

**ENVIRONMENT IMPACT ASSESSMENT  
REPORT ON**

**INVESTMENT PROPOSAL**

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

**PART IX**

**DESCRIPTION OF THE MEASURES MEANT TO PREVENT, DECREASE,  
OR WHERE POSSIBLE TO STOP SIGNIFICANT NEGATIVE IMPACTS ON  
THE ENVIRONMENT AND PLAN FOR THEIR EXECUTION**

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## CONTENTS

### PART IX

<b>9 DESCRIPTION OF THE MEASURES MEANT TO PREVENT, DECREASE, OR WHERE POSSIBLE TO STOP SIGNIFICANT NEGATIVE IMPACTS ON THE ENVIRONMENT AND PLAN FOR THEIR EXECUTION.....</b>	<b>4</b>
9.1 PLAN FOR IMPLEMENTATION OF MEASURES.....	4
9.2 RECOMMENDATIONS FOR ENVIRONMENT MANAGEMENT .....	11
9.2.1 NON-RADIOLOGICAL ASPECT.....	11
9.2.1.1 ATMOSPHERIC AIR .....	11
9.2.1.2 WATERS.....	11
9.2.1.2.1 SURFACE WATERS .....	11
9.2.1.2.2 GROUND WATERS .....	12
9.2.1.3 BOWELS OF THE EARTH.....	12
9.2.1.4 LANDS AND SOILS .....	12
9.2.1.5 NOISE .....	13
9.2.1.5.1 DESIGN STAGE .....	13
9.2.1.5.2 CONSTRUCTION STAGE .....	13
9.2.1.6 HAZARDOUS SUBSTANCES AND MIXTURES.....	13
9.2.1.7 WASTE.....	13
9.2.1.7.1 RADIOLOGICAL ASPECT.....	13
9.2.2 RADIOLOGICAL ASPECT .....	13
9.2.2.1 GROUND WATERS .....	13
9.2.2.2 BOWELS OF THE EARTH.....	14
9.3 RECOMMENDATIONS CONCERNING THE INDIVIDUAL MONITORING PLAN.....	15
9.3.1 NON-RADIOLOGICAL ASPECT .....	15
9.3.1.1 ATMOSPHERIC AIR .....	15
9.3.1.2 GROUND WATERS .....	15
9.3.1.3 BOWELS OF THE EARTH.....	15
9.3.1.4 LANDS AND SOILS .....	16
9.3.1.4.1 RECOMMENDATIONS CONCERNING THE SOIL MONITORING OF THE RADIANA SITE: .....	17
9.3.1.5 NOISE .....	17
9.3.2 RADIOLOGICAL ASPECT .....	17
9.3.2.1 GROUND WATERS .....	17
9.3.2.2 BOWELS OF THE EARTH.....	18
9.4 RECOMMENDATIONS CONCERNING THE EMERGENCY PLAN.....	18
9.4.1 NON-RADIOLOGICAL ASPECT.....	18
9.4.1.1 ATMOSPHERIC AIR .....	18
9.4.1.2 LANDS AND SOILS .....	18
9.4.2 RADIOLOGICAL ASPECT.....	18

**LIST OF TABLES**

***PART IX***

TABLE 9.1-1 PLAN FOR IMPLEMENTATION OF MEASURES.....4

## 9 DESCRIPTION OF THE MEASURES MEANT TO PREVENT, DECREASE, OR WHERE POSSIBLE TO STOP SIGNIFICANT NEGATIVE IMPACTS ON THE ENVIRONMENT AND PLAN FOR THEIR EXECUTION

For the purpose of prevention, mitigation or compensation of any negative environmental impact as part of the implementation and operation of the IP a program must be developed, including short and long-term activities, to ensure the facility’s compliance with the environmental and occupational health and safety regulations.

The proposed measures are developed in accordance to the requirements of the Regulation on the terms and procedures for preparation of environmental impact assessments (SG 25/2003, last amended and supplemented in SG 3/2011). These measures also take into consideration the planned programs of measures for prevention and mitigation of anthropogenic pressure (point and diffuse sources of pollution) and impact on the water resources, monitoring and control measures, including ones for the water protection areas in Program 7.1.5, Program 7.1.6, Program 7.1.7 and Program 7.1.8 of RBMP 2010-2015 according to Letter No. 3804/08.01.2013 of BDWMDR - Pleven.

