality of water intended for drinking and household purposes*. Long-term tests of drinking water conducted by Kozloduy NPP within the program for environmental monitoring showed that the levels of total beta activity are significantly lower than the limits under *Ordinance № 9 of 16.03.2001 on the quality of water intended for drinking and household purposes*, and the content of the technogenic ^{90}Sr and ^{137}Cs is many times below the norms under *Regulation on basic norms of radiation protection, 2012*.

The results for total beta activity in drinking water in 2013 are in the range of 0.024÷0.084 Bq/l, with an average of 0.046 Bq/l. The tritium activity varied within <2.2 ÷ 7.6 Bq/l, with an average of 3.6 Bq/l. The values are much lower than the permissible limits for drinking water: 1 Bq/l total beta activity and 100 Bq/l for tritium under *Regulation № 9/16.03.2001*. The results are similar and comparable with those of previous years. In 2013 the ^{137}Cs activity in all analyzed samples is below MDA (<0.5 ÷ <0.9) mBq/l.

The ^{90}Sr activity in drinking water in 2013 varied in the range of<0.5 ÷ 2.4 mBq/l. The results are similar to those of previous years. Hence, the radiation status of the drinking water in the region is not affected by the NPP operation and is in conformity with the sanitary limits according to *Regulation № 9 of 2001* (last amended, SG, issue 15 of 2012).

3.2.2.2. RADIOLOGICAL MONITORING OF THE GROUND WATER AT THE RADIANA SITE

On the Radiana site sampling system for groundwater monitoring is built with 12 boreholes subject to control under the Program for predisposal radiological monitoring of the Radiana site id. No TK.D-142-D3/2012 and "Program for predisposal hydrogeological monitoring of the national disposal facility, id. No HX-PEM-PM-002/01." According to the performed radiological analysis up to June 2014 it can be concluded that no technogenic activity is registered in the groundwater. The results of controlled radiological parameters indicate gamma spectrometry: ^{54}Mn<0.13÷<0.21 Bq/l, ^{60}Co:<0.14÷<0.21 Bq/l, ^{134}Cs: <0.14÷<0.25 Bq/l, ^{137}Cs: <0.15÷<0.23 Bq/l, tritium: <2.2 ÷ <7.8 Bq/l, total alpha activity: 0.016 ÷ 0.281 Bq/l and total beta activity: 0.011 ÷ 0.240 Bq/l.

3.2.2.3. POTENTIAL IMPACT

No negative impacts from the investment proposal are expected during the construction, operation and closure of the NDF in non-radiological and radiological aspects, taking into consideration the envisaged engineering barriers to radionuclide transfer in the environment and the existing unsaturated zone between the disposal facility and the saturated zone *(*aquiferous horizon*)*. This is confirmed by the applied models for migration of radioactivity into ground waters used for the aquiferous horizon in the area of the NDF.

3.3. LANDS AND SOILS

3.3.1. LANDS

3.3.1.1. CURRENT SITUATION

The Radiana site falls within land estate No 000355[66] having area of 129 871 m^2 and within land estate No 000254[67] having area of 309 633 m^2, both located on the Starite Lozya country, on the land of the village of Harlets UCATTU 77548, Kozloduy municipality. The long-lasting land use is "other settlement land". The land estates are state-owned private property.

Acquisition of about 46 ha state-owned land is a prerequisite for the implementation of the Investment Proposal.

The NDF construction presupposes permanent occupation of the land under acquisition as an institutional control period will follow the post-closure period, during which there will be limited site access. The institutional control period will be 300 years following the NDF closure and after its expiration the land use of the site is restored. This will be analyzed and evaluated in the EIA Report.

3.3.1.2. POTENTIAL IMPACT

The site construction, ancillary supporting facilities included, requires *a* change of land use, which will have significant impact on some soils, as they remain under covering for more than 70-80 years, the balance of land use types is altered, etc.

The EIA Report will assess the potential of the land around and within the NDF area to compensate for the potential impacts during the IP's construction and operation and the cumulative impact on them. The following will be put under analysis and evaluation: Status of land within the site, subject to assessment; Land degradation or change of the land category; Existing land users and their adaptation to the sites and site routes; Land degradation and desertification as a result of the IP implementation; Occurrence *of* degradation and desertification of lands and soils; Land and soil contamination during accidents and incidents.

3.3.2. SOILS

3.3.2.1. CURRENT SITUATION

Carbonate chernozem soils of I and II bonity class prevail in the area of the Radiana site according to the Report on the results from the carried out geological, geophysical, engineering and geological, hydrogeologycal and hydrological laboratory studies, MGU Engineering, 2009. According to the Environmental Protection Program of the Kozloduy municipality for the period 2004–2010 no heavy metal as well as metalloid pollution has been registered in the site area. The content of the natural radionuclides ^{238}U, ^{226}Ra, $2^{32}Th$ is within the natural concentration range for the soils in this region, and the content of the technogenic ^{90}Sr и ^{137}Cs in the surface layer (0-30 cm) is within the normal levels and is not much different from the content of these pollutants in the whole Northern Bulgaria which is due to the Chernobyl's residual pollutions. The results of the predisposal monitoring of soils from the Radiana site indicate typical levels for the region. The measured activity levels are typical for the soils in the region, with minimal residual technogenic impact from the cross-border transmission as a result of the accident at the Chernobyl nuclear power plant and depositions from the global transfer of the nuclear tests in the last century.

[66] State property deed № 2319/03.09.2013, confirmed by district governor of Vratsa District

[67] State property deed № 2320/03.09.2013, confirmed by district governor of Vratsa District

3.3.2.2. POTENTIAL IMPACT

During the investment proposal implementation under the EIA Ordinance and EPA, no radioactive contamination of soils that exceed MRLs is expected, because the operation of the NDF will be in accordance with the established principles and regulations for safe management of radioactive waste management facilities and with the safety requirements of the nuclear legislation and IAEA recommendations[68]. During the construction process the impact is associated with the removal of soil layer. The EIA Report contains an analysis and an assessment of the impact on the soils in the region during the construction, operation and closure of the NDF.

The EIA Report assesses in detail the potential of the soil to compensate for the potential impacts during the investment proposal's construction and operation. The following will be put under analysis and evaluation:

- → Status of soil within the site, subject to assessment;
- → Soil fertility change;
- → Degradation and alteration as a result of the IP implementation;
- → Measures for preventing occurrence of degradation and desertification;
- → Need for radiological monitoring of soils;
- → Measures for cleansing land and soils during operation;
- → Measures for cleansing soil in case of an accident;
- → Characterization of the soil status when the facilities are decommissioned;
- → Provided information about the content of natural radioactivity and the main technogenic radionuclides (^{137}Cs и ^{90}Sr) in the soils from 2 km zone of PAZ to 30 km SZ around the NPP, the NDF site included.

Conclusion: The data analyzed so far and upon implementation of all conditions required by experts plus the proposed measures allow the conclusion that the NDF's construction at the Radiana site will not have an additional significant negative impact on the lands and soils both at the NDF site and at the adjacent territories.

During the construction of the NDF the soils will be subjected to real impact from: earth digging; transport. The lands in the neighbouring estates will not be directly affected. No indirect negative impact on neighbouring lands is expected demonstrated by gaseous and dust emissions but in spite of this, special measures are proposed, so that they are minimized through fulfilment of certain requirements (maintaining the construction and transport equipment in order, irrigation of the sites in dry weather, etc.). Lands that may be considered destroyed in the long term are only the lands located on the site, on which facilities, buildings, roads, alleys, etc have been built.

During the operation no negative impacts are expected on the soils in the region. Upon closure the recultivation will have a positive effect on the soils at the site.

3.4. BOWELS OF THE EARTH AND NATURAL RESOURCES

3.4.1. BOWELS OF THE EARTH

3.4.1.1. CURRENT SITUATION

The geological structure of the Radiana site has been thoroughly explored within the frames of the geological explorations for site selection – during the Site characterization phase and during the Site

[68] (International Atomic Energy Agency (IAEA) – the world's centre for cooperation in the nuclear field

confirmation phase as well as a result of the performed geological, geotechnical and hydrological studies and researches during 2011-2012.

The earth bed is composed of Quaternary and Neogen sediments of the Brusarski and Archar Formation.

Archar Formation (Upper Pontian) is located at a depth of about 90÷100 m. It consists of aquiferous sands which are 40-50 m thick in the region of Kozloduy and over 100 m in the region of the Septemvriitsi village. Underneath Smirnenska Formation is located (Meotian-Lower Pontian) which is 200-250 m thick and is composed of calcareous and silty clays, and beneath it, at a great depth the Krivodolska Formation is located which is 120-140 m thick and is composed of aleurite and calcareous clays.

The Brusarski Formation is composed of sandy and aleurite clays and of yellowish-grey sand-coarse aggregates which are 50÷60 m thick.

The Quaternary deposits comprise of fluvial, eluvial, alluvial and elolithic-eluvial formations that are genetically connected with certain geomorphological forms.

The Radiana site is located in the middle of the stable part of the Moezian platform, which is characterized by low seismic activity. The maximum magnitude of earthquakes expected in the sub-region of the site is M_{max}=5.0. The main seismic hazards are the earthquake source zones beyond the borders of the site. According to the shakeability maps for recurrence periods of 1000 and 10 000 years, earthquakes of degree VII according to the MSK-64 intensity scale may strike the region. The strongest earthquakes occurred so far are with intensities above VI.

3.4.1.2. POTENTIAL IMPACT

3.4.1.2.1. DURING CONSTRUCTION

In non-radiological aspect the impact will reflect on:

- → mechanical disturbance of the upper layers of soil during the preparation of the construction site and stage-by-stage implementation of the NDF. This impact will be inevitable, direct, permanent and irreversible, covering the range of the site area, possibly also part of the area around it (for temporary roads, dump for dredge spoil, etc.).
- → possible infiltration into the near-surface layer of soil of small quantities contaminated water, generated in the process of construction activity.

In radiological aspect no impact on the bowels of the earth is expected, due to absence of radioactive sources during construction.

3.4.1.2.2. DURING NORMAL OPERATION AND CLOSURE

In non-radiological aspect: Insignificant impact is expected due to disturbance of the upper part of the surface layer – an excavation for a trench or tunnel galleries.
In radiological aspect: Lack of migration of radionuclides and protection of the environment, including the bowels of the earth, is ensured by the constructed engineering barrier. Thus, no radiological impact on the bowels of the earth is expected.

3.4.2. UNDERGROUND RESOURCES

3.4.2.1. UNDERGROUND RESOURCES

3.4.2.1.1. CURRENT SITUATION

According to the information in the letter outgoing No 92-00-79/15.05.2014 of the Ministry of Economy and Energy, within the Radiana site there are no deposits, which are listed on the national

balance of reserves and resources, and no rights for underground natural resources are granted and there are no permits in effect for prospecting and/or exploration of underground natural resources.

According to the data of the long-term municipal program[69] there are quarries for inert materials in the Kozloduy municipality (at Ogosta River, at the village of Butan and in the river-bed of the Danube River at the town of Kozloduy). At a distance of about 1 km from the village of Kriva bara there are quaternary clay deposits for bricks production, while near the village of Butan there is a developed gas field.

3.4.2.1.2. POTENTIAL IMPACT

These deposits are at a far enough distance from the site and no impact on the environment is expected.

3.4.2.2. INERT MATERIALS /RUBBLE, SAND, ETC.

Rubble and sand will be the inert materials used during construction, which will be necessary mainly during the stage of the NDF construction from the site preparation through the construction of underground and above-ground communications to the main ground construction of buildings and facilities on the site. The supply of the construction site with the necessary quantities of river gravel and sand will be carried out according to the regulated under the WA ballasts within or outside the area.

The site selection for the IP implementation is of significance for the construction road network, the existing concrete plants and for the location of new ones.

3.4.2.2.1. POTENTIAL IMPACT

In a non-radiological aspect it is expected an impact on the reserves of the ballasts which will be appointed in the specific projected related to the facility's construction. The impact is expected to be of a very low limit because the production will only be from renewable reserves of the inert materials under strictly regulated permits for the activity and under control carried out by the authorised authorities.

In radiological aspect no impact is expected on the ballasts because the usage of radioactively contaminated inert materials is impermissible.

3.5. BIODIVERSITY. PROTECTED TERRITORIES AND PROTECTED AREAS

3.5.1. FLORA

3.5.1.1. CURRENT SITUATION

In regards to morphology the Radiana site is situated on the slope near the Kozloduy valley in the altitude range of 35-94 m. At present the region including the Kozloduy NPP site is occupied mainly by agro-landscape and partially by meadow and forest landscapes, as the latter type is also widely distributed on the site designed for the construction of the disposal facility, which is occupied by forest-shrub (forest) vegetation. The forest vegetation on the Radiana site is represented predominantly by artificially planted tree species - mainly acacia, oak, linden, mountain ash, walnut, maple and wild shrubs, among which predominate common hawthorn, common briar, also common privet, dogwood and some others. None of the registered plant species, grasses included, has conservation value.

[69] Community long-term programme for encouraging the usage of renewable energy sources and biofuels in the Kozloduy municipality 2013 - 2023

Radionuclide contamination of the vegetation in the area (as far as it has been established) is due to the Chernobyl accident, according to the Environmental Protection Program of Kozloduy Municipality for the period 2004–2010.

The radiation level of agricultural production is within the typical natural levels.

3.5.1.2. POTENTIAL IMPACT

In the EIA Report after additional field studies the impact on the flora is analyzed and evaluated during the periods of NDF construction, operation and post-closure, as the radiation risk to the flora in the area is additionally analyzed.

During the implementation of the investment plan no significant negative impacts are expected to occur on the widespread natural vegetation in the region, including agricultural production. Only a local impact is expected on a limited area associated with the removal of the plant species growing within the construction site and in the immediate vicinity of it. There are no identified species among them which are put under special protection regime under the Biodiversity Act.

3.5.2. FAUNA

3.5.2.1. CURRENT SITUATION

The fauna in the site, including both the vertebrate and invertebrate ones, consists of species typical of lower (plain) parts of the country, including the Danube plain. The character of the territory of the future NDF site as a habitat determines the characteristics of its animal world - mostly species of woodlands on one hand, and on the other - species of open, grass-shrub habitats, agro-landscape included, can be found due to the bio-corridor function of the territory and the existence of agricultural land adjacent to the selected site.

From the results of the researches conducted to this moment, it can be stated that on the envisaged NDF site and near it, there are no massive habitats of rare and endangered species of the wild fauna - such are registered neither during the conducted field observations, those from previous years included, nor from literature sources.

The livestock production in the region is tested for radioactive contaminants within the Program for the radio-ecological monitoring of the environmental of Kozloduy NPP and the Program for predisposal monitoring of the site designated for the NDF construction. Such quality indicators for radiation monitoring are milk and fish.

Regarding the milk, milk samples from three farms in the area are analyzed – from the town of Kozloduy, the village of Harlets and the town of Mizia. The total average value in 2013 for the three farms was 40.4 Bq/l. According to NCRRP the average annual total beta activity in milk from the region of Kozloduy NPP for the period 1972-1974 was 44.0±1.5 Bq/l. With an average content of potassium per litre of cow's milk of 1.3 g/l, the specific activity of ^{40}K is 40 Bq/l. The cited results make it clear that virtually the whole measured total beta activity is due to the natural isotope ^{40}K. The gamma-spectrometric measurements of milk in 2013, as in previous years, have not registered ^{137}Cs activity, and the results are within the MDA (<0.010- <0.13 Bq/l). In 2013, the activity of radioactive strontium ranges from 4.2 to 19.8mBq/l, with an average of 14.7 mBq/l.

