CONSORTIUM

"DICON – ACCIONA ING."

ENVIRONMENTAL IMPACT ASSESSMENT REPORT

for Investment Proposal:

BUILDING A NEW NUCLEAR UNIT OF THE LATEST GENERATION AT THE KOZLODUY NPP SITE

CHAPTER 4: DESCRIPTION, ANALYSIS AND EVALUATION OF THE POTENTIAL SIGNIFICANT RADIATION AND NON-RADIATION IMPACT ON THE POPULATION AND THE ENVIRONMENT RESULTING FROM THE IMPLEMENTATION OF THE INVESTMENT PROPOSAL, THE USE OF NATURAL RESOURCES, THE EMISSIONS OF HARMFUL SUBSTANCES DURING NORMAL OPERATION AND IN EMERGENCY SITUATIONS, THE GENERATION OF WASTE AND THE CREATION OF DISCOMFORT

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4.3 LANDS AND SOILS

4.3.1 LANDS

The presented information about the restituted property shows the terrain condition in the region around the proposed sites for construction of the new nuclear unit. They are located on the lands of the town of Kozloduy and Harlets village. The sites distribution (in decares/daa[1]/) is represented as a structure, a way of permanent usage and type of property (see Table 3.3-3 of item 3.3-1).

The terrain structure in Kozloduy region includes water streams and water areas such as: drainage canals, of them 16.107 daa are on state private property, 1.829 daa on municipal private property and another type of canal occupying the largest area of 530.265 daa on land possessed by different public organizations. The total area of canals amounts to 548.194 daa. The earth roads made to meet agricultural needs are on public municipal property and are 42.125 daa of the territory. The grazing grounds and common pastures cover 3 plots of 12.614 daa only.

The fields share amounts to 426.848 daa, of them 355.512 daa private property, 26.901 daa belong to public organizations, 25.187 daa are private state property and 19.250 daa are fields on municipal private property.

Vineyards are on total area of 82.001 daa, of them 46.440 daa are private property, and 27.065 daa cultivated by the municipality. Four plots of vineyards with total area of 8.496 daa belong to public organizations.

The total area of the town of Kozloduy territory in the vicinity of the discussed sites for selection of the most suitable one for the construction of the new nuclear unit amounts to 1111.781 daa.

The area of Harlets village territory adjacent to the sites is considerably larger (over 4 times). On it three drainage canals are built occupying area of 53.728 daa. Two of them

[1] International abbreviation of decare - *deka* (**da**) + *ar* (**a**) = **daa** – equal to 10 ares or 1000 m^2.

are built on state private property with area of 27.279 daa and one on municipal private property of 26.479 daa.

The earth roads cover 37.872 daa of municipal public property only. The fields of total area 910.208 daa belong to different owners. Private lands cover 338.131 daa. The public organizations possess 293.211 daa, and the state private property share is 278.866 daa. In the presented information 28.974 daa are indicated as destroyed fields on state private property. 17.747 daa are indicated as deserted perennial plants, owned by public organizations and 6.443 daa are on municipal private property. The area of one grazing ground of 6.199 daa is a municipal public property.

On the territory of Harlets village the type of land usage is of greater variety. Part of the territory is occupied by energy transfer facilities. It has the biggest share amounting to 3714.745 daa, owned by public organizations. A terrain of 101.712 daa is cited as industrial ground for agricultural needs located on state private property, and also for agricultural needs public organizations possess 0.255 daa on another village territory. The total Harlets village area in the region of the sites is 4877.916 daa, and the territory of both settlements' lands amounts to 5989.697 daa.

The lands in the region are mainly used for plant growing – grain crops. The land is used by means of copyhold, cooperatives and part of it is for private needs. Agriculture is in agreement with the characteristics of agro-ecological regions of chernozem and those of alluvial-meadow, alluvial-delluvial meadow and meadow-marshy soils, the latter on smaller areas. In this region corn, cereals and beans are mostly grown as well as less vegetables and vines as perennial plants. Livestock farming is developed a little, mainly breeding sheep, goats and less cattle.