**Table 9.1-1** shows the Plan for implementation of 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-radiation aspect on the environment, as well as a plan for the implementation of these measures. They are related to the: **D** – design; **C**- construction; **E** – exploitation; **CI** – closure.

The proposed Plan for implementation of measures is elaborated for the various components and factors of the environment.

### 9.1 PLAN FOR IMPLEMENTATION OF MEASURES

In accordance with the foreseen measures and stages, a plan for the implementation of the measures is drawn and shown in Error! Reference source not found..

**TABLE 9.1-1 PLAN FOR IMPLEMENTATION OF MEASURES**

<b>№</b>	<b>Measures</b>	<b>Period (phase) of application</b>	<b>Result</b>
<b>A/ Non-radiological aspect</b>			
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, E, 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, E, 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, E, 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 exploitation and closure of the facility.	D,C,E, 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 maximal 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 exploitation 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, E, 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 E (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, E,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, E,CI	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, E,CI	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 asphaltting, when working in the laboratories, etc.) a strict observation of all requirements under the safety, labour hygiene and fire safety.	C, E,CI	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,E, CI	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, E, CI	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 safe 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.	E, CI	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, E, 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, E	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, E, 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, E, 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.	E	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, E, 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	<p>The implementation of the Program for pre-operational radiological monitoring to continue:</p> <ul style="list-style-type: none"> <li>- at the Radiana site monitoring the radio ecological status of the atmospheric air, ground waters, soils, flora</li> <li>- at the foreseen areas and points of surface flowing waters in the vicinity of the Radiana site</li> </ul>	C	Analysis of the radio ecological 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 radio ecological status of the site and the environment	E, Cl	Analysis of the radio ecological 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 exploitation. Assessment of the professional exposure of the personnel during the exploitation and the closure of the repository.	E	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 exploitation.	E, Cl	Ensuring radiation protection within the site, of the environment and of the population in the area.
<b>C/ Others</b>			
51	Ensuring jobs during the periods of construction and exploitation, and their occupation by experts who have the necessary experience for managing the particular activity.	C,E,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, E, 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	<p>In the following design phases to be developed the following plans which should be periodically updated during the exploitation and closure:</p> <ul style="list-style-type: none"> <li>- A Program for non-radiological and radiological monitoring,</li> <li>- Emergency plan.</li> </ul>	E,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,E, CI	Prevention of risk for the environment and the working conditions.
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**D – Design, C – construction, E – exploitation, CI – Closure.**

## **9.2 RECOMMENDATIONS FOR ENVIRONMENT MANAGEMENT**

### **9.2.1 NON-RADIOLOGICAL ASPECT**

#### **9.2.1.1 ATMOSPHERIC AIR**

Regarding the atmospheric air, only during the construction should be implemented the requirements of article 70 (1) of the Regulation 1/2005 about *the emission limit values of harmful substances (pollutants) released in the atmosphere by sites and activities with stationary sources of emissions* for reduction of emissions of powdery substances upon loading and unloading, storage and handling of powdery materials, namely:

1. during transportation – usage of closed or covered with tarpaulin vehicles; regular irrigation of factory transportation road;
2. during handling – limitation of the activities during high wind speeds and directions; the open-air areas for loading and unloading should be irrigated.

#### **9.2.1.2 WATERS**

##### **9.2.1.2.1 SURFACE WATERS**

The proposed measures take into consideration the planned programs of measures for prevention and mitigation of anthropogenic pressure (spot and diffuse sources of pollution) and impact on the water resources, monitoring and control measures, including ones for the water protection areas in Program 7.1.3, Program 7.1.5.1, Program 7.1.5.2, and Program 7.1.6. Program 7.1.7, Program 7.1.8 and Program 7.1.9 of the RBMP of the Basin Directory for Water Management of the Danube River and according to Letter No. 2915/05.06.2014 of BDWMDR - Pleven. These programs implement the requirement of the RBMP for regulation of emissions through prohibitions to introduction of spot sources of pollution, prohibitions to instructions of diffuse sources of pollution, prevention of water pollution with priority compounds and prevention or reduction of the impact by emergency pollutions and compliance with the regimes of protected territories. These requirements will be necessary to observe during the implementation of the IP for NDF. According to Letter No. 2915/05.06.2014 of BDWMDR the specific ecological purpose for surface water body Danube River with code BG1DU000R001 is: „Prevention of the deterioration of the ecological capacity and reaching a good one until the year 2021“, „Prevention of the deterioration of the chemical status and reaching a good one until the year 2027“.