It should be noted that in the past years all the results of such radiological studies regarding the Danube fish caught in the area of BPS (before and after the outlet channels) are much lower than the standards (600 Bq/kg, *Regulation No 10 of the Ministry of Health from 18.04.2002*).

3.5.2.2. POTENTIAL IMPACT

During the site construction of the investment proposal no considerable inflicted damage to the fauna in this region of the country, is expected, as on one hand the territorial scope of the NDF is within a limited area, and on the other, there is no serious or significant risk of destruction of rare and endangered species that are of limited distribution in the country and the Danubian fauna region. In practice, the numbers of the faunal complexes in the area between the village of Harlets and the town of Kozloduy will remain almost unchanged or will not change at all. Impacts on the widely distributed fauna in this region as a result of the construction of investment proposal will have very limited local characteristics in territorial scope - within the site and in the immediate vicinity of it; and will be direct, mild, transient and of average duration and without any cumulative effect due to the absence of investment proposals for other large-scale construction facilities in the area.

During the operation of the investment proposal and its post-operation period no significant negative impacts are expected to occur on the wildlife in the region, including livestock production in the area, as the NDF will be designed and constructed in compliance with the safety requirements laid down by the legislation and with the IAEA recommendations, using the defence in-depth principle and the NDF construction as a multi-barrier engineering facility hampering the radionuclide migration in the environment, as well as operation of the disposal facility according to the principles and rules for safe management of facilities for radioactive waste management.

3.5.3. PROTECTED TERRITORIES AS DEFINED IN THE PAA, SIGNIFICANT NATURAL OBJECTS AND PROTECTED AREAS AS PART OF THE EUROPEAN ECOLOGICAL NETWORK NATURA 2000.

3.5.3.1. CURRENT SITUATION AND POTENTIAL IMPACTS

3.5.3.1.1. PROTECTED TERRITORIES AS DEFINED IN THE PAA AND SIGNIFICANT NATURAL OBJECTS

The area closest to the NDF site, for which the nature protection statute under the Protected Areas Act, is applied and for which information was obtained from the electronic Register of protected areas and protected zones in Bulgaria published on the website of the EEA, is Kozloduy protected area (PA) situated 9.8 km northwest in a direct bee-line of the proposed NDF site.

The PA has a total area of 10 hectares and falls within the territory of the town of Kozloduy, Kozloduy Municipality, a few kilometres from the settlement, within the jurisdiction of RIEW-Vratsa. Order No 913 of 08.04.1972, SG 41/1972 declared the area to be protected area, and Order No 639 of 26.05.2003, SG 60/2003 recategorized it. The purpose of the announcement of the status is to protect the landscape, the result of the harmonious coexistence of man and nature.

The location of the NDF site towards the Kozloduy protected area is displayed in **Figure 3.5-1.**

FIGURE 3.5-1 KOZLODUY PROTECTED AREA

The NDF construction and operation activities don't contradict the prohibitions and restrictions imposed on the territory of the protected area as they will be performed out of it and at a reasonable distance – the activities are in no way envisaged to invade the PA and violate of the adopted regime of prohibited activities in it.

The other protected areas closest to the NDF site are at a distance of between 10 and 30 km from it, and they are Daneva Mogila PA (at a distance of 11,5 km); Koritata PA (at a distance of 11,5 km); Ostrov Tsibar PA (at a distance of 18 km); Ibisha Managed Reserve (at a distance of 24,6 km); Kalugerski Grad – Topolite PA (at a distance of 22,2 km); Kochumna PA (at a distance of 24,6 km); Gola Bara PA (at a distance of 25,1 km).

Single specimens of over 100-year-old trees can be considered unique among the other more significant natural objects within the territory of the Kozloduy Municipality. Their age is between 170 and 300 years. These trees are preserved and they develop normally. The Botev Park historical site, occupying an area of 16.3 hectares, was recommended to become a protected area. Sensitive areas within the territory of the municipality are the so called "wetlands". The nearest "wetlands" around the Shishmanov Val Dam, the islands and the Danube River, are all located at a distance of 5-10 km from the Radiana site. Sensitive areas are also all water bodies within the Danube catchment area, according to the data of the Basin Directorate Water Management Danube River – Pleven.

The NDF construction, operation and the post-operation period won't have a negative impact on the PAA and on other significant natural objects, and this is well-founded in the EIA Report.

3.5.3.1.2. PROTECTED AREAS UNDER NATURA 2000

The selected site for the NDF implementation does not fall within the **European ecological network Natura 2000**. The nearest protected areas of this network are located in the following sequence:

- following protected areas fall within the 10-km zone around the NDF:

- → *Zlatiyata Protected Area identified by code BG0002009 declared under the Directive 2009/147/EC on the conservation of wild birds.* The area is located at 0.45 km south and west from the NDF site.
- → *Kozloduy Islands Protected Area identified by code BG0000533 declared under Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora.* The area is located at 3.8 km north from the NDF site.
- → *Ogosta River Protected Area identified by code BG0000614 declared under Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora.* The area is located at 6 km north from the NDF site.
- → *Skat River Protected Area identified by code BG0000508 declared under Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora.* The area is located at 6.3 km east from the NDF site.

As a separate appendix of the EIA Report[70] is attached the Report on the level of impact of the IP with the subject and purposes for protection of the protected areas (EIA Report)[71] on the mentioned PA.

- ➢ The following PA are located at a distance over 10 km from the boundaries of the site:
  - → *Kozloduy Protected Area identified by code BG0000527 declared under Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora.* The area is located at 12.4 km north-west from the NDF site.
  - → *Zlatiya Protected Area with code BG0000336 declared under Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora.* The area is located at 14.5 km west from the NDF site.

The IP does not have an impact on these two PA.

Map with the location of the zones in the Republic of Bulgaria towards the NDF site is presented in **Figure 3.5-2** .

[70] Article 12 (2), paragraph 6 of the Regulation for the Terms and Conditions for Implementation of an Environmental Impact Assessment

[71] Regulation on Assessment of the Compatibility of any Plans, Programmes, Projects and Investment Proposals with the Subject and Purposes of Preservation of the Protected Areas, SG No 73/11.09.2007, effective as of 11.09.2007, last amended SG № 94/30.11.2012

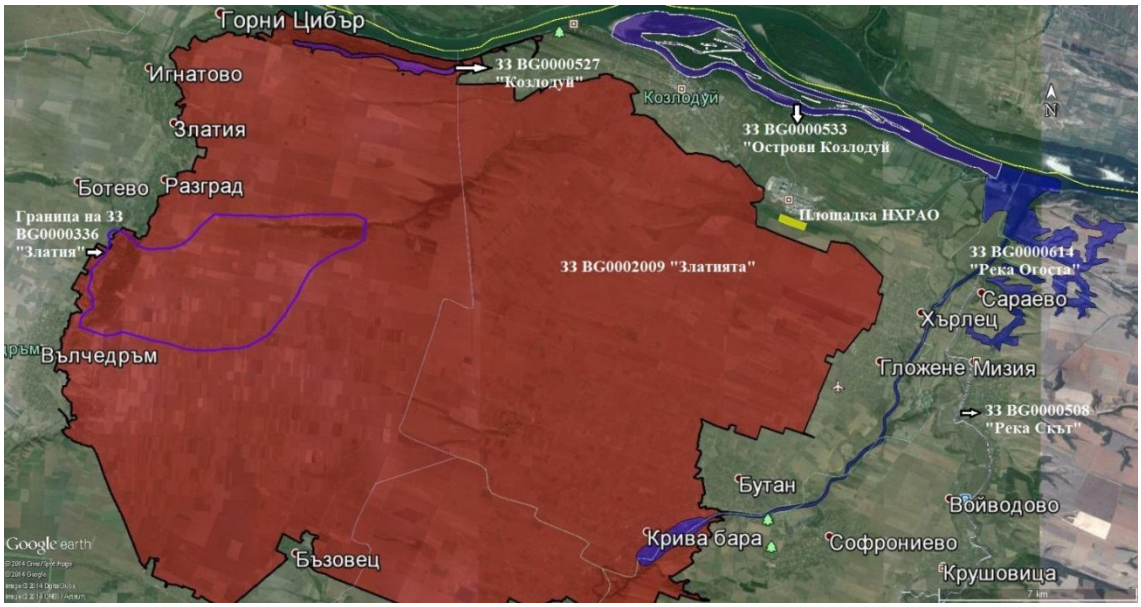


FIGURE 3.5-2 PROTECTED AREAS TOWARDS THE NDF SITE IN THE REPUBLIC OF BULGARIA

In the Republic of Romania, on the other side of the Danube River, at 5.5 km and 18 km west of the NDF site, there are 3 more protected areas under Natura 2000, one of which overlaps the other two. These are:

1. PA ROSCI0045 „Coridorul Jiului" declared under Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora;
2. PA ROSPA0023 „Confluenţa Jiu – Dunăre" declared under the Directive 2009/147/EC on the conservation of wild birds;
3. PA ROSPA0010 Bistreţ declared under the Directive 2009/147/EC on the conservation of wild birds.

Map with the location of the zones in the Republic of Romania towards the NDF site is presented in **Figure 3.5-3**:

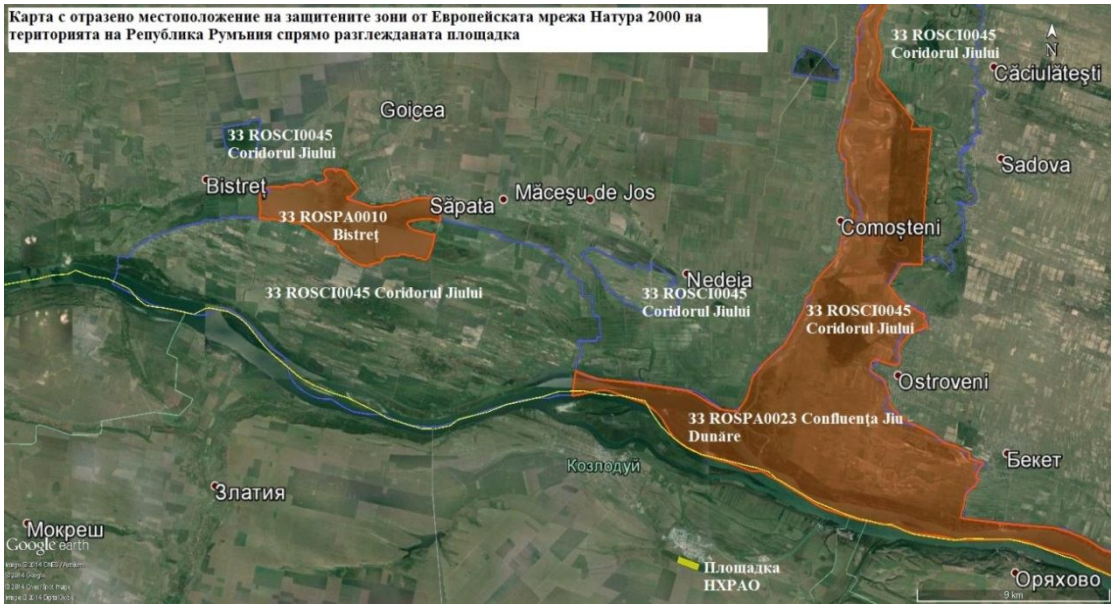


FIGURE 3.5-3 PROTECTED AREAS TOWARDS THE NDF SITE IN THE REPUBLIC OF ROMANIA

3.5.3.2. POTENTIAL IMPACT

Having in mind that the NDF site does not fall within the protected areas of the European ecological network Natura 2000 and does not adjoin such areas, the IP implementation cannot have any impacts on the nearest protected areas, related to damage and fragmentation of their territories, and habitat areas subject to conservation in them, as well as any significant impacts on the target species inhabiting the territories and habitats of these areas. No negative indirect impacts in radiation aspect can be expected, as NDF will be designed and constructed in compliance with the safety requirements laid down by the legislation and with the IAEA recommendations, using the principle of defence-in-depth and the NDF construction as a multi barrier engineering facility hampering radionuclide migration in the environment as well as operating the disposal facility according to the principles and rules for safe management of facilities for radioactive waste management. However, because the site is of public importance, a separate assessment of the degree of impact from the IP implementation on the closest protected areas under Natura 2000 is enclosed in the EIA Report for further completeness and clarity. The assessment includes detailed consideration and evaluation of the potential impacts on habitats and species subject to conservation in these areas as well as proposed measured to minimize the potential impacts on them.

3.6. LANDSCAPE

3.6.1. CURRENT SITUATION

According to the system of the regional taxonomic units in the country's landscape (G= Petrov, Geography of Bulgaria, 1997) the sites and 30 km zone around them fall into the North Bulgarian zonal region of Danube Plain. They comprise of two sub regions: North Danubian lowland sub region (4 Zlatiyski area - Kozloduy municipality and the eastern part of the municipality of Lom and 5 Dolnoiskyrski area - Oriyahovo municipality), and South Danubian lowland sub region: (13 Lutensko-Borovanski area - Byala Slatina, Krivodol, Borovan and Boychinovtsi municipalities).

The landscape is an essential element of the environment into which new structural and visual elements are introduced.

Significant role in determining the landscape structure play the ecological elements relief type, hydro-geographic network, geological foundation and soil, vegetation. The anthropogenic factor affects the character of the landscape not only by the degree of interference, participation and impact, but also by the determination of the main purposes of the landscape area.

3.6.2. POTENTIAL IMPACT

As a result of IP implementation, the character of the landscape of one of the studied sites (the selected one) will change.

The individual components of the landscape are discussed in separate sections of the EIA Report. As a result of the IP implementation the following components of the landscape: geological foundation, soils and vegetation will be affected by the excavation work.

The impact on the geological foundation will be direct, irreversible, negative and local - within the construction site.

The impact on the components of the landscape soils and vegetation will be direct, negativeq reversible, and local.

The construction stage is not associated with any effects on the landscapes of the neighbouring Romanian territories.

The IP operation period is not associated with any negative impacts on the components of the landscape. In case of unforeseen accidents local contamination of all components of the landscape is possible.

Implementation of a project for recultivation of the damaged areas will have a positive impact on the landscape and it will contribute to the better integration of the new structure unit into the existing local landscape.

The visual landscape complexity is characterized by the specifics of the local landscape (anthropogenic-industrial type of landscape) – manifestation of its dominance through the Kozloduy NPP. The visual framework of the future NDF will be defined mainly by road and communication networks and by the various view perspectives from neighbouring areas. The elements that affect the aesthetics and vision are related to the construction process, later to the built object.

The local landscape will be changed, but the main landscape type will not be changed.

The EIA Report assesses the changes in the structure and functioning of the landscapes caused by non-radiological and radiological impacts during the construction, operation, and closure of the facility as well as the cumulative impact.

3.7. WASTE

3.7.1. CURRENT SITUATION

There is no accumulated waste generated during previous activities at the Radiana site.

3.7.2. POTENTIAL IMPACT

The expected waste generated during the implementation of the investment proposal includes generation of nonradioactive and radioactive waste.

3.7.2.1. WASTE GENERATED DURING THE CONSTRUCTION PERIOD

3.7.2.1.1. NON-RADIOACTIVE WASTE

The non-radioactive waste generated during the construction, operation and closure of the NDF are classified according to *Regulation №2 on the classification of waste of 23.07.2014*, promulgated SG 66/08.08.2014. It is expected that during the construction period will be generated non-radioactive household, construction, non-hazardous manufacture and hazardous waste as follows:

Household waste – code 20 03 01 (mixed household waste) generated by the construction workers will be about 37.5 m^3/a. It will be stored in containers at the temporary set locations at the site, will be deposited at the Depot for non-hazardous household and industrial waste at Oryahovo.