There is no forest lands in the region of the sites envisaged for the construction of the new nuclear unit (NNU).

4.3.1.1 IMPACT DURING CONSTRUCTION

When choosing the location of the new nuclear site, a preliminary consent by the Minister of Agriculture and Foods is to be requested as per Art. 24c of the Ownership and Use of Agricultural Land Use Act concerning the limitations affecting properties of the state lands; also a procedure has to be conducted for changing the land designation from agricultural to non-agricultural use in agreement with the Agricultural Lands Protection Act and the Regulations on its implementation in case agricultural lands are affected.

For the agricultural lands within the territory of the alternative proposed sites a procedure has to be conducted for changing the type of their use under the terms of the Agricultural Lands Protection Act and the Regulations on its Implementation. In September 2008 a procedure was undertaken for properties No 000231 and No 000238 by State Forest Lands – Oryahovo (Letter No 617/06.07.2009) for including them in the forest fund of afforested and self- afforested lands on the grounds of Forestry Act.

According to the data, only agricultural lands from II, III and IV category will be affected.

Prior to NNU construction, the lands of the sites selected for construction of the investment proposal have to be alienated and their use changed. According to the information presented in item 3.3 of the present EIA Report, the change of usage of 278.700 daa agricultural lands is necessary.

The concrete impact during NNU construction can be described in short as follows:

1. The territorial scope of impact: will be limited – only on the site territory. As the first three sites are of approximately the same area, the territory scope will be limited mainly on 53-55 ha. During transportation of construction materials and depositing of construction waste dust loading on roads and adjacent lands in the region will get increased. The territorial scope of impact on Site 4 is less as the area is smaller.
2. Impact level: the level of impact is low on the lands mainly on the sites themselves.
3. Impact duration: during the NNU construction – about 5 – 7 years.
4. Impact frequency: continuous by the time of building NNU.

4.3.1.2 DURING OPERATION AND DECOMMISSIONING

During operation the negative impact on the lands will be insignificant – lands are anthropogenized.

4.3.1.3 AFTER DECOMMISSIONING

After the final decommissioning of the site, the lands will be entirely recultivated and their future use designated as “brown areas”.

4.3.2 SOILS IN THE NNU REGION

4.3.2.1 IN NON-RADIATION ASPECT

In this region corn, cereals and beans are mostly grown as well as less vegetables and vines as perennial plants. Livestock farming is developed a little, mainly breeding sheep, goats and less cattle.

The data shows that the soils to be affected by the investment proposal realization are mainly those in the region of the selected future site in the NPP region as well as the soils within 30 km zone around “Kozloduy” NPP – chernozem (calcareous, typical and leached) which are most widely spread. Part of them are eroded to different stage, there are also less alluvial-meadow and alluvial-swampy soils.

With regard to their pollution resistance the soils mentioned fall into first and second class because of the high quantity of carbonates and comparatively high quantity of humus. The active soil acidity is within the alkaline specter 7.4 – 8.4. The buffer capacity

of soils is high which successfully compensates pollution impact. The region is characterized by very strong wind erosion in Zlatyata geographical area.

The NNU impact on the population and environment can be divided into impact during construction, during operation and during decommissioning, the expected impact being discussed in radiation and non-radiation aspect.

After construction on lands is realized, soils get thoroughly destroyed as their humus layer is being removed. Also the lower soil layers will be removed and stored for future recultivation or for filling and smoothing of the site relief. For this reason, after the construction we cannot speak of natural soils with their characteristic soil layers. Upon closing and recultivation of the construction or industrial site they will be restored as anthropogenic soils with non-toxic earth masses and humus cover no thinner than 0.30 m. That is why in this section of the EIA Report, the division of soils and lands is a little conditional.

Great impact on soils due to construction is expected only on the construction site. The soils there will be destroyed and sealed by concrete and asphalt because large scale production facilities will be built.

Deposition and storage of different types of waste is expected. Domestic waste during construction will be stored at the existing waste depot of "Kozloduy" NPP or at the regional domestic waste depot of the town of Oryahovo. Construction waste is to be safely disposed for future processing at the construction waste depot designated by Kozloduy Municipality.