#### 9.2.1.2.2 *GROUND WATERS*

The measures for protection of the quantitative and chemical status of ground waters are noted in the technical project for NDF, elaborated by Westinghouse, DBEtec, Enresa, EQE Bulgaria, namely:

- locating the depository in an unsaturated aeration zone with sufficient thickness over the ground waters layers, which eliminates direct impact on them;
- construction of the cells' fundament on a loess-cement cushion, which is 5,0 m thick, to increase the bearing capacity of the earth fundament and of the thickness of the unsaturated zone over the ground waters layer; construction of systems for organized catching and evacuation of rain and potentially non-radiation polluted waters through ditches, drainages, canal collectors, rain water collection pond, galleries and a infiltration control network;
- supplying water for drinking and domestic needs from the water-supplying network of the Kozloduy town, which is being supplied by already existing water intake facilities with a regulated intake regime;
- implementation of an elaborated programme for pre-operational hydro-geological monitoring of ground waters.

These measures are in compliance with part of the planned programmes of measures for prevention and mitigation of anthropogenic pressure (spot and diffuse sources of pollution) and impact on the water resources, monitoring and control measures, including ones for the water protection areas in Programs 7.1.3, 7.1.5.1, 7.1.5.2, 7.1.6, 7.1.7, 7.1.8 and 7.1.9 of the RBMP of the Basin Directory for Water Management of the Danube River and according to Letter No. 2915/05.06.2014 of BDWMDR - Pleven.

#### 9.2.1.3 *BOWELS OF THE EARTH*

The technical project, elaborated by Westinghouse, DBEtec, Enresa, and EQE Bulgaria, provides the following measures for protection of the bowels of the earth:

- technology for conduction of excavation works, which ensures preservation of the slopes' sustainable parameters and the trench of the depository without setting off landslides and in cases of earthquake impact;
- technical solutions for elimination of slumping layers and improvement of the bearing capacity of the earth fundament under the RAW disposal cells and other buildings and facilities;
- measures for prevention and mitigation of surface erosion through security ditches for catching and leading rainwater outside the excavation, and covering and planting the slope surface and the depot for soils;
- a programme for pre-operational geodesic monitoring of the movements and deformations, as well as a similar programme for operational monitoring which is about to be elaborated.

#### 9.2.1.4 *LANDS AND SOILS*

All recommendations regarding the environment management are clearly elaborated in the legal framework concerning management of the nuclear energy, of the MOEW, ME, MOAF and EFA. Thus, the single and clear recommendation can be to be observed the requirements of the legal framework – acts, regulations and orders.

### **9.2.1.5 NOISE**

#### **9.2.1.5.1 DESIGN STAGE**

According to its design, the investment proposal foresees the usage of modern machines and facilities for the construction and operation of the repository, which have good technical and acoustic indicators. The design foresees the usage of suitable mufflers for the ventilation systems.

#### **9.2.1.5.2 CONSTRUCTION STAGE**

The equipment and facilities used during the construction of the facility, should meet the requirements provided by Regulation on significant requirements and assessment of correspondence of equipment to be used outdoors regarding the noise they release to the air (CM, SG 11/2004). The Regulation is synchronized with Directive 2002/88/EU.

The routes used for servicing transport during the construction of the NDF should be coordinated with the Kozloduy municipality and the respective city halls.

### **9.2.1.6 HAZARDOUS SUBSTANCES AND MIXTURES**

Prior to the beginning of the NDF construction it should be elaborated organizational and managerial measures for safe storage of the utilized hazardous chemical substances and mixtures (including paints, fuels and lubricating oils) in accordance with the Regulation on the terms and procedures for storage of hazardous chemical substances and mixtures, as well as with the set requirements noted in the attached safety data sheets for usage and storage of chemical substances and mixtures.

Prior to putting into operation of the storehouses, containers and 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.

Observation of all instructions for safe operation with hazardous substances. It is necessary a strict observation of all requirements under the safety, labour hygiene and fire safety.

All operations with hazardous substances should be carried out by qualified and well instructed personnel.

### **9.2.1.7 WASTE**

#### **9.2.1.7.1 RADIOLOGICAL ASPECT**

It should be carried out continuous strict control and efficient management of all types of generated waste during the different stages of the NDF implementation, so that all requirements of the existing legal framework are fulfilled in order to avoid accumulation at the production site and to limit its negative impact.