Construction waste – code 17 01 07 (mixtures of concrete, bricks, roof-tiles, tiles, faience and ceramic products) – will be deposited at the Oryahovo Regional Depot for Non-Hazardous Waste in a cage for construction waste (a possibility is considered to define a location for a construction waste depot or at the location in the Municipality of Kozloduy). Part of the waste can be used.

The excavated earth masses will be mainly used to fill damaged terrains of the NDF site and around it.

A preliminary balance of the earth masses separated into stages has been prepared. No excessive pollution is expected because of the location where they are generated. Part of the earth masses will be used for vertical planning, for covering layers of the depository (during the different stages of the module closing), for roads, for filling of damaged terrains, etc.

Industrial non-hazardous waste: Paper and cardboard packaging - code 15 01 01 – will be stored at the temporary set locations at the site in a container and are handed over to a company licensed for

recycling after signing a contract. Plastic packaging - code 15 01 02 –will be stored at the temporary set locations at the site in a container and are handed over to a company licensed for recycling after signing a contract. Mixed packaging - code15 01 06 - generated by materials and equipment, they are handed over to a company licensed for recycling after signing a contract.

Hazardous waste: Scavenged oils - code 13 02 05* (non-chlorate motor and lubricating oils, and mineral oils for gear transmissions) generated by the construction machines will be handed over to external licensed companies for neutralization. Burnt mercury and luminescent lamps – code 20.01.21* (fluorescent pipes and other waste containing mercury) – will be temporarily stored in accordance with the regulatory requirements and will be handed over to a licensed company for neutralization after their replacement. Disused electrical and electronic equipment fell in disuse, different from the one mentioned in 20 01 21 and 20 01 23 that contains hazardous components 20 01 35*. They will be temporarily stored in accordance with the regulatory requirements and will be handed over to a licensed company for neutralization after its replacement. Packages which contain residual hazardous substances or which are polluted with hazardous substances with code 15 01 10* (metal and plastic packaging from paints, lacquers, disinfectants, oils, etc).

3.7.2.1.2. RADIOACTIVE WASTE

No RAW is expected to be generated during the construction period.

3.7.2.2. WASTE GENERATED DURING THE PERIOD OF OPERATION

It is expected that during the operation period will be generated household, construction, industrial and limited amounts of hazardous and radioactive waste.

3.7.2.2.1. NON-RADIOACTIVE WASTE

Household waste – code 20.03.01 the mixed household waste generated by the servicing personnel will be about 32 m^3/a. It will be stored at temporary set locations at the site, will be covered with lime or lime chloride and will be transported and deposited.

Construction waste – code 17 01 07 (mixtures of concrete, bricks, roof-tiles, tiles, faience and ceramic products) will be generated accidently in cases of repair works during the operation. It will be deposited at the Oryahovo Regional Depot for Non-Hazardous Waste in a cage for construction waste (The Municipality of Kozloduy is specifying a possibility to appoint a terrain within its boundaries for disposition of construction waste).

Industrial non-hazardous waste: code 15 01 01 (paper and cardboard packaging) and 15 01 02 (plastic packaging) – will be handed over to a licensed company which has a signed contract with the SE RAW for further treatment; Mixed packaging code 15 01 06 - non-hazardous industrial waste will be handed over to a licensed company for further treatment.

Hazardous waste: Burnt mercury and luminescent lamps – code 20.01.21* - fluorescent pipes and other waste containing mercury - They will be temporarily stored in accordance with the regulatory requirements and will be handed over to a licensed company for neutralization after their replacement; Disused e*lectrical and electronic equipment fell in disuse,* different from the one mentioned in 20 01 21 and 20 01 23 that contains hazardous components 20 01 35*. It will be temporarily stored in accordance with the regulatory requirements and will be handed over to a licensed company for neutralization after its replacement.

The EIA Report contains a proposal for the temporary storage and subsequent treatment of the generated waste in accordance with the requirement of the current legislation in force.

3.7.2.2.2. RADIOACTIVE WASTE

During the operation period - it is expected that small amounts of radioactive waste are eventually generated, up to 1.5-2 m^3/y, established after radiometric control:

- Personal protective equipment (protective clothing, shoes, and gloves) – maximum amount of about 0,05 m^3 per year – they will be treated in the already existing installations of SD RAW.
- Minimal quantities of solid waste (cotton wool, filtrating paper, gloves, soiled working clothes, laboratory samples, glassware, and tools) will be treated in the already existing installations of SD RAW.

3.7.2.3. WASTE GENERATED DURING THE PERIOD OF CLOSURE

Nonradioactive waste – mainly construction waste and limited amounts of domestic and non-hazardous manufacture waste. After the closure the existing buildings will be used for the needs of the institutional control. Certain amounts of construction waste will be generated during the final sealing of the modules and the setting of the systems in a state of institutional control. These amounts are at this point estimated at 150 m^3.

The amounts of the construction waste cannot be defined at this stage and their treatment will be conducted in accordance with the Plan for construction waste management – after checking its radioactivity and proving it is not polluted – disposal and/or recycling.

Radioactive waste – it is expected that no radioactive waste will be generated but certain types of waste will be controlled for radioactive contamination and will then be classified and treated.

The EIA Report contains detailed characteristics of the nonradioactive and radioactive waste generated during the implementation of the investment proposal sorted by types and periods – construction period (household, construction, surplus earth masses, industrial, hazardous, radioactive), operational period (household, construction, industrial, hazardous, radioactive), closure period (construction, radioactive), as well as in cases of accidents during the NDF operation. The proposed waste management practices are assessed and relevant recommendations are provided.

Prognosis and assessment of the impacts of the waste generated by the realization of the NDF – during the construction only non-radioactive waste will be generated and their treatment will be in accordance with the normative requirements. The waste will not be deposited at the site and will be collected and transported for further treatment immediately after the generation. The waste is expected to have a negative impact on the NDF's site only during its construction, i.e. the impact is limited and will be discontinued after the construction is completed.

During the operation and closure periods the non-radiation waste is mainly household and is treated in accordance with the normative requires. The waste does not have a negative impact on the environment.

3.8. HAZARDOUS SUBSTANCES

3.8.1. CURRENT SITUATION

At the territory of the Radiana site are stored no hazardous substances generate during present and past activities (storehouses for pesticides and other hazardous substance, storage tanks and other containers with oils, petroleum products and other hazardous substances).

3.8.2. POTENTIAL IMPACT

Hazardous substances and mixtures will be used under strict control and management during the construction, operation and closure of the NDF. Measures for the safety storage of the waste at the site are foreseen and these measures are in conformity with all regulatory requirements.

When the regulatory requirements for operation with hazardous substances during the different stages of investment proposal implementation are observed and considering their limited amounts, no negative impact is expected over the various environmental components and facts, the personnel at the site and the population in the region.

The EIA Report contains an assessment and proposes recommendations for safe operation with hazardous substances used during the period of construction, operation and closure of the investment proposal objects.

The assessment of the potential impact of the IP is be based on an analysis of provided in the investment proposal values regarding the amounts of the hazardous substances and mixtures compared to the quantitative values provided by the normative documents[72,73].

3.8.2.1. DURING THE CONSTRUCTION PERIOD

The following substances will be used during the construction: ***Fuels*** – They are required for the operation of the construction equipment. Measures for reducing the impacts in cases of limited accidental spills are provided. ***Lubricants*** - It is expected that during the construction various types and amounts of oils and lubricants will be used – machine and compressor oil, turbine oil, motor oils, various types of lubricants. As a general rule, they come with the relevant certificates and other documents, such as safety information sheets that point their correct storage, usage and treatment. Other substances: concrete, lime, paints, varnishes, etc.

3.8.2.2. DURING THE OPERATION PERIOD

Liquid fuels - they are required for the operation of diesel generators, for heating, etc. Certain amounts of diesel fuels, gasoil and liquid fuels will be required. **Fuels and lubricants** - It is expected that during the NDF operation limited amounts of oils and lubricants will be used – machine and compressor oil, turbine oil, motor oils, various types of lubricants. As a general rule, they come with the relevant certificates and other documents, such as safety information sheets that point their correct storage, usage and treatment. **Chemical substances and mixtures** – No chemical reagents are used in the main technological process. Limited amounts of these substances are used in laboratories for laboratory analyses.

All required chemical substances and mixtures will come with safety information sheets, which is a prerequisite for their environmentally-friendly storage and usage.

All hazardous chemical substances and mixtures /mainly fuels and lubricants/provided for usage will described and analyzed in the EIA Report in terms of their possible impact on the environment. The prognostic assessment will be based on the properties and composition data provided in the safety information sheets, as well as on the existing practice for the management of the substances, including instructions, procedures and introduced good practices.

Upon observation of all instructions related to the usage of chemical compounds and mixtures, classified as hazardous compounds and those under the Safety, labour hygiene and fire safety, as well as upon observation of the requirements for their treatment, no negative impacts are expected

[72] Law on reducing the harmful impact of hazardous substances and mixtures

[73] Regulation on the terms and procedure for storage of hazardous chemical substances and mixtures

on the environment and not health risk is expected for the object's personnel and the population in the region.

3.9. HARMFUL PHYSICAL FACTORS: NOISE, VIBRATIONS, IONIZING AND NON-IONIZING EMISSIONS

3.9.1. NOISE

3.9.1.1. CURRENT SITUATION

The site for the NDF construction will be located close to the Kozloduy NPP site. During the inspection of the place it has been found that currently there are no sources of noise at t the Radiana site. The sources of noise in the region are the vehicles on road II-11 for Kozloduy, the road leading to the main portal of the NPP and the production site of the power plant but the industrial activity at the Kozloduy NPP Site is not a source of excessive noise levels at the territory of the town of Kozloduy because of the distance between the two (over 2 km).

At the moment no activities taking place at the territory of the Radiana site cause abnormal noise.

3.9.1.2. POTENTIAL IMPACT

The noise emissions in the environment are related to the three main stages of the investment proposal implementation – construction, operation and closure.

Construction - The main source of noise emitted in the environment will be the construction equipment and the vehicles used for delivery of the necessary materials and equipment as well as for transporting the waste. According to data provided by the National Centre of Public Health and Analyses, Sofia and other literature sources the levels of the noise emitted by the traditionally used machines and equipment are between 80÷105 dBA. The construction equipment will be concentrated on the site. The construction works taking place at the site will not emit noise affecting the settlements in the region because of the big distances. The noise emitted by the construction equipment will affect the industrial zone of Kozloduy NPP. The noise emitted by the means of transportation servicing the construction will affect the settlement in the region that they will travel through but the impact will not be significant.

Operation - The main source of noise emitted in the environment will be the main and supplementary technological equipment and the means of transportation used for the construction need. The noise emissions in the environment will be defined on the basis of passport data for the noise characteristics of the foreseen equipment. The NDF operation will not emit noise affecting the settlements in the region because of the big distances. The noise will affect the NDF site. The noise emitted by the means of transportation servicing the operation needs will not affect the nearby populated areas.

The EIA Report proposes measures for minimizing the noise impact during the construction and operation periods.

3.9.2. VIBRATIONS

3.9.2.1. CURRENT SITUATION

There are no technological vibrations in the environment emitted by the Radiana Site.

The means of transportation used for the NDF operation needs are not sources of vibrations in the environment.

3.9.2.2. POTENTIAL IMPACT

The construction equipment used during the construction period is not a source of vibrations in the environment. Vibrations are a factor affecting the working environment when certain types of machines, equipment and means of transport are used.

3.9.3. NON-IONIZING RADIATION

3.9.3.1. CURRENT SITUATION

The existing parameters of the non-radiological risk energy sources at the Radiana site are determined by the Kozloduy NPP operation. The parameters of the electromagnetic fields do not exceed the allowable hygiene standards. The requirements for establishing hygiene protection zones in the vicinity of the substations and high voltage power lines have been met according to the Report on the environmental impact assessment for the Dry spent fuel storage facility in NPP Kozloduy, 2005.

3.9.3.2. POTENTIAL IMPACT

At this stage of the investment proposal it is assumed that the NDF's contribution to the non-radiological energy factors will be insignificant both in respect to the NDF personnel and the population.

3.9.4. IONIZING RADIATION

3.9.4.1. CURRENT SITUATION

At the moment there is no ionizing or radiological radiation in the vicinity of the Radiana Site. According to the reports from the departmental radio ecological monitoring the gaseous emissions from the ventilation pipes at the Kozloduy NPP site put under control do not alter the radiation background.

Non-destructive metal control is periodically conducted the supervised area and controlled area of the Kozloduy NPP. These technological tests of the equipment have radiological radiation from a gamma-source in the direction of the ray. A special program for radiation protection is implemented during these brief periodical tests.

In the annual reports for the departmental radio ecological monitoring issued by PPT and MoEW it has been proved the lack of impact outside the fence of the site from the radiological emissions caused by the operation of the Kozloduy NPP reactors.

The reinforced concrete containers for the RAW are licensed and protect against ionizing radiation up to a certain boundary of the dosage's power.

A program for prior operation monitoring is conducted at the site of the future NDF. The results from the radiometric measurements of different types of samples will allow the establishment of the impact of the future operation on the radio ecological condition of the environment.

3.9.4.2. POTENTIAL IMPACT

NDF is a facility intended for disposal of containers with conditioned RAW, so that uncontrolled migration of radionuclides is prevented and its isolation from the biosphere is ensured. All activities related to the RAW's conditioning are and will be conducted in the workshop for RAW treatment, Specialized Division "RAW – Kozloduy" to State Enterprise RAW. At the NDF are accepted for diposal low and intermediate level RAW category 2a conditioned through a technology approved

by the facility's operator and generated during the NPP operation, decommissioning of the NPP units and other waste from nuclear applications in the fields of science and medicine.

The ionizing emissions during the whole technological process at the NDF comes from the processed solid low and intermediate level RAW placed in the containers. For this purpose the dose limitation is achieved through limitation of the radioactive contents in a single packaging and for the whole disposal facility:

- → The maximum activity in a single package is limited to 1.1.E+11 Bq. The specific activity of ^{137}Cs is limited to 1.E+11 Bq.
- → There are also limitations in the concentrations of the long-living alpha-emitters, such as the isotopes of uranium, plutonium and americium. Their concentration is limited to 4000 Bq/g and an average of 400 Bq/g for the whole facility.

It is expected that the personnel working controlled zone of the NDF to accept, control and transport the waste packages to be classified as category A personnel for which are applied all rules and limitations specified in the *Regulation on the Basic Norms of Radiation Protection* and the *Regulation on radiation protection during activities with sources of ionizing radiation*.

The Instruction for Radiation Protection will contain the measures and control over ionizing radiation at the NDF's site and the measures for radiation protection of the personnel. In accordance with the Instruction for Radiation Protection, it will be conducted a Programme for monitoring of the radiation parameters caused by ionizing radiation in the controlled zone of the NDF and the site.

It is not expected to be reached the limitations set in the *Regulation for radiation protection during activities with sources of ionizing radiation* and the *Regulation for safe management of radioactive waste* issued by NRA. The radiological conditions and the risks for the personnel and the population are expected to be significantly lower than the ones set in the above-mentioned Regulations.

The EIA Report contains a detailed analysis of this limitation and an assessment of the personnel's safety, and the methods and means for minimizing the consequences caused by the normal operation of the NDF.

During the period of closure is planed the construction of a multi-layer cover and the decommissioning of the buildings that are not necessary for the following institutional control.

During the institutional control a monitoring of the site will be ensured. No other activities are planned with the exception of minimum technical servicing or repair works, if such are necessary. After the completion of this period the disposal activity is limited to allowing the site to be used without any radiological limitations. No ionizing radiation caused by the disposed RAW containers is expected out of the site. According to article 8 (2) of the *Regulation for safe management of radioactive waste* the annual effective dose from the NDF after closure should not exceed 0.1 mSv/a. This limit is a result of the reduced power of the dose from external gamma radiation of 0.114 μSv/h.