At good organization and control, the waste being managed ecologically, will slightly affect the environmental components and the soils in particular.

During the NNU construction the following are envisaged to be built: the main NNU building, auxiliary buildings and facilities, checkpoint, administrative and laboratory complex and auxiliary buildings (stores, garages, workshops) and other.

4.3.2.1.1 During construction

On **Site 1** the established humus seam thickness and the necessary area of 55 ha involves deposition of 210 000 m^3 humus. 4 420 000 m^3 will be needed for filling the ground to elevation zero, or earth activities will totally amount to 4 630 000 m^3. Both the land and the soils on this site will be degraded and transformed. Upon the completion of construction these lands will no longer function as agricultural lands and the land on the site will change its function. The remaining non-built up part of the terrain will be used as landscape only.

On **Site 2** the humus seam thickness is comparatively equal to this of **Site 1** and thus the humus to be removed is estimated to 220 000 m^3. The excavation works are calculated to be 343 000 m^3 earth from the lower layers, and embankments will be half of the excavated – 165 000 m^3. Both the land and the soils on this site will be degraded and transformed. Upon the completion of construction these lands will no longer function as

agricultural lands and the land on the site will change its function. The remaining non-built part of the terrain will be used as landscape only.

Site 3 has similar characteristics to these of Site 1 with regard to the earth works: 210 000 m^3 humus layer, excavated earth will amount to 3440000 м^3, and filling earth will be 3 650 000 m^3. Both the land and the soils on this site will be degraded and transformed. Upon the completion of construction these lands will no longer function as agricultural lands and the land on the site will change its function. The remaining non-built part of the terrain will be used as landscape only.

Site 4 is an urban territory. Soils on the site are destructed and sealed by concrete and asphalt.

During construction the use of the soils will be changed both on the areas to be built-up and on the terrain where buildings, auxiliary roads, canals and other will be built, due to the direct earth works. The effects on the soils are irreversible, direct and negative. These effects will be almost the same on each of the discussed sites except Site 4 where greater part of the soils are sealed under covering or are destructed during previous construction. The earth works will not be done on soils but on construction materials, foundations and geological foundation.

4.3.2.1.2 During operation

At operation stage negative impacts on lands and soils will be significantly less compared to these during construction. Smaller areas of natural soils will remain –areas of greenery and protection zones. The impacts will be temporary – a result of trampling by the off-site transport, spilling of liquids, waste and other. The degree of impact on the soils on all sites during operation is low.

4.3.2.1.3 At decommissioning

Decommissioning and the recultivation of the cleared terrains will have almost the same impact on the environment as during construction. At this stage all the facilities will be disassembled, buildings will be demolished, earth will be provided for filling the places of the former underground facilities, the harmful radioactive waste will be transported to RAS and detoxification of the region will be carried out. After these activities green areas will be built by preliminary developed and approved territory development plan and landscape planning project. Nevertheless, for a long period this region will remain unpopulated by people or domestic animals. The territory scope of impact will be limited within the present area of impact. The degree of impact in the region of the NNU is limited. Duration of impact – many years after NNU decommissioning.

4.3.2.2 IN RADIATION ASPECT

4.3.2.2.1 Impact during construction

There will be no radiation impact connected with the investment proposal construction due to the absence of radioactive sources at this stage. At this stage the only possibility radioactive sources to be used is during controlling the metal when welding constructions by means of radio-flaw detection. In such a case the rules for work and the norms have to be strictly observed.

During the construction of the new nuclear unit no impact on soils from radiation point of view is expected as a result of the construction works. This is valid for all the four sites discussed.

4.3.2.2.2 During operation

During NNU operation the impacts on the soils are negative, direct, temporary, and irreversible.

During NNU normal operation and observation of all technological and engineering requirements no significant impact related to radiation pollution of soils is expected. The possible ways of soils pollution are through air pollution by the radioactive component of emissions or through adsorption of radio nuclides in surface and ground waters polluted as a result of spilling.