## **9.2.2 RADIOLOGICAL ASPECT**

All recommendations regarding the environment management are clearly elaborated in the legal framework concerning the management of nuclear energy, of the MOEW, MH and NRA. Thus, the single and clear recommendation can be to be observed the requirements of the legal framework – acts, regulations and orders.

### **9.2.2.1 GROUND WATERS**

In the design of the investment proposal are applied all requirements of the Regulation on safe management of radioactive waste, which are based on the conception for in-depth protection of the repository and the environment through simultaneous application of a module multi barrier system and administrative measures.

The multi barrier system consists of:

- first barrier - a cement matrix which includes the reinforced concrete container with RAW. It ensures a full retention on the RAW by maintaining its integrity for a minimum of 50 years.
- second (intermediate) barrier is a constructive element of the repository: the reinforced concrete walls of the repository chamber, its bottom slab and the filling material. Its safety function is: retention of the potentially released radionuclides from the waste packages through maintaining their mechanical integrity to a reasonable extend for a period of 300 years after the closure of the repository.
- third (external) barrier includes the ground base and a multilayer cover. In addition to prevention of the migration of radionuclides, the barrier also increases the thickness of the unsaturated area and improves the overall condition of the base. The multilayer cover is constructed from natural materials - clay, sand and gravel., and it limits water infiltration through the walls of the disposal cells;
- fourth (natural) barrier are the geological formations with their physic and mechanical, filtration, geochemical and other features.

Additional elements of this concept are also the measures included in the technical design for NDF, which is elaborated by Westinghouse, DBEtec, Enresa and EQE Bulgaria, namely:

- construction of systems for organized catching and evacuation of rainwater and potentially radiologically polluted waters through galleries and a infiltration control network;
- implementation of an elaborated programme for pre-disposal radiological monitoring of the National disposal facility for radioactive waste, which also includes monitoring of the ground waters and the sources of drinking water.

The administrative measures, which are implemented during the operation and after the closure of the repository, are expressed in a system of technical and organizational measures for protection of the barriers and preservation of their efficiency, as well as protection of the population and the environment.

#### **9.2.2.2 BOWELS OF THE EARTH**

The measures, which are foreseen in the technical design elaborated by Westinghouse, DBEtec, Enresa and EQE Bulgaria and mentioned above in section 9.2.1.3, are also directed to protection of the bowels of the earth in a radiological aspect because:

- the integrity of the RAW disposal cells largely depends on the stability of the NDF slopes. Therefore, the strict observation of the project's sustainable parameters and excavation works technology ensures protection of the bowels of the earth from radiation contamination;
- technical solutions for elimination of slumping layers and improvement of the bearing capacity of the ground base under the RAW disposal cells also ensure protection of the bowels of the earth from radiation contamination;
- the programme for predisposal geodetic monitoring of the movements and deformations, as well as the similar programme for disposal monitoring which is about to be elaborated, contributes to the integrity of the cells with RAW, respectively to the protection of the bowels of the earth from radiation contamination.

### **9.3 RECOMMENDATIONS CONCERNING THE INDIVIDUAL MONITORING PLAN**

#### **9.3.1 NON-RADIOLOGICAL ASPECT**

##### **9.3.1.1 ATMOSPHERIC AIR**

In accordance with the set terms and procedures concerning special-statutory areas in the vicinity of nuclear facilities and sites with sources of ionizing radiation, continuous meteorological monitoring of temperature, humidity, atmospheric pressure, winds, precipitation, etc. should be conducted .

##### **9.3.1.2 GROUND WATERS**

SE „Radioactive Waste“ has elaborated and approved the following programmes for pre-disposal monitoring:

- Programme for predisposal hydrogeological monitoring of National disposal facility for radioactive waste, identification № HX-IIEM-IIM -002/01;
- Programme for predisposal radiological monitoring of the national disposal facility for radioactive waste, identification № HX-IIEM-IIM -001/01, including monitoring of the ground waters and the sources of drinking water.

The aim of these programmes is to ensure additional more detailed and reliable information about:

- the hydrogeological conditions, including the geochemical, radiological and hydro-dynamic features of ground waters and the sources of water for drinking and domestic needs;
- the dose rate for the population living in the proximity of the repository during the period of operation.

Based on the achieved results will be elaborated programmes for hydro-geological and radiological monitoring during the NDF operation and after its closure.

For the implementation of these programmes are used 8 existing boreholes at the Kozloduy NPP site and 12 new monitoring points (piezometers) are built along the south and north border of the Radiana Site. The scope and activities involved in the implementation of the programmes are described in section 3.2.2.