3.10. HEALTH AND HYGIENE ENVIRONMENTAL ASPECTS AND RISK TO HUMAN HEALTH

3.10.1. CURRENT SITUATION – HEALTH AND HYGIENE ASPECTS

3.10.1.1. DEMOGRAPHIC CHARACTERISTIC

The Radiana site is situated at the territory of Vratsa region, Kozloduy municipality which consists of the following populated areas[74]: the town of Kozloduy (12775 inhabitants), the village of Harlets (2013 inhabitants), the village of Glojene (2733 inhabitants), the village of Butan (2850 inhabitants) and the village of Kriva Bara (418 inhabitants).

The average population density in the municipality for the year 2012 is 74.4 people/km^2 – it is comparable to the average population density in this country, but it is higher than that in the Vratsa region (50.2 people/km^2)[75].

Ten municipalities are located within the administrative boundaries of the region – Vratsa, Borovan, Mezdra, Krivodol, Hayredin, Mizia, Byala Slatina, Oryahovo, Roman and Kozloduy with a total of 123 populated areas (8 towns and 115 villages) part of which are located within the 30-km area around the site appointed for the implementation of the investment proposal. The population in the 30-km zone of the Kozloduy NPP is 65 994 people (Population Census, 2011)[76].

The demographic development only in the Kozloduy municipality is specific and at the same time it is characteristic of such populated areas with big industrial capacity. On one hand, this is due to the migration of part of the population (common for the agricultural regions) towards the big cities, as in the case – from the villages towards the Kozloduy town.

3.10.1.2. STATE OF HEALTH

Data provided by the National Cancer Registry 2013[77] show that in the year 2011 in Bulgaria were registered cases of malignant diseases (total for all locations, with the exception of non-melanoma skin cancer) and it is determined that the morbidity in Bulgaria is lower than the average in Europe. Against that background, the population of the Vratsa region has indicators for standardized morbidity that are below the average values for the country and is in the final ten among the 28 regions in the country. No death cases caused by inborn abnormalities were registered in the Vratsa region in the year 2012.

In *conclusion,* it should be noted that based on the above-mentioned demographic and social and economic tendencies the investment proposal has a positively expressed health and social significance for, on one hand, achieving an efficient control and safe RAW management and, on the other hand, creation of new jobs.

The EIA Report analyzes the conditions and the achieved safety requirements when choosing a technology and constructive solutions, including from the point of view of the health and hygiene environmental aspects and the risk to human health.

3.10.2. POTENTIAL IMPACT AND ASSESSMENT OF THE RADIOBIOLOGICAL RISK

During the construction and operation, the EIA Report assesses the impact of the site's operation on the health and hygiene conditions in the nearby populated areas as well as other factors that are subjected to health protection against air pollution with fine dust particles (FDP) of up to 2.5

[74] The population data are for the year 2012 – NSI, http://www.nsi.bg/bg/content/

[75] NSI. Statistical year book. 2013

[76] NSI data (2011 census) http://www.nsi.bg/bg/content/3077/

[77] Specialized hospital for active treatment in oncology. Cancer rate in Bulgaria, 2011. Volume XXII. 2013. Paradigma Publishing House, pp. 164

microns and up to 10 microns, pollution with harmful gaseous emissions, noise and ionizing radiation.

The EIA Report reviews all factors of the working environment that are risky to the human health, incuding for the workers, as follows: Chemical factors; Physical factors; Radiation factors; Non-ionizing radiation, etc.; Psychological and sensory factors; Social factors.

The anticipations about the health and hygiene positions, which are based on studies of design materials, collected information and other similar sites, are that the above-mentioned risks are practically inexistent or are limited to the defined permissible concentrations and levels of reference.

3.11. RADIOBIOLOGICAL RISK

3.11.1. CURRENT SITUATION

The NDF's construction and operation of the NDF may potentially have an impact on the population living in the nearest population area – the town of Kozloduy. A specific "critical group" of this population will be formed on the basis of the *Regulation on basic norms of radiation protection, 2012*. At the moment, the population living in the vicinity near the Radiana site is subjected to a potential radiation impact caused by the operation of the Kozloduy NPP.

For the year 2013 and on the basis of the meteorological data for the region, the maximum individual effective annual dose for the population in the SZ of the gaseous and aerosol emissions (RNG+LLA+^{131}I+^{3}H+^{14}C) of the Kozloduy NPP is estimated at 0.877μSv/a the maximum values are estimated in south-southeaster direction at a distance of 1.4 km, for the age group 7-12 years.

The collective effective annual dose is estimated at $1.97.10^{-2}$ man.Sv/a. In the year 2013 the estimated maximum individual effective dose for the population in the 30 km SZ combining the gaseous, aerosol and liquid emissions in the environment is 4.75 μSv/a. This is hardly 0.2% of the radiation from the natural background radiation in the country (2330μSv/a). During the last 5 years, the estimated maximum individual effective dose for the population that exceeds the background and is caused by the operation of the Kozloduy NPP varies between 4 ÷ 7 μSv/a, which, according to article 8 of the Regulation on basic norms of radiation protection, 2012, is really low and under the levels that require regulation of the activity.

The data have been verified against results provided by the NCRRP/MH and are completely comparable to the values of other power plants in the EU and around the world (UNSCEAR and EURATOM reports). The model and mathematical assessment programs are verified and validated; they are based on the CREAM[78] methodology approved by the EU and indicate the characteristics in the region.

The EIA Report assesses the radiobiological risk with the usage of the most recent risk coefficients provided in Publication 103 of the ICRP and the expected doses for the personnel and the population as a result of the NDF's operation. The social acceptance of the risk is valid mainly for the boundary values. The ICRP proposes the boundary acceptance to be 1 case per 1 000 000 people for a period of one year (10^{-6}). This is a theoretical value and is unfeasible from a practical point of view.

The EIA Report compliments the information related to the risks of occurrence of exterior and interior for the facility events that disturb its safety functions.

[78] **CREAM- C**onsequences of **R**eleases to the **E**nvironment **A**ssessment **M**ethodology, Radiation Protection 72 – Methodology for assessing the radiological consequences of routine releases of radionuclides to the environment

The significance of impacts on the environment is analyzed in different scenarios for occurrence of events, accidents and/or failures at the site of the facility, as well as of analyses in cases of potential impact caused by failure of facilities outside the site.

3.11.2. POTENTIAL IMPACT

Since a "zero" contribution towards the dose pressure exceeding the background is expected for the population in the surveillance zone, no impact is expected to be caused by the implementation of investment proposal on the radiobiological effects related t to the radiation risk to the population. It is expected a lack of risk from deterministic effects and low risk of stochastic (non-threshold) effects.

3.12. TANGIBLE AND CULTURAL HERITAGE

3.12.1. CURRENT SITUATION

According to the Environmental Protection Programme of the Kozloduy municipality for the period 2004–2010 in the Kozloduy municipality there are no natural monuments and physical and geographic formations of significance in terms of conservation on a national scale. The letter of the National Institute for Preservation of the Tangible Cultural Values[79] does not contain any information on the availability of tangible cultural heritage, which could be influenced by the investment proposal. The Botev Pat historical complex is situated at the territory of the municipality, which includes the following: Botev Park, Mateev Geran, Popovo Hanche and Boteva aleya. At about 1 km from the village of Harlets the unexplored Augusta Roman excavations are located, the explorations were renewed in 2003. Along the Western part of the Kozloduy municipality there is situated the Shishmanov Val hill, which was a border of the Second Bulgarian state.

Close to the site there has been registered a Thracian tumulus necropolis[80]. According to the requirements set out in Article 161, paragraph 1 of the *Cultural Heritage Act* (promulgated SG issue 19 from 13th March 2009, amended SG issue 45 from 15th June 2012), preliminary archaeological explorations are carried out (on-site explorations) so as to determine that the excavations will not affect or damage the tangible cultural heritage. The Regional Historic Museum – Vratsa performs the explorations as needed with the assistance of the SE RAW.

3.12.2. POTENTIAL IMPACT

After the additional monitoring is carried out and the protective archaeological explorations are finalized, the results will be analysed in the EIA Report and recommendations for the cultural heritage preservation will be provided, if necessary.

If the measures provided by the Cultural Heritage Act, which are described above, are followed, potential negative impacts will be prevented on already existing and registered tangible heritage as well as on tangible heritage that is not registered yet.

3.13. SOCIAL AND ECONOMICAL ASPECTS

3.13.1. CURRENT SITUATION

The Kozloduy municipality features specific demographic development typical for settlements with established great industrial capacity – increased number of population as a result of:

[79] Letter from the National Institute for Preservation of the Tangible Cultural Values, Ministry of Culture, Outgoing No 1316/09.06.2009

[80] Letter from the Regional Historic Museum, the town of Vratsa, Outgoing No 27/03.06.2009

- ✓ natural migration from the villages to the big towns, in this particular case, from the villages to the town of Kozloduy;
- ✓ migration of construction workers and specialists from all parts of Bulgaria for Kozloduy NPP construction and servicing.

The age distribution of the population is also determined by the big industrial site, Kozloduy NPP. The unemployment coefficient for the Kozloduy municipality is lower than the average one on a national scale.

The NDF construction and the activities at the SE RAW facilities which allow additional jobs creation as well as new qualification of part of the personnel dismissed from the closed 1-4 units of the Kozloduy NPP have a positive effect.

The NDF construction and operation will lead to additional jobs creation during the periods of construction, operation and closure, hence a positive social effect is expected.

3.13.2. POTENTIAL IMPACT

The EIA Report contains sufficient topical data concerning the social and economic conditions in the region as well as an analysis and assessment of the potential impact of the investment proposal for NDF implementation.

4. SIGNIFICANCE OF THE ENVIRONMENTAL IMPACT, ASSESSMENT OF THE STEADY ENVIRONMENTAL IMPACT DUE TO CONSTRUCTION AND OPERATION OF THE INVESTMENT PROPOSAL OBJECT, WHICH COULD TURN OUT TO BE SIGNIFICANT AND SHOULD BE CONSIDERED IN DETAIL IN THE EIA REPORT

4.1. NATURE OF THE IMPACTS

4.2. ASSESSMENT OF THE POTENTIAL IMPACTS

The impact upon environment and people due to the NDF construction and operation will be within the range of the limits as set out in the Bulgarian and international regulations for construction and operation of civic buildings and RAW management facilities. NDF will be in compliance with the IAEA Safety Standards.

The potential non-radiological impact upon environment and people during the NDF construction will not be transboundary impact.

The potential non-radiological impact upon environment and people during the NDF operation is expected to be slight and within a constrained perimeter, i.e. at this stage no transboundary non-radiological impact is expected. At this stage the radiological effects upon environment and people during the NDF operation are expected to be insignificant as demonstrated during the operation of identical facilities in other countries.

Analyses of the impact for each particular situation of other previous (if any), present and reasonably foreseeable future activities at the NDF, foreseeable cumulative or adverse impact upon people and environment are assessed in the EIA Report.

4.3. PROBABILITY OF IMPACT OCCURRENCE

The EIA Report assesses the potential impact on environment and people as per the existing information provided in this investment proposal for NDF implementation. There has been preliminarily estimated the **significance of the conjectural impact** so as to specify the **inevitable and steady** radiological and non- radiological impact upon environment and people due to the NDF construction and operation. For the sake of comprehensiveness most of the potential impacts have been considered rather than only those supposed to turn out to be significant. These effects are considered in detail in the EIA Report pursuant to Article 10 paragraph 3 point 4 of the *Regulation for the Terms and the Conditions for Implementation of an Environmental Impact Assessment*.

It is not expected:

- The investment proposal is not expected to cause any negative **light, thermal or electromagnetic emissions** both at the site's territory and beyond it, still this issue will be analysed and assessed in the EIA Report.
- The NDF is not expected to cause significant **social changes**, for example in terms of demography or the traditional way of life. The only change of similar nature, which is expected, is in positive aspect and it concerns increase in employment during the construction and operation of this investment proposal object.
- It is not foreseen to use any **additional land**, but the site designed for NDF.
- Need of **involuntary migration** of population is not foreseen, since the land designed for

the NDF implementation is a state private property and the site is situated within the 2 km Kozloduy NPP PAZ, which is not populated.

- At the investment proposal territory there are no **densely populated/built up** areas, which can be affected by the investment proposal. The site selected is situated within the boundaries of the existing Kozloduy NPP 2 km PAZ, which is not populated. There are no buildings at the site that are being used.
- No impact is expected upon agricultural lands at the territory of the site because no such lands exist there.
- **Protected Territories** since there are no such zones at the territory of the Kozloduy municipality. The impact upon the protected zones beyond the municipality's boundaries, but within the boundaries of the 30 km area in the vicinity of the NDF, the sensitive territories (wetlands), the impact on the protected zones under the Natura 2000 Networking Programme is analysed and assessed in the EIA Report (Section 3.5.3 Protected and Sensitive Territories).
- No impact upon the **climate** in the region is expected due to the NDF construction and operation.

It is possible:

- The investment proposal implementation leads to impact upon **land use**. The impact concerns **only the site**, it affects real estates, which are mainly state property and much smaller area of municipal property (as per the map of the restitution of the lands of the village of Harlets). The impact is *permanent* as the NDF will permanently occupy the site. Even after the NDF closure (reclaiming) the land use of the site will be constrained during the entire period of institutional control (300 years). The impact upon the land is described and assessed in detail in the EIA Report.
- The expected impact upon the **soils and the foundation bed soil** during the construction period is related to the excavation and removal of the earth mass, which will be *permanently* removed from the site. This impact is described and assessed in detail in the EIA Report.
- The expected impact upon the **landscape** at the site (the appearance of the terrain) is described and assessed in detail in the EIA Report. The impact will be exerted throughout the whole period of operation, but it is not expected to be negative impact since measures for aesthetic appearance will be planned in the design. Following the NDF closure the original appearance of the terrain will be recovered. The damages of the terrain having occurred during the construction will be reclaimed on the construction completion.
- The **non-radiological impact** upon the **ambient air** during the NDF construction implies dust pollution during the excavation and construction work – dust and gases from the motor vehicles and construction machines. (The excavation and levelling activities related to the NDF construction are expected to generate temporary local harmful ambient pollution – dust and release from the vehicles.) It is recommended in the EIA Report to be assessed the significance of this impact; at this stage it is this impact to be *inevitable*, but *non-durable* – mainly during the excavation and construction work.
- The **non- radiological impact** upon the **ambient air** during the NDF operation implies generation of gases and dust from the motor vehicles. At this stage it is predicted that the impact upon the ambient air will not be *significant*.
- At this stage of the investment proposal **the radiological impact upon the ambient air** due to the NDF operation is expected to be insignificant since the RAW will be taken into the NDF immobilized in a solid matrix and packed in reinforced concrete containers. The impact

upon the ambient air on the site, in the Radiation Protection Area and the Monitored Area, is analysed and assessed in the EIA Report.