The long-lived radioactive aerosols (LLA) (such as: ^{134}Cs, ^{137}Cs, ^{89}Sn, ^{90}Sn,^{95}Zr, ^{59}Fe, ^{58,60}Co, ^{54}Mn, ^{51}Cr, ^{110m}Ag) are of basic importance in the assessment of the possibility of soils pollution as a result of aerosol emissions. Their half life compared to that of the other two groups of radio nuclides in the radioactive emissions is longer and that is why they are especially interesting in the assessment of their impact on the soils, irrespective of their less participation in the NPP activity. Based on the long observations and assessments of Kozloduy NPP impact on the environment (EIA Report Kozloduy, 1999) the maximum design values of ground concentration of LLA (3.2 μBq/m^3 in 1994 and 1996 to 1.06 in 1998) are near the boundary of the 3 km zone, mainly westwards of the NPP. These values are in good correspondence with the emitted activity of LLA by years. They greatly decrease with the increase of the distance from the plant. In this connection, the provision of reliable monitoring of radio-active waste disposal in environment and the maintenance of their impact at as low degree as can be reasonably attained are one of the main objectives in the NNU operation.

In conformity with the legislative requirements for monitoring and control of pollution around and in the national industrial enterprises within a radius of 100 km, more specifically – 30 km around Kozloduy NPP, own monitoring of soils is necessary to be carried out, as well as such by the state authorities. A wide-scope programme has been realized for the observation of the radioactive pollution of soils by four independent

institutions – internal authorities (RMAS) of Kozloduy NPP, NCRRP, divisions of MoEW (EWRI – Vratsa) and ISSAPP "N. Pushkarov" in 2008 – 2011.

In conformity with the international requirements for radiation monitoring around Kozloduy NPP bench mark and control stations for observation have been established. Their choice is in conformity with the particular meteorological and geographic conditions of the region and is representative for obtaining true and comprehensive information.

The data of the radiological monitoring of non-arable soils obtained as a result of the analyses made in the radiation measurement laboratories of Environment Executive Agency (EEA) in 2011 are presented in **Figure 4.3-1.**

No above background values have been established at the assessment of the obtained data concerning the values of the specific activities of the natural radio nuclides in the surface soil layer of the individual monitoring stations.

For the period of Kozloduy NPP operation the contents of the two biologically most dangerous radio nuclides Sr-90 and Cs-137 have been regularly measured. Some institutions have followed the levels of other radio toxic elements like Co-60, Am-241, Ag-110m, the isotopes of U, Ra-226 and in the last few years also of Pu-238,239+240.

The radio ecological monitoring carried out of "NPP Kozloduy" EAD meets fully the national and European norms requirements in this field and is in conformity with the experience and good practice of the countries with well developed nuclear power engineering. It fully corresponds to the Requirements of Art. 35 of Euratom Contract and Recommendation 2000/473/Euratom. The organization and volume of control cover basic components of importance to the preservation of population health and environment status. The carried out analyses' quality is verified by control laboratory analyses in certified national and international laboratories. The results of the conducted monitoring are also verified by means of independent examinations of the controlling authorities in the country – NCRRP/MA, EEA/MoEW, ISSAPP/MHF „N. Pushkarov".