##### **9.3.1.3 BOWELS OF THE EARTH**

For an assessment of the expected permissible deformations of the ground base and on the slopes of the deep excavations, SE RAW has elaborated technical Terms of reference of a „Project for pre-disposal geodetic monitoring of the Radiana Site“ and a „Programme for pre-disposal seismic monitoring of a National disposal facility for radioactive waste“, identification № HX-IIEM-IIM-003/01.

The purpose of the project for predisposal geodetic monitoring is to create a basic network for geodetic monitoring for the Radiana Site and to present updated geodetic information prior to the beginning of the NDF construction and operation. The implementation of this purpose foresees:

- Design and construction of a geodetic monitoring network for measuring numerous geometric elements;
- Assessment of earth movements and deformation at the site during the predisposal period as important input information for the analysis of deformations during the NDF construction and operation;
- Providing data for long-term stability of the natural slope to confirm the design assumptions in order to ensure the long-term stability of the NDF;
- Elaboration of a geodetic monitoring programme during the operation of the NDF.

The purpose of the pre-disposal seismic monitoring is to ensure up-to-date seismic information prior to the operation of the disposal facilities. The main tasks which should be implemented within the frames of the pre-disposal seismic monitoring and the expected results are:

- Design and construction of a local monitoring system for obtaining of instrumental seismic information;
- Registering and analysis of all seismic events and impacts, including micro earthquakes and aftershocks in the vicinity of the NDF site;
- Forecasting a potential future development of unfavourable geodynamic processes in the ground base and assessment of their impact on the long-term stability of the RAW disposal cells;
- Elaboration of a programme for disposal seismic monitoring;
- The scope and activities involved in the implementation of these programmes are described in section 3.3.

#### **9.3.1.4 LANDS AND SOILS**

The purpose of the monitoring is to cover both the unfavourable processes, which will occur after the NDF construction, and the geo-ecological risks, which will be generated in the region. Like other facilities, whose operation is continuous and related to the condition of the environment, the monitoring and control system of the NDF should be built simultaneously with the construction and operation of the disposal facility. A specific type of measurement will continue after the capacity of the NDF is exhausted and the facility is closed. This ensures reliable operation and obtaining of information about the processes occurring in the soils and the geological environment. The plan for soil monitoring is an inseparable part of the design for landscape organization and recultivation of the terrains damaged during the NDF construction and operation. The observations and measurements during the monitoring are in accordance with Regulation №4 of 12<sup>th</sup> January 2009 on soil monitoring, issued by the Ministry of Environment and Waters, Promulgated SG 19/13.03.2009.

The type of the control tools and systems are consistent with:

- The characteristic features of the site;
- The climate indicators in the region;
- The type of the energetic capacity and the potential risk of land and soil contamination;
- The requirements regarding the type and security of alarms in case of ecological dangers;

The zones, which are subjected to soil control, can be of two types:

**1<sup>st</sup> zone** – the external environment around the NDF site – precipitation and temperature (lowest and highest); strength and direction of the wind; surface waters and radiation emissions. These measurements are used to create the water balance of the site and hence to define the eventual anti-erosion measures. The measurements of the temperature, the strength and direction of the wind, and the evaporations add to the complex of meteorological data. The water balance and the other meteorological features – air temperature, humidity, precipitation, atmospheric pressure and wind – can be measured by the hydro-meteorological station which is the nearest to the NDF.

The first group covers parameters that are affected by the physical and chemical processes that take place for a long period of time in geological environment and in the soils. Control is achieved through radiological control, which is continuous during the operation, and through periodical measurements at the terrain, which are carried out from the beginning of the construction works to the recultivation after the end of NDF operation.



**2<sup>nd</sup> zone** – the area over and around the NDF – compression and stability of the soils after the construction (especially of the soils over the elevation terrain) and radiation emissions. The monitoring of the soils at the NDF site both during its operation and its closure, controls two groups of parameters, which usually affect each other and have a direct influence on the environment.

The second group includes geo-technical parameters related to the stability of the NDF. Parameters, such as subsidence or movement of slopes are of primary significance for the security and the safe existence of the recultivated terrain.

**On the basis of the geodetic network created prior to the elaboration of the recultivation design, the subsidence of the terrain should be monitored at the territory of the site itself. These type of measurements are conducted once in two years in case there are no emergency situations (major floods, earthquakes, etc.).**

#### *9.3.1.4.1 RECOMMENDATIONS CONCERNING THE SOIL MONITORING OF THE RADIANA SITE:*

The elaboration of a monitoring project requires obtaining the minimum necessary information for the specific conditions within the range of the site and the natural parameters of the environment. The project of the monitoring plans/programmes should be based on conducted studies.