- The RAW disposal facilities as the NDF will be designed, constructed and operated so as to ensure that the **radiological impact upon the surface water, geological baset and groundwater** in the deeply situated water-permeable soil beds and running into the drinking water sources, water sources used for irrigation and/or cattle-breeding, is *insignificant*. The best practices of underground waters protection imply observing the standards relevant to drinking water as defined in the special regulations and/or in the basic norms for radiation protection – as for the NDF, these standards are defined in *Regulation No 9/16.03.2001 (last am. SG issue 15/ 2012) on the Quality of Water for Drinking and Household Use* and in the *Regulation on the Basic Norms for Radiation Protection.* Regarding the NDF, according to the regulatory requirements, good practices and the IAEA Safety Standards, this will be achieved by applying the defence-in depth principle – a set of engineering barriers precluding radionuclide migration into the environment, implementing the best practices in the facility operation and last but not least strict control of the entering RAW, control of the technological processes and the disposal facilities as well as implementing the programmes for monitoring of the site, Radiation Protection Area and Monitored Area. This issue is analysed and assessed in detail in the EIA Report.
- By analogy these considerations are relevant to the plant and animal kingdoms, including plant agricultural produce and animal species used for food, as the influence is exerted through waters used for irrigation, watering or waters providing natural living environment, as in the case of the fishes. The expected **radiation impact upon the plant and animal lives** will be *insignificant* and it is analysed and assessed in detail in the EIA Report.
- The anticipated **radiological impact upon the population** (the critical groups of the population) is expected to be *insignificant*. Direct exposure is impossible due to the RAW nature (low and intermediate level RAW conditioned in reinforced concrete containers licensed for transportation). The potential influence can be exerted by consumption of contaminated water, plant and animal species, which is impossible as per the above described. The EIA Report contains an analysis of the potential radionuclide migration through the geosphere into the biosphere of man as well as an assessment of the radiological impact (radiation dose).
- **Radiological** effects upon the **personnel** during the NDF operation are possible, but at this stage they are predicted to be insignificant as the design is based on the radiation protection requirements defined in the *Regulation on Radiation Protection during Activities with Sources of Ionizing Radiation* and the *Regulation on the Basic Norms for Radiation Protection, 2004* as well as on the good practice of RAW management as established by the SE RAW – specifying dose budgets for the personnel, which are considerably lower than the limits set out in the regulation mentioned above.
- **Risk of accident** is possible during the NDF construction and operation as is the case with any other object.
- Impact upon tangible row materials **is expected** but it can be minimized in case of proper management and observation of the measures proposed in the EIA Report:
    a. during the NDF construction due to the use of fuels, electric power and construction materials (materials usually used for construction – concrete, metals, plastic, timber, sand, gravel, water. etc.),
    b. during the NDF operation due to the use of row materials and materials – electric power, fuels and materials.

The design is foreseen to contain measures for storage and effective use of fuels, raw materials and materials as per the requirements stipulated in the legislation.

- Impact upon **natural resources** is also considered to be the consumption of water during the NDF construction and operation; this impact will not be significant.
- The impact due to waste water generation, including domestic sewage, during the NDF construction will be insignificant.
- The impact due to drain water generation - surface water drainage at the NDF site, domestic sewerage, which will be discharged into the infrastructure facilities established at the Kozloduy NPP site – will be insignificant.
- Non-radiological impact due to generation and disposing of **non-radioactive waste** is expected as follows:
    a. during the NDF construction – excavation and storage of earth masses, waste generated during construction – construction waste, domestic waste, etc.,
    b. during the NDF operation – domestic waste, industrial waste and some types of hazardous waste (luminescent lamps, sensors, etc.).

The effects expected and the extent of significance there of assessed in the EIA report are insignificant.

- Generation of waste waters is expected during the NDF operation (for example: generation of **waste water** from the NDF special sewerage system or generation of **waste water** from the process operations for status control). The impact due to waste water generation at this stage is predicted to be insignificant as the design foresee waste water collection and control in special facilities. Recommendations for the best way of waste water management are provided.
- NDF is expected to cause **noise and vibrations**:
    a. during construction - *temporarily and periodically* due to the excavation work and transportation activity,
    b. during operation – *periodically* due to the transportation of the containers of RAW.

It is expected that the *negative* effects upon people and environment are *insignificant* and are not expected to spread beyond the site at levels affecting the main population and nature. No noise and vibration transboundary impact is expected during the construction related activities and the NDF operation.

It is expected the NDF noise effects regarding technology to be confined to the effects due to transportation of workers and materials to and from the site (during construction and operation), which could affect any neighbouring municipalities.

The NDF is a passive facility; hence the conjectural noise impact upon the environment and people during the NDF operation is not expected.

- To assess the possibility of NDF impact upon the **tumuli** at the Mogilite locality on the land of the village of Harlets, a study was conducted in accordance to a requirement set by the *Regional Historic Museum – Vratsa.* No considerable impact is expected.

4.4. SCOPE OF THE IMPACT – GEOGRAPHICAL REGION, AFFECTED POPULATION; POPULATED AREAS (NAME, TYPE – TOWN, VILLAGE, NUMBER OF INHABITANTS, ETC.)

There are 5 populated areas in the Kozloduy municipality – the town of Kozloduy and the villages of Harlets, Glojene, Butan and Kriva Bara. The population density, demographic data, geographical region and the populated areas have been described above.

About 28 populated areas situated within the territory of Bulgaria fall completely within the 30 km monitored zone in the vicinity of the Kozloduy NPP (**Figure 4.4-1**) (Kozloduy, Mizia, Vyltchedrym and Hayredin municipalities) and 65 populated areas fall partially in the zone from the municipalities of Oryahovo, Byala Slatina, Borovan, Krivodol, Boytchinovtsi and Lom.

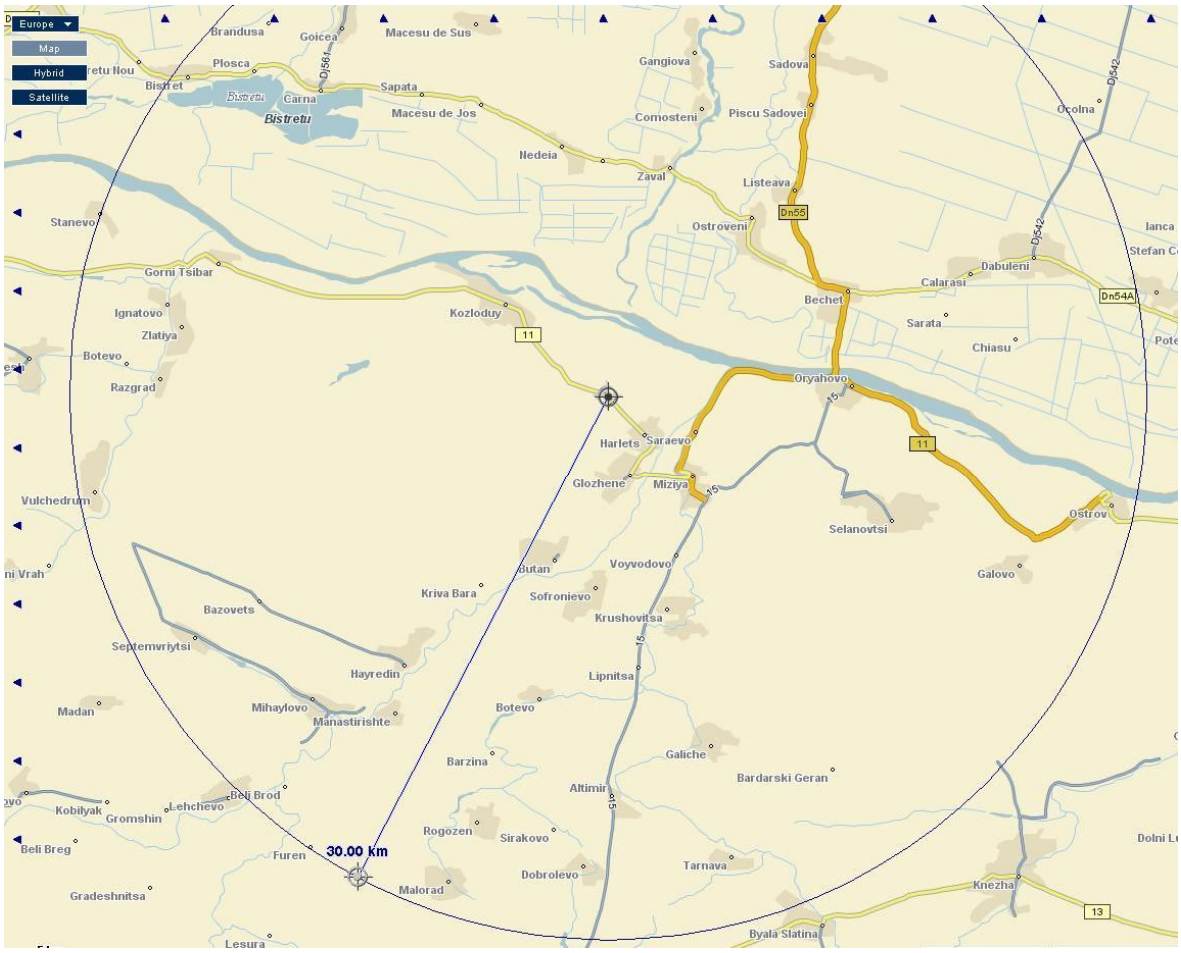


FIGURE 4.4-1 POPULATED AREAS IN THE 30 KM MONITORED ZONE OF THE REPUBLIC OF BULGARIA

About 23 unevenly distributed populated areas fall within the site's 30 km area at the territory of the Republic of Romania. Neither of them is situated at a distance less than 12 km, which can be seen at **Figure 4.4-2**.

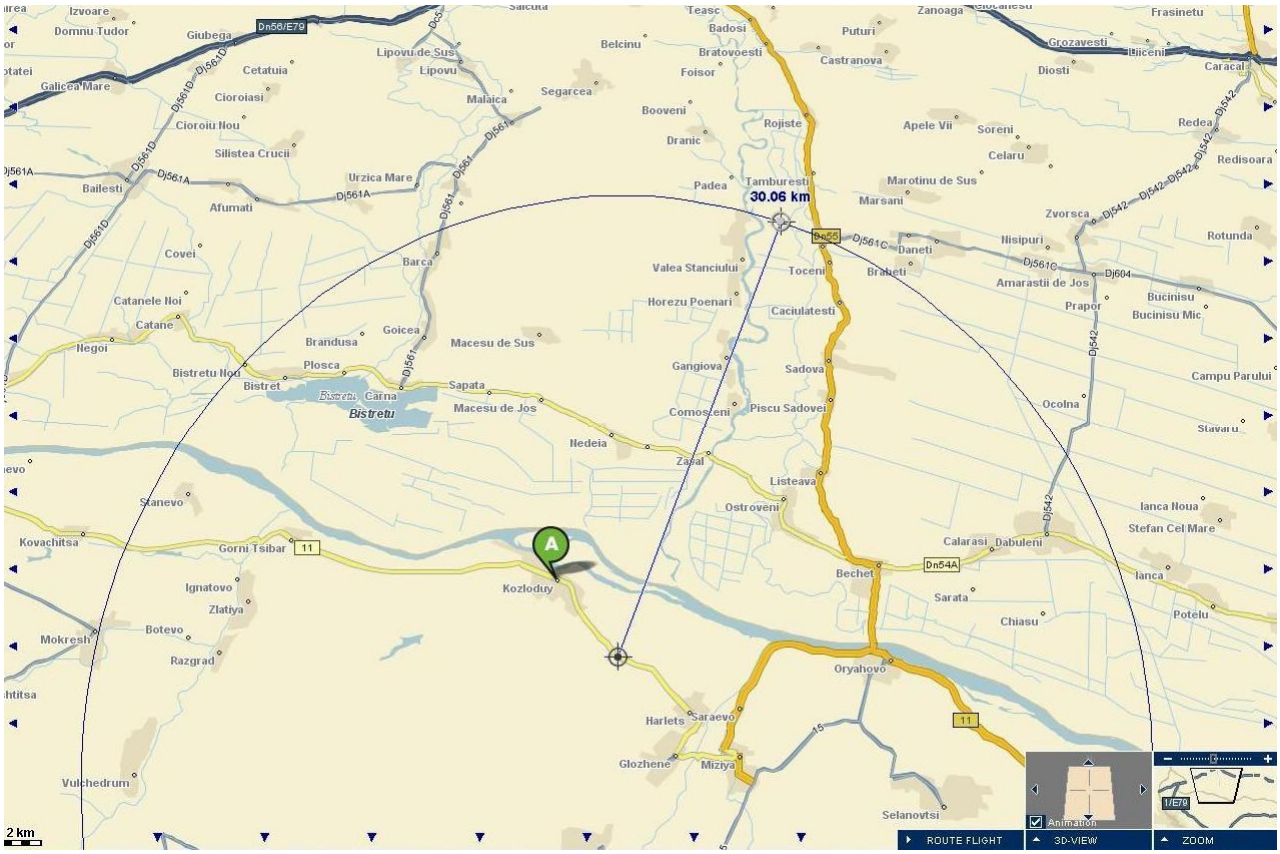


FIGURE 4.4-2 POPULATED AREAS IN THE 30 KM MONITORED ZONE OF THE REPUBLIC OF ROMANIA

4.5. TRANSBOUNDARY NATURE OF THE IMPACTS

Transboundary impact due to the NDF construction and operation, at this stage, **is not expected**.

During the NDF construction and operation the existing national and international standards on ensuring nuclear and radiation safety of environment and people will be observed. The Radiana site envisaged to host the NDF is situated in the thoroughly investigated and monitored area.

The Radiana site is located at a distance of 3.5 km from the nearest town of Kozloduy and at about 4-5 km from the Danube border between the Republic of Bulgaria and the Republic of Romania.

As mentioned above, in the 30 km area in the vicinity of the site, at the territory of Romania there are 23 populated areas. The nearest populated area at the territory of Romania is located at a distance of more than 12 km from the site. It is not expected any impact on the people and environment at the territory of the Republic of Romania caused by the construction and operation of the NDF.

No impact due to non-radiological emissions is expected on environment and people in Romania during the NDF construction stage.

The radiological impact upon people and environment during the NDF operation is predicted to be insignificant, as demonstrated during the operation of identical facilities in other countries.

In compliance with the requirements set out by the Bulgarian Ministry of Environment and Water, an information paper has been elaborated, in compliance with the Convention on Environmental Impact Assessment in Transboundary Context, which has been submitted by

the MoEW to the Romanian competent authority for decision-making on the part of Romania regarding participation/non- participation in the NDF environmental impact assessment procedure.

As per regulation, should the Republic of Romania express willingness to participate in the EIA procedure, in addition to the results from all the consultations held in the Republic of Bulgaria, the opinion on the part of Romania should be taken into consideration and reflected in the EIA Report.

The EIA Report contains the motives which base the statement about the provided information that no transboundary impact is expected due to activities during the construction and operation of the NDF.

4.6. CUMULATIVE EFFECT

The main purpose of the assessment of the cumulative effect as part of the EIA Report is to show an analysis and a judgement of the possible cumulative effect caused by the implementation of the Investment proposal and the operation of other (already existing and future) facilities at the site of the Kozloduy NPP and outside its boundaries - the implementation and operation of the 5 and 6 NPP units with increased heat power (104%), Dry SFSF, SFSF, closure of 1-4 NPP units (Size Reduction and Decontamination Facility – SRDF) and new nuclear power-generating capacity (NNPGC). The cumulative effect is an assessment of the impacts that act together and affect the same environmental component/factor due to the realization of the mentioned investment proposals.

Taking into account that the decommissioning of units 1-4 of the Kozloduy NPP and the removal of the nuclear fuel from the spent fuel pools causes significant reduction of the radiation risk at the site, as well as the expected limited potential impacts (limited to the 2 km zone for preventive and protective measures) from the provided NNPGC operations, it can be prognosticated that it is not expected any combined impact on the environmental components, biodiversity and radiological risk for the population.