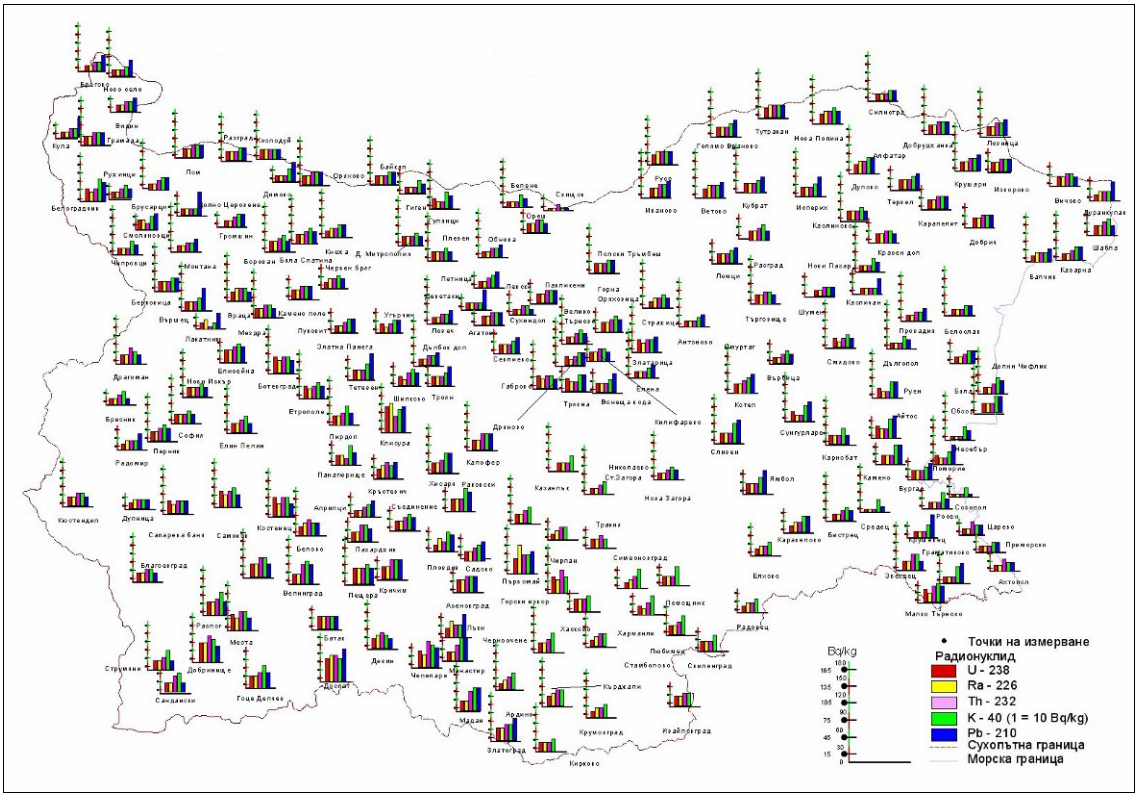


FIGURE 4.3-1: SPECIFIC ACTIVITY OF NATURAL RADIO-NUCLIDES IN NON-ARABLE SOILS FOR 2011 (BQ/KG)

As stated also in item **3.3.2.2.3** of the present report, NPP has no impact upon the radio-ecological status of the soils in the region. The registered technogenic activity (^{90}Sr, ^{137}Cs) is mainly of transborder origin as a result from "Chernobil" accident. In single samples (waste waters and ground waters, bottom sediments, soils and aerosol filters) on the territory of the industrial unit of the station and in the immediate vicinity of it, technogenic radio activity (^{60}Co, ^{137} Cs) has been measured, resulting from the Kozloduy NPP operation. Activity at these sites is usually low, presenting no risk for the staff, population and ecology in the region. Pollution is slight and local. The NPP has no impact on the radio ecological status of the soils in the region.

The technogenic activity in the ecological sites in the 100 km zone (air, waters, soils, vegetation, foods) is close to the background levels, much beyond the admissible norms. No technogenic activity resulting from the Kozloduy NPP operation has been registered. All radiation indicators meet fully the sanitary requirements and the legislative acts.

As a result of the long research work of the Laboratory of radio ecology and radiation investigation at the ISSAPP „N. Pushkarov" it was established that the contents of natural radioactivity in the soils of South Bulgaria and Rila and Rhodopa Mountain is higher than that of the North Bulgaria, respectively Kozloduy NPP. The registered values of the determined natural radionuclides are within the background values cited in literature, which is an indicator for the plant operation. The long research work gave

us the opportunity to work out charts of radionuclide pollution in specific areas – **Figure 4.3-2**.