It is recommended that the „Individual monitoring plan of the NDF“, together with the activities foreseen in the program for preliminary monitoring, should also include a ground waters monitoring, for which the following is necessary:

- design and construction of a minimum of two piezometers equipped for observation of the ground water levels and taking samples from them. Their depth depends on the natural variation of the ground water level;
- continuous and periodic examination of the chemical and radiological indicators of the taken water samples.

**These recommendations should be taken into consideration in the plans for individual (non-radiological and radiological) monitoring of the NDF.**

#### *9.3.1.5 NOISE*

It is not necessary to conduct monitoring of the noise factor in the environment.

### *9.3.2 RADIOLOGICAL ASPECT*

#### *9.3.2.1 GROUND WATERS*

The measures included in the individual monitoring plan of the NDF should be in compliance with the measures and recommendations provided in the Plan for monitoring of the Kozloduy NPP, which has already come into effect. Currently, SE RAW has elaborated and approved a Programme for pre-disposal radiological monitoring of the Radiana Site (identification № TK.Д-142-D3/2012) and a Programme for pre-disposal hydrogeological monitoring of a National disposal facility for radioactive waste (identification № HX-IIEM-IIM-002/01).

Both programmes are intended for ensuring additional more detailed and reliable information about the dose burdening of the population living in proximity of the repository during the period of operation.

The scope and activities related to the implementation of these programmes are described in section 3.2.2.

### **9.3.2.2 BOWELS OF THE EARTH**

The „Project for pre-disposal geodetic monitoring of the Radiana Site“ and the „Programme for pre-disposal seismic monitoring of the National disposal facility for RAW“, identification № HX-IIEM-ПМ-003/01, which are described above and which provide the information necessary for protection of the bowels of the earth in a non-radiological aspect, will contribute to their protection in radiological aspect through control of the technogenic and potential seismic deformation processes at the RAW disposal cells.

The scope and activities related to the implementation of these programmes are described in section 3.2.2.

## **9.4 RECOMMENDATIONS CONCERNING THE EMERGENCY PLAN**

### **9.4.1 NON-RADIOLOGICAL ASPECT**

#### **9.4.1.1 ATMOSPHERIC AIR**

During the emergency plan elaboration, the extreme climate conditions, which are characteristic of the site, should be taken into consideration.

#### **9.4.1.2 LANDS AND SOILS**

The emergency plans should provide for the following aspects in order to protect the lands and soils from non-radiological impacts:

- the prevention of fires and their consequences requires strict control conducted not only by the personnel, but also control on the checkpoint, so that outsiders do not have access to the site and its vicinity; strict calculations of all measures for extinguishing eventual fires, which are similar to the ones that occur in all other industrial sites; provision of a fire hydrant, hoses, functional fire extinguishers, water, etc.; non-admission of flammable objects and waste in proximity of the NDF; continuous monitoring of all facilities for fire safety control;
- to prevent floods, erosion and deflation of the soil surfaces in the vicinity of the NDF, immediately after the construction and assembly works are finished, the site and the area around it should be cleaned of earth masses, waste, chemical substances and unnecessary materials, so that the drainage shafts do not get clogged and they should be regularly cleaned. It is necessary an immediate recultivation and landscape gardening of the unoccupied soil surfaces using grass vegetation to prevent soil erosion and overflowing of water from the higher areas of the terrain to the lowest ones, as well as raising of ground waters.

The green areas also contribute to the limitation of the damages on the soil surface caused by earthquakes, so that control over their maintenance should be foreseen in the emergency plan.

The emergency plan should be elaborated in accordance with the organization of the NDF and NPP operation and with the authorities that are responsible for prevention or mitigation of the consequences caused by emergency situations. After the plan is approved and becomes effective, it should be implicitly observed and the NDF operation – an object of the investment proposal, should be controlled by the NPP supervisory bodies and the state monitoring bodies for emergency situations.

### **9.4.2 RADIOLOGICAL ASPECT**

The measures provided by the emergency plan of the NDF should be in conformity with the requirements for issuing a licence for the site and should be in accordance with the measures and recommendations foreseen in the Emergency plan of the Kozloduy NPP which is already in force. All measures should be consistent with the Regulation on emergency planning elaborated by the Nuclear Regulatory Agency.