5. DESCRIPTION OF THE MEASURES PROVIDED TO PREVENT, LIMIT OR, WHERE POSSIBLE, TO DISCONTINUE THE SIGNIFICANT NEGATIVE IMPACTS ON THE ENVIRONMENT AND PLAN FOR THE IMPLEMENTATION OF THESE MEASURES

To prevent, limit or compensate the negative impacts on the environment during the realization and operation of the IP, the EIA Report proposes measures to limit to the rational minimum the impact of the IP's realization on the different components and factors of the environment.

Table 5.1-1 shows the Plan for implementation of these measures and it is developed for components and factors of the environment that are provided to prevent, limit or, where this is possible, to discontinue the significant impacts in radiation and non-radiological aspect on the environment, as well as a plan for the implementation of these measures. They are related to the: D – design; C- construction; O – operation; Cl – closure.

5.1. PLAN FOR IMPLEMENTATION OF THE MEASURES

In accordance with the foreseen measures and phases, a plan for the implementation of the measures is drawn and shown in **Table 5.1-1**.

TABLE 5.1-1 PLAN FOR IMPLEMENTATION OF THE MEASURES

№	Measures	Period (phase) of application	Result
	A/ Non-radiological aspect		
1.	When the construction company elaborates a Plan for organization of the construction works, the proposed transportation scheme should limit the passing of heavy-fright machines through populated settlements. If this is unavoidable, quick and unimpeded passing through the populated settlement should be assured with steady speed (without stopping and reduction of the allowed speed).	C	Limitation of the harmful emissions to the atmosphere in the region. Reduction of the additional increase of noise levels in the populated areas. Effective waste management.
2	Construction and transport machinery to be maintained in working order (to be presented proof of passing an annual vehicle test)	C, O, and Cl	Protection of the atmospheric air in the region. Ensuring of safe labour conditions.
3	Usage of modern construction machines and equipment characterized by good indicators. The machines should be in order and should fulfil all contemporary technical requirements, specification and regulations that are compulsory for the EU.	C, Cl	Protection of the atmospheric air in the region. Limitation of noise levels. Protection of the health of the personnel and the population in the region.

4	The transport vehicles loaded with earth masses and ballast should not be overloaded. The transport vehicles should be covered when they transport excavated earth masses, construction materials, construction waste, etc.	C, Cl	Protection of the air, soils and the health of the personnel and the population in the region.
5	The working regime of the construction and transport machines should not allow idle running of the engines.	C, O, Cl	Protection of the air and the health of the personnel and the population in the region.
6	The open-air storage areas for bulk construction materials (mainly sand) and construction waste to be water-sprayed in dry and windy weather.	C, Cl	Reduction of the dust in the atmospheric air. Protection of the health of the personnel and ensuring safe labour conditions.
7	The storage areas for bulk construction materials to be cleaned (recultivated) immediately after the construction works are completed.	C, Cl	Protection of the atmospheric air from dust due to wind imposed erosion. Waste management.
8	Accidental leaks and spillage of oils, petroleum products, etc. should be avoided. In case of spillage immediate measures should be taken for its localization and following treatment.	C, O, Cl	Protection of the soils and ground waters from pollution.
9	Chemical WCs should be used during the construction until household and faeces sewage of the object is constructed.	D, C	Protection of the soils and waters from pollution.
10	New permits under the Waters Act to be issued or to be changed existing ones if necessary.	D, C, Cl	Fulfilment of all normative requirements regarding the protection of surface and ground waters.
11	The sewage system to be made of materials that allow high level of water impermeability.	D, C	Protection from penetration of pollutants in ground waters and the bowels of the earths.
12	The concrete structures of the water and sewage infrastructure to be designed and made of damp-proof concrete.	D, C	Spillages should not be allowed. Protection of the waters and soils from pollution.
13	A special site to be provided for the used construction machines in a way that does not allow pollution of surface and ground waters with oil products.	D, C	It is not allowed pollution with oil products of soils, ground and surface waters.
14	A separate sewage network for household and faeces waters, and rain and waste waters to be constructed.	D, C	Prevention of soils and surface water pollution.
15	Design and construction of a system for ground and surface water monitoring which will function during the operation and closure of the facility.	D, C, O, Cl	Ensuring efficient control of the waters' status. Prevention of pollution.

16	Application of the technology for implementation of the excavation works without provoking setting off of landslides and in cases of earthquake impact.	C	Ensuring the design steady parameters of the repository's fill slopes.
17	Implementation of the program for pre-operational geodesic monitoring of the movements and deformations, and elaboration of a program for operational geodesic monitoring.	D, C	Control of the steadiness status of the geological environment, and the constructed building and facilities.
18	The humus should be stored separately from other earth masses. Making use of maximum quantity of humus reserves upon minimal damage of the soils in neighbouring terrains.	C	Preservation of the humus soil layer. Protection of the soils not only on the territory of the site but also on the territory of the adjacent terrains.
19	Maximum use of the excavated earth masses at the site of the IP during conduction of its vertical planning. Making maxiamal use of part of these masses at the NDF's site for backfill, shaping the construction damages and during the recultivation.	D, C	Restoration of the landscape in the region. Waste management.
20	Recultivation of the territory affected by the construction, temporary sites and depots for earth masses and restoration of the damaged soils and plants.	D, C, Cl	Restoration of the damages soil and landscape in the region.
21	Reinforcement of the damaged terrains with grass and local plants.	D, C	Preservation of the flora that is characteristic of the region.
22	Implementation of biological recultivation and planting of suitable grass species, and implementation of a design for landscape planning of the territory.	Cl	Preservation of the flora that is characteristic of the region. Protection of the landscape.
23	It is not allowed pollution of the soils outside the territory of the site with construction materials and deposition of earth masses or waste.	C, Cl	Soil protection. Waste management. Protection of the landscape.
24	Before the beginning of construction, at any stage of the investment proposal implementation, the construction sites to be visited and if some slowly moving animals (eventually, amphibians and reptiles) are found, they should be removed in a safe way and then released in neighbouring territories with trees and in other suitable habitats in the region that are at a sufficient distance from the construction sites.	C,	Protection of animal species from extinction. Protection of biodiversity.

25	A project for planting and a project for recultivation to be developed and coordinated with expert ornithologists, biologists, forestry engineers, etc, who will offer recommendations for sustained development of the ecosystem, and respectively, the biodiversity in the region.	Cl	Protection of the biodiversity in the region. Aesthetical shaping of the region in respect to the landscape.
26	If the construction of the facilities, auxiliary buildings and infrastructures of the NDF, and the preparation of the operation is about to begin during the breeding season of birds (the end of March – July), the terrain (the whole Radiana site) should be checked for the presence or absence of nests with nesting couples. If such are registered, specific "saving" activities should be undertaken to move them into similar biotopes at a safe distance.	C	Protection of the birds' generation from extinction.
27	It should be ensured strict control and efficient management of the generated waste during the different periods of the NDF's realization.	D, C, O, Cl	Protection of the soils and waters from pollution.
28	After the completion of the construction works, the construction waste should be transported to a depot for disposal of construction waste.	C O (in cases of repairs), Cl.	Waste management. Reduction to a minimum of the environmental impact (Protection of soils and waters)
29	Signing contracts with licensed companies for transportation and following treatment of hazardous waste in accordance with article 35 of the Waste Management Act.	D, C, O, Cl	Waste management. Reduction to a minimum of the environmental impact
30	To be provided sites for storage and, where necessary, temporary storage of non-radioactive waste (household, industrial and hazardous waste) until it is transported by a specialized company.	D, C, O, Cl	Efficient waste management and protection of the environment. Protection of the region and the adjacent terrains from pollution.
31	The storage houses and the separate volumes for temporary storage of various types of waste should be realised and exploited in accordance with the normative requirements.	D, C, O, Cl	Efficient waste management and protection of the environment. Protection of the region and the adjacent terrains from pollution.
32	Elaboration of instructions for safe operation with hazardous compounds and their strict implementation (During construction works on the object, upon asphalting, when working in the laboratories, etc.) a strict observation of all requirements under the safety, labour hygiene and fire safety.	C, O, Cl	Prevention of health risk for the personnel of the object.

33	Ensuring the requirements for the storage houses for storage of chemical compounds and mixtures. The reduction of the potential unfavourable compounds requires observation of the loading and unloading for powdery substances and materials supplied in paper and polymer bags, suitable storage of hazardous compounds.	D, C, O, Cl	Ensuring safe working conditions for the personnel and prevention of health risk. Strict observation of the legal framework concerning hazardous chemical substances and mixtures.
34	The supplied materials for the operation of the object should be accompanied by analysis certificates, Safety information sheets, including measures in cases of spillages, dusting and affected health of the personnel. Each original packaging should have a label which includes data about the health and ecological risk and the safety measures.	C, O, Cl	Prevention of health risk for the personnel of the object. Protection of the health of the personnel and the environment.
35	Prior to the beginning of the NDF construction it is necessary to develop organisational and management measures for sage storage of the used hazardous chemical substances and mixtures (including paints, fuels and lubricants) in accordance with the existing legislation.	C	Prevention of health risk for the personnel of the object. Prevention of the impact of hazardous substances and mixtures on the environment.
36	A special storage facility should be realised in the NDF's laboratory for chemical substances and mixtures, which is built in accordance with the normative requirements.	O, Cl	Prevention of health risk for the personnel. Protection of the health of the personnel and the environment.
37	Prior to putting into operation of the storage facilities for storage of hazardous chemical substances and mixtures it is necessary to be made an assessment of their safe storage and the results from the assessment should be documented in accordance with the existing regulations.	C, O, Cl	Prevention of health risk for the personnel of the object. Protection of the health of the personnel and the environment. Prevention of the impact of hazardous substances and mixtures on the environment.
38	During the construction, the personal prevention against noise of the personnel should be ensured by the usage of personal protective means against noise.	C, Cl	Ensuring safe and healthy working conditions for the personnel.
39	Observation of all instructions about labour safety and health, and fire safety for the different types of jobs.	D, C, O	Ensuring safe labour conditions for the personnel.
40	All construction and repair works should be in accordance with the minimal requirements for healthy and safe labour conditions.	C, Cl	Reduction of the health risk for the personnel.

41	Observation of all requirements for health prevention regarding the physiological labour and break regimes and the physiological norms for handling weights. Strict usage of the provided personal and collective protection means.	C, O, Cl	Reduction of the health risk for the personnel. Prevention of health risks.
42	Obligatory instruction of the personnel by experts on health and safety labour.	C, O, Cl	Prevention of health risks, ensuring healthy and safety labour conditions.
43	Annual medical check-ups should be carried out at least once per year in relation to the conducted activities.	O	Disease prevention and timely diagnosis.
44	The regime for work and breaks for the various jobs (vibration impact, noise impact, etc.) should be determined in a way as to prevent health risks.	C, Cl	Ensuring healthy and safety labour conditions.
45	A first aid kit to be maintained in working order to give first aid.	C, O, Cl	Timely first aid of injured people.
46	In case structures and findings which appear to be cultural values are found during construction and developing works the activity is immediately stopped and the requirements of the existing legislation are implemented.	C	Protection of cultural monuments.
	B/ Radiological aspect		
47	The implementation of the Program for pre-operational radiological monitoring to continue: - at the Radiana site monitoring the radioecological status of the atmospheric air, ground waters, soils, flora - at the foreseen areas and points of surface flowing waters in the vicinity of the Radiana site	C	Analysis of the radioecological status of the site and ensuring compliance with the legal framework in the area.
48	It should be elaborated and implemented a Program for disposal radiological monitoring of the site and the SZ of the NDF that monitors the radioloecological status of the site and the environment	O, Cl	Analysis of the radioecological status of the site and the environment and ensuring compliance with the legal framework in the area.
49	Program for radiation protection during the NDF operation. Assessment of the professional exposure of the personnel during the operation and the closure of the repository.	O	Ensuring radiation protection within the site in accordance with the requirements of the regulation and the Licence of the NDF. Observation of the ALARA principle.
50	Update of the safety assessment during the NDF operation.	O, Cl	Ensuring radiation protection within the site, of the environment and of the population in the area.
	C/ Others		

51	Ensuring jobs during the periods of construction and operation, and their occupation by experts who have the necessary experience for managing the particular activity.	C, O, Cl	Ensuring employment. Ensuring quality functioning of the NDF's facilities, optimal conditions for the technological processes, prevention of risk for the environment and ensuring good quality of the labour conditions and the environment.
52	Training courses to improve the qualification of the personnel.	C, O, Cl	Prevention of health risk for the personnel. Protection of the health of the personnel. Ensuring optimal conditions for the technological process and good quality of the labour conditions and the environment.
53	In the following design phases to be developed the following plans which should be periodically updated during the operation and closure: - A Program for non-radiological and radiological monitoring, - Emergency plan.	O, Cl	Prevention of risk for the environment and the labour conditions.
54	In the following design phases it should be taken into consideration all recommendations and measures proposed by the experts in the EIA Report, so that strict control and management is carried out for their implementation during the realization of the IP's objects.	D, C, O, Cl	Prevention of risk for the environment and the working conditions.

D - design , C - construction, O - operation, Cl - closure.

6. CONCLUSION OF THE EXPERTS

The current EIA Report – an update of the Investment proposal of SE RAW for implementation of a NDF in the lands of Harlets village, Kozloduy municipality, Vratsa region is developed by a team of independent experts working for "Eko Energoproekt" OOD on impact assessment on the separate components and factors of the environment. During the development of the EIA Report these experts have been guided by the principles for reduction and prevention of the risk for the environment and human health, and ensuring sustainable development in accordance with the existent norms about the quality of the environment.

The EIA Report describes and assesses the impact of the IP on the environment and human health, and it includes a detailed analysis, prognosis and assessment of the impacts on all environmental components and factors, as well as the health and sanitary aspects during the construction, operation, closure and the following institutional control of the NDF.

The EIA Report is developed in accordance with the requirements of the existent to date regulations. It proposes specific measures for reduction, prevention or the most possible elimination of the identified impacts on the environment and human health, and all synergetic effects of the radiation background are recognised.

The analyses and assessments of the impact level of the IP on the different environmental components and facts, as well as the proposed measures to minimize the negative impacts of the object reflect the received consultations, expressed opinions and recommendations during the

meetings with the affected publicity, competent authorities and institutions regarding the Updated terms of reference and the contents of the EIA Report, and respectively the development of the EIA Report and Report on the level of impact of the IP with the subject and purposes for protection of the protected areas as an integral part (appendix) of the EIA Report.

The EIA is developed on the basis of:

- → Updated Terms of reference on the Scope and Contents of the EIA Report – 2014;
- → Inspections and terrain observations of the terrain of the NDF's site;
- → Studies, designs and other materials;
- → Inventory control, analysis and assessment of the existing data related to the development of the report (actual observations and measurements, scientific research, publications, reports, literature review, etc);
- → Consultations with experts;
- → Opinion of the competent authorities involved in the protection of the environment, opinions and recommendations of the administrations, institutions, the local population and authorities, non-governmental ecological organisations, etc, that are affected by the realization of the investment proposal;
- → Methodics for assessment and prognosis of the impacts caused by the object, used by the experts working on the different environmental components and the factors that affect it;
- → Normative documents.

Prognostic assessment of the potential NDF impacts are made during the periods of construction, operation and closure on the environmental component and factors, the personnel and the population in the region, and measures are proposed for reduction, prevention and elimination of the indentified impacts upon observation of all requirements of the European legislation and the Convention on Environmental Impact Assessment in a Transboundary Context (Espoo).

The EIA Report contains an ecological analysis of the alternative technological solution of the NDF construction, and numerous measures are proposed for the minimization of the object's impact on the environment and ensuring complete safety of the personnel and the population in the region during the periods of construction, operation and closure of the NDF in radiological and non-radiological aspect.

Upon effective management of the NDF significant negative impacts on the environment are not expected and the provided safety measures ensure prevention of health risk for the personnel of the object and the population in the region.