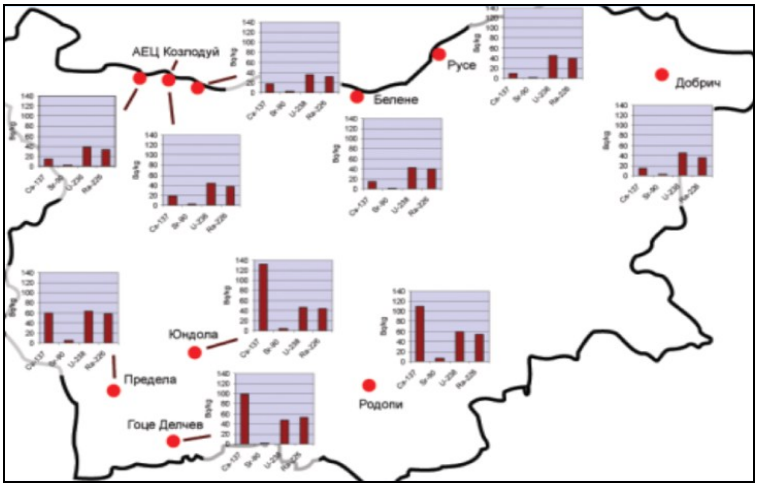


FIGURE 4.3-2: CHART OF RADIONUCLIDES POLLUTION ON THE TERRITORY OF THE COUNTRY AFTER CHERNOBIL NPP ACCIDENT IN THE PERIOD 2006 – 2009

For the needs of investigation, monitoring and assessment of the long-lived aerosols spreading from the Depot for Storing Spent Fuel under Water are necessary irrespective of their insignificant share in the total amount of radionuclides emitted in the atmosphere by Kozloduy NPP.

This comment is valid for the four discussed sites.

The short comment on the NNU impact during normal operation is as follows:

1. Territory range of impact: the production power impact covers 55 ha – mainly the area of production site. Radiation impact however covers also the adjoining territories in the radius of 30 km.
2. Degree of impact: the experience so far of the NPP activity shows that the impact is limited provided that production requirements and standards are observed. In case of non-observance of production requirements there is a real danger of radioactive pollution not only at the site of the investment proposal but also of the soils around.
3. Impact duration: During the nuclear unit operation.
4. The impact will be continuous but slight until ceasing of the site operation, its closure and recultivation.
5. The impact on environment will be of slight cumulative character all the more that part of the existing energy units has already been closed. The monitoring so far demonstrates that the region is relatively slightly affected

by the operation of the former units of the NPP, so the cumulative effect from the NNU will not much exceed the present one.

4.3.2.2.3 During decommissioning

The difference in the NNU decommissioning compared to this of any other industrial site is that during this period there is real danger of radioactive pollution of lands and soils both on the site territory and on the adjoining lands and soils. Decommissioning of the NNU has to be realized at strict observation of the requirements of the "Regulations on safety during decommissioning of nuclear facilities" (promulgated, SG, issue 73 of 20.08.2004), which provides for minimal impact on site soils from radiation aspect. The degree of impact on soils will be low to medium at observing all safety requirements for radioactive waste management. Radiation control and radiological survey of soils before, during and after NNU decommissioning are a must.

This comment refers to the four discussed sites.

NNU is envisaged to operate no less than 60 years. The waste to be generated during this period and the impact on soils in the region of investment proposal will depend on the agreements concluded with the fuel supplier.

The short forecast of the supposed impact during this stage is the following:

1. Territory range of impact: will be limited within the present range of impact.
2. Degree of impact: limited – in the region of construction.
3. Impact duration: many years after NNU decommissioning.
4. Frequency of impact: probably with comparatively low but constant level.
5. Cumulative impact on environment: the cumulative impact expresses itself in this that to the continuous anthropogenic impacts and radioactive effect on soils at decommissioning, new possible impact can be added via air – a result of demolishing the buildings, increased transportation of construction waste and other.

4.3.2.3 CONCLUSION:

The comparison of the sites with regard to the slightest negative impact on lands and soils shows the following:

On **Site 1** the earth works will amount to 4 630 000 m^3.