The impact on the different environmental components and the factors that affect it is assessed as insignificant with territory range of the impact within the boundaries of the investment proposal's site and the immediate terrain around it during the construction, the normal operation and after the NDF's closure.

Significant non-radiological negative impact on the environmental components and factors is not expected upon implementation and observation of the proposed measures.

No radiation impacts are expected on the waters, lands and soils, geological environment, bowels of the earth, land use, mineral diversity, biodiversity, objects of historical and cultural significance,

objected protected by an international or national legislation as well as on the health of the personnel and population within the 30-km zone.

The results from the doses assessment during the period after the closure of the repository in the Preliminary safety assessment show that during normal operation the individual effective dose for individuals of the population does not exceed the limit of 0.3 mSv/a, fixed by the nuclear legislation and the recommendations of the ICRP. The individual dose is even below 0.01 mSv/a. According to article 10 of the *Regulation for safe management of radioactive waste* which means that **the best possible means for RAW management are used and the exposure of the personnel and population is maintained at the lowest rationally achievable level**.

The NDF will ensure effective protection of the population health and the environment against potential impact caused by the disposed radioactive waste after its closure, by preventing uncontrolled distribution of the radioactive substances in the biosphere through the multi barrier protection of the biosphere and a complex technological and administrative measures.

During the construction of the NDF are applied nine fundamental principles for RAW management, formulated by the IAEA:

→ principle 1: Protection of human health;

→ principle 2: Protection of the environment;

→ principle 3: Protection outside the national boundaries;

→ principle 4: Protection (non-burdening) of future generations;

→ principle 6: National regulatory base;

→ principle 7: Control on the generated RAW;

→ principle 8: Dependences between the generated RAW and its management;

→ principle 9: Safety of the facility.

An assessment of the safety for surface disposal facilities is made, which is a procedure for the assessment of the disposal facility's behaviour, and, more specifically, of its potential radiological impact on human health and environment. The safety assessment defines the routes for distribution of the radionuclides in the environment and assesses the potential health effects.

To this effect, the final section of the analysis in the EIA Report is **the limit of the annual individual effective dose for critical groups of individuals from the population**.

The EIA Report demonstrates that the dose loading of the personnel during the operation does not exceed the limits, fixed in the Regulation on the basic norms of radiation protection, 2012 and in practice it will be significantly lower, in accordance with the ALARA principle.

The monitoring prior to the operation ensures basic levels for determination of all additional changes in the environment which may be related to outbursts from the disposal facility.

The monitoring during the operation and after the closure of the disposal facility is meant for demonstrating that the actual measurements in the environment do not invalidate the admissions and prognosis for the safety assessment,

It is expected that there will not be any significant migration of radioactive substance from the disposal facility during the period of operation and after its closure, during the period of control. The maintenance of the monitoring ensures detection of specific radionuclides and lack of statistically significant changes in the levels of other pollutants.

In cases of potential deviations from the normal operation, which are limited to a minimum under strict control and management, they are insignificant or non-existent – *the dose criteria for normal operation is observed.* For accidents, i.e. the so-called design base accidents foreseen in the project, are taken measures, so that the NDF can stand without loss of systems, structures and components. These events are of **limited possibility** because of prevention and administrative measures, but they have expected radiological consequences upon which the dose limit for an individual of the population is determined to up to 1 mSv/a.

Consequences from accidents are examined and analysed, and it is recognized the characteristics of the RAW packages, the type of waste form, the specific activities that should be carried out during the operation. The most probable accident with radiological consequences is an drop, falling down of a container. The ISAR contains a detailed analysis of this design base accident in order the maximum content of different radionuclides in the RAW packaging to be determined.

It is foreseen that the design base accidents are controlled over the course of time and respective protective measures to be applied which would actually allow significant reduction of the conservatively assessed individual dose. The potential surface radioactive pollution causes by any design base accident is also completely under control.

Despite the excessive conservativeness, the results for the dose assessment during the period after the closure of the facility show that in case of normal evolution, the individual effective dose for individuals from the population does not exceed 0.01 mSv/a, i.e. the best possible practice is applied.

Considering the present radiation characteristics of the packages with radioactive waste which will be disposed at the NDF and the presented assessments for the environmental impact of the Kozloduy NPP, according to an expert assessment **cumulative effect is not expected** in the supervised zones of the two facilities. This is a natural conclusion because of the fact that there are not direct gaseous and liquid emissions during the operation period of the NDF and during the period after its closure.

Beyond design base events (accidents) are also analysed that are not examined in the projectin order to gain knowledge and assess the capacity of the design of the facility to cope with such an event.

On the basis of the conducted analyses and the assessment of impact on all environmental components and factors, including protection of the biological diversity from the realization of the investment proposal *"Construction of national facility for disposal of low and intermediate level radioactive waste – NDF"* a **priority selection of disposal technology is a repository of TRENCH TYPE as it ensures greater safety**.

In view of the conclusions and measures proposed in the EIA Report by the experts for reduction, prevention or as most complete as possible elimination of the identified impacts on the environment and human health, which are described in detail in Chapter 9 of the EIA Report and which ensure strict observation of the norms for environmental quality fixed by the **Bulgarian and European legislation** and prevent unfavourable impacts on the health of the population and the personnel, as well as the conducted assessment of the correspondence of the IP with the subject and purposes of protection of the protected areas, we propose to the respectable Senior Expert Ecological Council of the MOEW to approve the implementation of the investment proposal for **"Construction of National disposal facility for low and intermediate level radioactive waste – NDF".**

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[76] A Conceptual design for NDF in two versions prepared by consortium Westinghouse Electric Spain, DBE Technology and Entresa, 2012

[77] Multiatribute evaluation and recommendations to SERAW prepared by consortium Westinghouse Electric Spain, DBE Technology and Enresa, 2012

[78] A technical design for NDF at the Radana Site prepared by consortium Westinghouse Electric Spain, DBE Technology and Enresa, 2013

[79] Interim safety assessment report prepared by consortium Westinghouse Electric Spain, DBE Technology and Enresa, 2014

[80] Detailed site development plan – a plan for regulation and development for a NDF at the Radiana Site, 2012

[81] Preliminary NDF safety assessment, SE RAW, 2013, the report is part of the documentation accompanying the Application form for approval of the selected site;

[82] Report on the opportunities for application of measures for protection of the population in cases of severe radioactive accident, SE RAW, 2013; the report is part of the documentation accompanying the Application for approval of the selected site;

[83] Programme for pre-disposal radiation monitoring of the national disposal facility for radioactive waste; SE RAW, 2013, the programme is part of the documentation accompanying the Application form for approval of the selected site;

[84] Programme for pre-disposal hydrological and geological monitoring of the national disposal facility for radioactive waste; SE RAW, 2013, the programme is part of the documentation accompanying the Application form for approval of the selected site;

[85] Programme for pre-disposal seismological monitoring of the national disposal facility for radioactive waste; SE RAW, 2013, the programme is part of the documentation accompanying the Application form for approval of the selected site;

[86] Terms of reference for pre-disposal geodesic monitoring of the Radiana Site, SE RAW, 2013;

[87] Terms of reference for pre-disposal seismological monitoring of the Radiana Site, SE RAW, 2013;

[88] Detailed Programme for Realization of the Hydrogeological Monitoring and Geochemical Analysis, 2013г., a report prepared by consortium Nuclear Laboratory, UK and British Geological Survey under a contract with SE RAW for implementation of Pre-disposal hydrological and geological monitoring of the Radiana Site;

[89] Preliminary Hydrogeological model for the Radiana Site, 2013г., a report prepared by consortium Nuclear Laboratory, UK and British Geological Survey under a contract with SE RAW for implementation of Pre-disp[osal hydrological and geological monitoring of the Radiana Site;

[90] Design of the Overall Monitoring System Including Vadose Zone and Saturated Zone (Aquifer) Monitoring, 2013г., a report prepared by consortium Nuclear Laboratory, UK and British Geological Survey under a contract with SE RAW for implementation of Pre-disposal hydrological and geological monitoring of the Radiana Site;

[91] Construction of Vadose Zone Monitoring Systems, 2013г., a report prepared by consortium Nuclear Laboratory, UK and British Geological Survey under a contract with SE RAW for implementation of Pre-disposal hydrological and geological monitoring of the Radiana Site;

[92] Construction of the Saturated zone (Aquifers) Monitoring System, 2013г., a report prepared by consortium Nuclear Laboratory, UK and British Geological Survey under a contract with SE RAW for implementation of Pre-disposal hydrological and geological monitoring of the Radiana Site;

[93] Program for pre-disposal radiological monitoring at the Radiana Site, 2013, a report prepared by Tita Consult Ltd under a contract with SE RAW for Pre-disposal radiological monitoring of the Radiana Site;

[94] Operational project for relocation of a part of the ELBA electric power line 20 kV, owned by CEZ Elektro Bulgaria AD, 2013;

[95] Conceptional design for dislocation of an irrigation canal crossing the territory of the Radiana Site

[96] Detailed site development plan – Site plan for relocation of part of an irrigation canal crossing the Radiana Site, 2013

[97] Technical terms of reference for elaboration of a Technical design for relocation of part of an irrigation canal crossing the Radiana Site, 2013

[98] Detailed design for drinking water-piping and water-meters shaft with water-meters knot for water supply of the Radiana Site and relocation of part of a drinking water piping crossing the vicinity of the Radiana Site

[99] Detailed site development plan – Site plan for dislocation of part of drinking water-piping crossing the Radiana Site, 2013

[100] Detailed design for construction of a temporary road access to Radiana Site, 2013

[101] Detailed design for construction of an industrial fence at the Radiana Site, 2013

[102] Lithographic boreholes along the longitudinal axis of the NDF disposal modules at the Radiana Site for justification of the Pliocene sediments upper surface elevation, report of the Institute of Geology to the Bulgarian Academy of Sciences under a contract with SE RAW, August 2011

[103] Lithographic drillings at the longitudinal axis of the storage modules of the NDF at the Radiana Site for specifying the elevation of the attitude of Pliocene sediments, report of the Institute of Geology to the Bulgarian Academy of Sciences under a contract with SE RAW, November 2012

[104] Report for elaboration of geological and hydrogeological profiles of the plateau between the Radiana Site and the Danube River, report of prof. Jordan Evlogiev under a contract with SE RAW, December 2012

[105] Assessment of the risk of flood and erosion from the Danube River at the Radiana Site for disposal facility for low and intermediate level radioactive waste, report of prof. Dimcho Evstatiev and prof. Jordan Evlogiev under a contract with SE RAW, May 2011

[106] Assessment of the change in underground waters level at the Radiana Site in cases of maximal increase of the Danube River level, report of prof. Iliya Yotov under a contract with SE RAW, May 2011

[107] Results from the Kozloduy NPP Radioecological Monitoring – years 2009, 2010, 2011, 2012, 2013. Annual reports of the Kozloduy NPP EAD, 2013

[108] Report on environmental impact assessment of the investment proposal "Construction of a new nuclear capacity of the latest generation at the Kozloduy NPP Site, "Kozloduy NPP – New Nuclear Capacity" EAD

[109] EIA Report on impact degree assessment of the investment proposal "Construction of a new nuclear capacity of the latest generation at the Kozloduy NPP Site, with the subject and purposes of protection and protected zones. "Kozloduy NPP – New Nuclear Capacity" EAD, 2013

[110] Report on the elaboration of a hydrogeological map of the region of the national disposal facility at the Radiana Site, 2014

[111] Regulation on emergency planning and emergency preparedness in case of nuclear and radiological emergencies, promulgated SG № 94/11.2011

[112] ICRP Publication 103, International Commission on Radiological Protection, 2007

7.1. LIST OF THE APPLICABLE BULGARIAN AND INTERNATIONAL REGULATORY DOCUMENTS, DOCUMENTS OF EBRD, ICRP AND IAEA

BULGARIAN ACTS	
1.	Environmental Protection Act, SG No 91/2002, last amended SG 22/11/03.2014
2.	Act on Safe Use of Nuclear Energy, SG No 63/28.06. 2002, last emended SG No 68/02.08.2013
3.	Protected Territories Act, SG No 133/1998, last amended SG No 66/26.07.2013
4.	Health Act, SG No 70/2004, last amended SG No 1/03-01-2014
5.	Law on healthy and safe labour conditions, SG №124/1997, last amended SG №27/25.03.2014
6.	Biodiversity Act, SG No 77/2002, last amended SG No 66/26.07.2013
7.	Farm Land Protection Act, SG No 35/1996, last amended SG No 66/26.07.2013
8.	Clean Ambient Air Act, SG No 45/1996, last amended SG No 102/21.12.2012
9.	Waters Act, SG No 67/27.07.1999, last amended SG No 26/21.03.2014
BULGARIAN REGULATIONS	
10.	Regulation on the Terms and Procedure for Elaborating an Environmental Impact Assessment, SG No 25/18.03.2003, last amended SG No 94/30-11-2012.
11.	Regulation on the Basic Norms for Radiation Protection, SG No 76/05-11-2012
12.	Regulation on Safe Radioactive Waste Management, SG No 72/17.08.2004, last amended SG No 68/02.08.2013
13.	Regulation on the Terms and Procedure for Defining Special-statutory areas in the vicinity of Nuclear Facilities and Objects Comprising Sources of Ionizing Radiation, SG No69/06.08.2004, last amended SG № 5/19.01.2010
14.	Regulation on Radiation Protection during Activities with Sources of Ionizing Radiation, SG No 74/24.08.2004, last amended and supplemented SG No 76/8.10.2012
15.	Regulation on the Terms and Procedure for Radioactive Waste Transportation, SG No 60/ 22.07.2005, last amended SG №13/14.02.2014
16.	Regulation on the Procedure for Issuing Licenses and Permits for Safe Use of Nuclear Energy, SG No 41/18.05.2004, last amended SG № 78/30.09.2005
17.	Regulation No 6 on Emission Standards for the Allowable Content of Harmful and Hazardous Substances in Waste Waters Discharged in Water Bodies, SG No 97/2000, last amended SG No 24/23.03.2004
18.	Regulation No 3 of 1 August 2008 on Standards Regarding the Allowable Content of Harmful Substances in the Soil, SG No 71/12.08.2008

19.	Regulation No 2 of 08.06.2011 on Issuing Permits for Waste Waters Discharge in Water Bodies and Specifying the Individual Emission Limits of Point Sources of Contamination, SG No 14/17.02.2012
20.	Regulation on Ensuring Safety of Nuclear Power Plants, SG No 66/30.07.04, last amended SG No 5/19.01.2010
21.	Regulation on Assessment of the Compatibility of any Plans, Programmes, Projects and Investment Proposals with the Subject and Purposes of Preservation of the Protected Areas, SG No 73/11.09.2007, effective as of 11.09.2007, last amended SG № 94/30.11.2012
22.	Regulation No 3 on the Terms and Procedure for Study, Design, Approval and Operation of the Sanitary Protected Areas in the Vicinity of Water Sources and the Facilities for Water Supply for Drinking and Household Use as well as in the Vicinity of Mineral Waters Used for Healing, Prophylactic, Drinking and Hygiene Use, SG No 88/ 27.10.2000
23.	Regulation No 9/16.03.2009 on Quality of Water for Drinking and Household Use
24.	Regulation № H-4 of14.09.2012 on characterization of ground water, issued by the minister of the environment and waters, SG 22/ 5.03.2013
25.	Regulation № 1 of 10.10.2007 on research, usage and protection of ground waters
EBRD DOCUMENTS	
26.	EBRD Environmental and Social Policy, approved on 12.05.2008
27.	EBRD Public Information Policy, approved on 12.05.2008
28.	EBRD Environmental Procedures, 28.07.2003
EU DIRECTIVES	
29.	Directive 2011/92/EU of the European Parliament and of the Council of 13 December 2011 on the assessment of the effects of certain public and private projects on the environment Text with EEA relevance
30.	Directive 2001/42/EC of the European Parliament and of the Council of 27 June 2001 on the assessment of the effects of certain plans and programmes on the environment
31.	Council Directive 92/43/EEC (1992) on the conservation of natural habitats and of wild fauna and flora (Natura 2000) – Directive on dwellers
32.	Council Directive 78/659/EEC of 18 July on the quality of fresh waters needing protection or improvement in order to support fish life
33.	Council Directive 79/409/EEC of 2 April 1979 on the conservation of wild birds
34.	Council Directive 1999/31/EC (supplemented by Directive 2003/33/EC) on the landfill of waste 91/689/EEC (supplemented by Council Directive 94/31/EC) on hazardous waste management
35.	Council Directive 2006/117/Euratom of 20 November 2006 on the supervision and control of shipments of radioactive waste and spent fuel

36.	Council Directive 2011/70/EURATOM of 19 July 2011 establishing a Community framework for the responsible and safe management of spent fuel and radioactive waste
37.	Commission Recommendation of 11 October 2010 on the application of Article 37 of the Euratom Treaty (2010/635/Euratom)
OTHER EU REQUIREMENTS	
38.	ILO labour conventions
39.	Convention on Biological Diversity, 1993
CONVENTIONS	
40.	Convention on Environmental Impact Assessment in Transboundary Context, (Espoo, Finland), 25 February 1991. Ratified by an Act passed by the 37th National Assembly on 16 March 1995. SG No 28 of 1995, elaborated by the Bulgarian Ministry of Environment and Water, promulgated SG № 85/1.10.199, effective as of 10 September 1997, amended SG No 89/12.10.1999
41.	Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters , (Aarhus, Denmark), 25 June 1998
42.	European convention on landscape, 20.04.2000, ratified by an Act passed by the 39th National Assembly, SG № 94/22.20.2004
43.	Convention on the Physical Protection of Nuclear Material (ratified April 1984 – amendment ratified March 2006).
44.	Convention on Early Notification of a Nuclear Accident (ratified February 1988).
45.	Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency (ratified February 1988)
46.	Convention on Nuclear Safety (ratified November 1995).
47.	Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management (ratified June 2000)
ICRP DOCUMENTS	
48.	ICRP, Radiological Protection Policy for the Disposal of Radioactive Waste, Publication No. 77, Elsevier, Oxford (1997)
49.	ICRP, Radiation Protection Recommendations as Applied to the Disposal of Long-Lived Solid Radioactive Waste, Publication No. 81, Elsevier, Oxford (1999)
IAEA SAFETY STANDARDS AND TECHNICAL DOCUMENTS, WHICH CAN BE USED FOR ASSESSMENT OF THE GOOD PRACTICES IMPLEMENTATION	
50.	Fundamental Safety Principles, SF-1, 2006
51.	The Principles of Radioactive Waste Management, Safety Fundamentals. Safety Standards Series No. No. 111-F, 1995,
52.	Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards (Interim Edition). Safety Standards Series No. GSR Part 3 (Interim), 2011,
53.	Near surface disposal of radioactive waste, Safety Requirements No. WS-R-1, 1999
54.	Safety assessment for the near surface disposal of radioactive waste, Safety Guide No. WS-G-1.1

55.	Technical considerations in the design of surface disposal facilities for radioactive waste, IAEA-TECDOC-1256, 2001
56.	Performance of engineered barrier materials in near surface disposal facilities for radioactive waste, IAEA-TECDOC-1255, 2001
57.	Procedures and techniques for closure of near surface disposal facilities for radioactive waste, IAEA-TECDOC-1260, 2001
58.	Scientific and technical basis for the near surface disposal of low and intermediate level waste, Technical reports series No.412, 2002
59.	Safety considerations in the disposal of disused sealed sources in borehole facilities, IAEA-TECDOC-1368, 2003
60.	Considerations in the development of near surface repositories for radioactive waste, Technical reports series No.417, 2003
61.	Surveillance and monitoring of near surface disposal facilities for radioactive waste, Safety Reports Series No. 35, 2004
62.	Disposal options for disused radioactive sources, Technical reports series No.436, 2005
63.	Disposal Aspects of low and intermediate level decommissioning waste, IAEA-TECDOC-1572, 2007
64.	Low and intermediate level waste repositories: socioeconomic aspects and public involvement, IAEA-TECDOC-1553, 2007
65.	Disposal of Radioactive Waste. Safety Standards Series No. SSR-5, 2011;
66.	Near Surface Disposal Facilities for Radioactive Waste. Safety Standards Series No. SSG-29, 2014.
67.	Monitoring and surveillance of radioactive waste disposal facilities. Safety Standards Series No. SSG-31, 2014.

7.2. LIST OF MATERIALS RELATED TO THE ELABORATION OF THE EIA REPORT OF THE INVESTMENT PROPOSAL FOR THE NDF IMPLEMENTATION

EIA REPORTS	
1.	Environmental Impact Assessment Report of the Kozloduy NPP (EIA Report of Kozloduy NPP), Sofia, 1999
2.	Environmental Impact Assessment Report of the Kozloduy NPP Dry Spent Fuel Storage Facility, 2005
3.	Environmental Impact Assessment Report of the investment proposal "Construction of new nuclear capacity of the latest generation at the Kozloduy NPP Site", Kozloduy NPP-New nuclear capacity EAD, 2013
4.	Impact Degree Assessment Report of the investment proposal "Construction of new nuclear capacity of the latest generation at the Kozloduy NPP Site", with the subject and aims for protection of the protected areas, Kozloduy NPP-New nuclear capacity EAD, 2013
5.	Environmental Impact Assessment Report of a facility for treatment and conditioning of RAW with large coefficient of volume reduction at the Kozloduy NPP, 2013
6.	Environmental Impact Assessment Report of the closure of units 1-4 of the Kozloduy NPP
REPORTS ON THE PRE-DESIGN STUDIES AND SITE STUDIES PERFORMED BY THE SE RAW, REPORTS SUBMITTED WITH THE BULGARIAN NUCLEAR	

REGULATORY AGENCY	
7.	Report on Completion of the Development of a Concept and Planning for Site Selection Phase, a report submitted with the Bulgarian Nuclear Regulatory Agency
8.	Report on Completion of Data Acquisition and Regions Analysing Phase, a report submitted with the Bulgarian Nuclear Regulatory Agency
9.	Report on Completion of Sites Characterization Phase 3, a report submitted to Bulgarian Nuclear Regulatory Agency
10	Report on Review and Selection of Potential Sites for NDF, Institute of Geology to the Bulgarian Academy of Sciences, 2007; the study has been carried out during the Data Acquisition and Regions Analysing Phase
11	Complex analysis of the regional geophysical fields and assessment of the seismic risk, Institute of Geology to the Bulgarian Academy of Sciences, 2007; the study has been carried out during the Sites Characterisation Phase, 2007
12	Methodological research to verify the methods and methodologies for study and providing evidence for the acceptability of the relevant sites for the NDF implementation, Institute of Geology to the Bulgarian Academy of Sciences, 2007; the study has been carried out during the Sites Characterisation Phase
13	Performance of Engineering and Geological, Hydrogeological and Geophysical Studies, Institute of Geology to the Bulgarian Academy of Sciences, 2007; the study has been carried out during the Sites Characterisation Phase
14	Joint analysis of the results from the high-accuracy geodesic measurements, geomorphologic and geotectonic measurements, Institute of Geology to the Bulgarian Academy of Sciences, 2007; the study has been carried out during the Sites Characterisation Phase
15	Site Characterization No 4, Institute of Geology to the Bulgarian Academy of Sciences, 2007; the study has been carried out during the Sites Characterisation Phase
16	Geophysical study of the slope to the South of Kozloduy NPP, Sv. Ivan Rilski University of Mining and Geology, 2007
17	Engineering and Geological, Hydrogeological Studies for Implementation of a National Facility for Disposal of Low and Intermediate Level Waste, Sv. Ivan Rilski University of Mining and Geology, 2007; the study has been carried out during the Sites Characterisation Phase
18	Prediction of the Possible Distribution of radionuclides from the NDF into the Sub-soil space and Underground Waters of the Radiana Site, Aqua Modelling Group, 2008; the study has been carried out during the Sites Characterisation Phase
19	Analysis of the Conditions for Near Surface Disposal of RAW, Sv. Ivan Rilski University of Mining and Geology, 2007; the study has been carried out during the Sites Characterisation Phase
20	Report on the Results from Geological, Geophysical, Engineering and Geological, Hydrogeological, Hydrological and Laboratory Studies, MGU-Engineering, 2009, the study has been carried out during the Sites Confirmation Phase
21	Report for elaboration of geological and hydrogeological profile of the plateau between the Radiana Site and the Danube River, report of prof. Jordan Evlogiev under a contract with SE RAW, December 2012

22	Prediction about the risk of flood and erosion from the Danube River at the Radiana Site for disposal facility for low and intermediate level radioactive waste, report of prof. Dimcho Evstatiev and prof. Jordan Evlogiev under a contract with SE RAW
23	Assessment of the change in underground waters level at the Radiana Site in cases of maximal increase of the Danube River level, report of prf. Iliya Yotov under a contract with SE RAW
24	Engineer, geological, hydrological and geological on-site and laboratory studies of the level-flat area of the Radiana Site; report elaborated by Institute of Geology to the Bulgarian Academy of Sciences under a contract with SE RAW, August 2011
25	Lithographic drillings at the longitudinal axis of the storage modules of the NDF at the Radiana Site for specifying the elevation of the attitude of Pliocene sediments, report of the Institute of Geology to the Bulgarian Academy of Sciences under a contract with SE RAW, November 2012
26	Programme for predisposal radiation monitoring of the National disposal facility for radioactive waste; SE RAW, 2013; the programme is part of the documentation of the Application for approval of the selected site
27	Programme for predisposal hydrological and geological monitoring of the National disposal facility for radioactive waste; SE RAW, 2013; the programme is part of the documentation of the Application for approval of the selected site
28	Programme for predisposal seismologic monitoring of the National disposal facility for radioactive waste; SE RAW, 2013; the programme is part of the documentation of the Application for approval of the selected site
29	Terms of reference for predisposal geodesic monitoring of the Radiana Site, SE RAW, 2013
30	Terms of reference for predisposal seismologic monitoring of the Radiana Site, SE RAW, 2013
31	Programme for predisposal radiological monitoring of the Radiana Site, 2013; report of Tita Consult OOD under a contract with SE RAW for Predisposal radiological monitoring of the Radiana Site; protocols demonstrating the implementation of the contract;
32	Conceptional project of the NDF in two versions, prepared by consortium Westinghouse Electric Spain, DBE Technology and Enresa, 2012
33	Technical project of the NDF in two versions, prepared by consortium Westinghouse Electric Spain, DBE Technology and Enresa, 2013
34	Detailed site development plan - Plan for regulation and development for the NDF at the Radiana Site, 2012
35	Preliminary report for safety analysis, Report on Task 4.2 of the PHARE Project №EUROPEAID/122568/D/SV/BG, 2008
36	Programme for site monitoring, Report on Task 4.4. of the PHARE Project №EUROPEAID/122568/D/SV/BG, 2008
37	Update of radionuclide inventory for the NDF, Report on Task 3 of the PHARE Project №EUROPEAID/122568/D/SV/BG, 2008
38	Pre-project study for NDF construction, disposal facility type shaft, Minproekt EAD, 2009
39	Pre-project study for NDF construction, disposal facility type tunnel, Minproekt EAD, 2009
40	Updated preliminary safety analysis of the NDF, under development, Risk Engineering
41	Technical and economical foundation, under development, Risk Engineering

42	Preliminary safety assessment of the NDF, SE RAW, 2013, the programme is part of the documentation of the Application for approval of the selected site
43	Interim safety assessment report, prepared by consortium Westinghouse Electric Spain, DBE Technology and Enresa, 2014
44	Report on the possibilities for implementation of measures for population protection in case of a severe radiation failure, SE RAW, 2013, the programme is part of the documentation of the Application for approval of the selected site
45	Working project for dislocation of part of the ELBA electric power line 20 kV, owned by Chez Electro Bulgaria AD, 2013
46	Conceptual project for dislocation of part of an irrigation canal crossing the Radiana Site, 2013
47	Detailed site development plan – Site plan for dislocation of part of an irrigation canal crossing the Radiana Site, 2013
48	Technical terms of reference for elaboration of a Technical project for dislocation of part of an irrigation canal crossing the Radiana Site, 2013
49	Working project for drinking water-piping and water-meters shaft with water-meters knot for water supply of the Radiana Site and dislocation of part of a drinking water piping crossing the vicinity of the Radiana Site
50	Detailed site development plan – Site plan for dislocation of part of drinking water-piping crossing the Radiana Site, 2013
51	Working project for construction of a temporary road for access to the Radiana Site, 2013
52	Working project for construction of an industrial fence at the Radiana Site, 2013
53	Multiattribute evaluation and recommendations to SERAW, (evaluation and recommendations to SE RAW), prepared by consortium Westinghouse Electric Spain, DBE Technology and Enresa, 2012г.
54	Detailed Programme for Realization of the Hydrogeological Monitoring and Geochemical Analysis, 2013г., report of consortium National Nuclear Laboratory, UK and British Geological Survey upon a contract with SE RAW for implementation of Predisposal hydrological and geological monitoring of the Radiana Site
55	Preliminary Hydrogeological model for the Radiana Site, 2013, report of consortium National Nuclear Laboratory, UK and British Geological Survey upon a contract with SE RAW for implementation of Predisposal hydrological and geological monitoring of the Radiana Site
56	Design of the Overall Monitoring System Including Vadose Zone and Saturated Zone (Aquifer) Monitoring, 2013г., report of consortium National Nuclear Laboratory, UK and British Geological Survey upon a contract with SE RAW for implementation of Predisposal hydrological and geological monitoring of the Radiana Site
57	Construction of Vadose Zone Monitoring Systems, 2013, report of consortium National Nuclear Laboratory, UK and British Geological Survey upon a contract with SE RAW for implementation of Predisposal hydrological and geological monitoring of the Radiana Site
58	Construction of the Saturated zone (Aquifers) Monitoring System, 2013, report of consortium National Nuclear Laboratory, UK and British Geological Survey upon a contract with SE RAW for implementation of Predisposal hydrological and geological monitoring of the Radiana Site
STRATEGIES	
59	Strategy on Spent Fuel and Radioactive Waste Management to the year 2030. Approved by the Council of Ministers by a Protocol Decision No 1.5/05.01.2011

60	Updated Strategy on Decommissioning of the Kozloduy NPP Units 1-4; KPMU/DCS/001 – Rev. 0, 2006
61	Regional Strategy for Development of the Vratsa Region for the period 2005–2015; approved at a meeting of the Regional Council for Development of the Vratsa Region of 28 November 2005
OTHER MATERIALS	
62	Programme for Environmental Protection of the Kozloduy Municipality for the period 2010–2013
63	Municipal programme for waste management of the Kozloduy Municipality, 2010-2013
64	Marketing profile of the Kozloduy municipality
65	Programme for Tourism Development in the Kozloduy Municipality for the Period 2008-2011
66	Report on the Status of the Environment in the period 2009-2013, Regional Inspectorate of Environment and Waters - Vratsa, MoEW
67	Results from the Kozloduy NPP Radioecological Monitoring – years 2009, 2010, 2011, 2012, 2013
68	Purposely acquired/retrieved materials in the course of the consultations

APPENDICES