On **Site 2** the humus layer seam thickness is comparatively the same as this of **Site 1**, but excavation works will be 343 000 m^3 earth from the lower layers, embankments will be about half of the first – 165 000 m^3.

The characteristics of **Site 3** are close to these of the first site as far as the earth works are concerned, but excavation masses amount to 3 440000 m^3, embankments to

3 650 000 m^3, which demonstrate a balance – the amount of earth to be excavated is almost the same as this to be filled in.

Site 4 is sealed so no humus will be excavated from it. Excavation works will be 310 000 m^3. With regard to excavation works and the slightest impact on soils this site is in the most favourable situation.

The difference of using the lands of the first, second and third sites after removing the humus layer is that on Site 1 filling will be necessary for levelling the terrain on which construction is to be realized later.

Site 3 has to be drained because both natural and drainage canals are running through it.

On **Site 2** the balance of earth is most favourable with regard to impact on soils and from soils upon the remaining components and factors of environment. **For this reason it is the most favourable one**. In addition, the terrain there is more stable, and the volume of earth to be transported and stored at the places indicated by Kozloduy Municipality is the smallest one.

4.4 SUBSURFACE AND MINERAL RESOURCES

4.4.1 SUBSURFACE

4.4.1.1 IMPACTS DUE TO EXOGENIC (SURFACE) GEOLOGICAL PROCESSES

Exogenic processes may cause deformation of NPP facilities and may affect environment as a result of unsealing of facilities and breaking the engineering safeguards integrity. For this reason the requirements concerning them are formulated in a great number of legislative acts (NRA, 2004[2]; IAEA: 2004[3], 2010[4], 2011[5]).

At the potential sites for construction of the new nuclear unit of Kozloduy NPP there are conditions for the following exogenic processes of geological danger to occur:

- ✓ increase of ground water level;
- ✓ river erosion;
- ✓ earth sinking and subsidence
- ✓ marsh formations;
- ✓ liquefaction of sands.

[2]Nuclear Regulatory Agency, 2004. Regulation on ensuring the safety of nuclear plants. NRA, Sofia.

[3]International Atomic Energy Agency, 2004. Geotechnical Aspects of Site Evaluation and Foundations for Nuclear Power Plants Safety Guide Series No. NS-G-3.6, IAEA, Vienna.

[4]International Atomic Energy Agency, 2010. Seismic Hazards in Site Evaluation for Nuclear Installations Specific Safety Guide Series No. SSG-9, IAEA, Vienna.

[5]International Atomic Energy Agency, 2011. Meteorological and Hydrological Hazards in Site Evaluation for NuclearInstallations Specific Safety Guide Series No. SSG-18, IAEA, Vienna.

4.4.1.1.1 Increasing the level of ground waters

In accordance with Art. 29 of the Regulation ensuring safety of nuclear plants (adopted by CoM letter No 172 of 19.07.2004, amended and supplemented SG, issue 5/19.01.2010) when choosing a site it is necessary to explore the danger of increasing the ground water level (GWL). The maximum allowed GWL is at 3 m under elevation 0.00 (Art. 26 of the Regulation).

The last requirement from the data in **Section 3.4** concerning hydro-geological conditions is not met at potential sites 1 and site 3, situated on the flooded Danube terrace T_0, where the GWL is close to surface. If any of these sites be chosen, the construction of thick embankment will be necessary. On Site 2 and Site 4, situated on the first non-flooded Danube terrace T_1, the GWL is at 8-10 m or averagely at 5 m under the foundation elevation, i.e., it is below the maximum admissible one.

The existing GWL may increase due to the following:

- the Danube River floods;
- W&S losses, losses from cool channels and other – this concerns Site 2 and Site 4 situated on T_1;
- increase of ground water from the slope located to the South of Terrace T

Floods from the Danube River

The danger of floods is considered as one of the most important because the nuclear power plants are built near rivers or seas. A special document of MAAE (IAEA, 2011, Specific Safety Guide Series, Nr SSG-18) is in presence for its evaluation.

The danger of flooding Kozloduy NPP is explored both at the present existing hydrological conditions and at upset river regime as a result of collapsing a dam wall along the river course. The forecast of flooding is calculated for a period of 10 000 years. At the present hydrological conditions even with extreme rainfalls in the river catchments, the short-term water level at the range of Kozloduy NPP can reach elevation 32-33 m, which is by 2-3 m lower than the elevation of the surface terrace T_1 (35-36 m), on which the Kozloduy NPP has been built and about 6.0 m above the elevation of the flooded terrace T_0.

Under this scenario the increase of ground water may occur in the foundations of sites No 1 and No 3, situated on terrace T_0, where the NNU will have to be constructed upon a thick ballast embankment. Due to the high ballast filtration ratio even at short-term flood on terrace T_0, fast increase of GWL may occur.

At Site 2 and Site 4 at short-term (a several day) flood due to breaking the "Zhelezni vrata" no rising of ground water is expected for the following reasons:

– both sites are far enough from the boundary between the non-flooded T_1 and the flooded T_0 Danube terraces – the Northern end of Site 2 is at 180 m, and of Site 4 – at 250 m from this boundary;

- during flooding of T_0 to elevation 32-33 m the water level on T_1 would raise because of pressure in the water layer of alluvial gravels under the clayey depositions of the terrace and the front contact of the foremost end of the terrace with the lake which will appear in T_0 for a few days;
- increase of GWL will be insignificant because of the greatest share of the water to penetrate under the site through the alluvial and loess clays covering the gravels on T_1. These clays have low flow capacity (coefficient of filtration kf = 0.1 m/24h) and possess water retention qualities.

4.4.1.1.2 Increasing of GWL due to water losses from the NPP facilities

Increasing of GWL is an inevitable process on all built-up territories. Its amount depends on the conditions of ground waters feeding and draining. On the NPP terrain it is due to losses from cool channels, WS&S system and watering the green areas. The moderate coefficient of clayey loess at the place of GWL rising facilitates its increase, and the good drainage of the non-flooded terrace T_1 delays it.

Increase of GWL is observed on the whole NPP territory, shown on the piezometric maps like "water dome" (Investigation and determining of the location of preferred site for the construction of a new nuclear unit at the site of "Kozloduy NPP" EAD and Adjacent territories[6]). The measurements of piezometric boreholes in the region of 1st energy unit show that the GWL in 2011 was at elevation 27.74 m compared to 25.36 m in 1967, i.e., there is an increase with about 2.4 m[7]. Due to the long interval between measurements – 45 years, we can assume that the values 2.0-2.5 m show the maximum increase of GWL for terrace T_1. At this value, the GWL is about 4 m under the medium elevation for facilities foundation which is more than the maximum allowable 3 m. Nevertheless, ongoing hydro-geological monitoring has to be conducted; also the status of the old underground water conduits has to be controlled. Some of them are not being used but the connection to them is not cut, which makes them undesired source of over damping of the ground.

4.4.1.1.3 Increasing of GWL due to waters, running down from the hill

Due to slope of the water resistant mass of the first water bearing layer on the plateau towards Ogosta River, no significant increase is expected of receiving waters in T_1 from the slope.

4.4.1.1.3.1 Erosion

In Chapter **3.4.1.2 – Geo-morphological conditions,** it was stated that in the Kozloduy NPP region the pliocenic terraces T_5, T_4 and $T_{3\ are}$ not present, and the area of the

[6] Survey of conducted investigations, ref. No REL-1000-ST-001-2, January 2013

[7] Research data base in geo-technics of IoG-BAS. 2012. Development of geological and hydro- geological profiles of the plateau through "Radiana" site to the Danube River. Report as per contract with "RAW" SC, prof. I. Evlogiev, Manager

existing terraces is reduced. This shows that Paleodanube has caused serious erosion along its South bank which makes it necessary to clarify whether there might be some danger of erosion in the near future.

Figure 4.4-1 shows the terraces T_1 and T_0, on which the potential sites for new nuclear unit are located, and also the remaining existing Danube terraces.

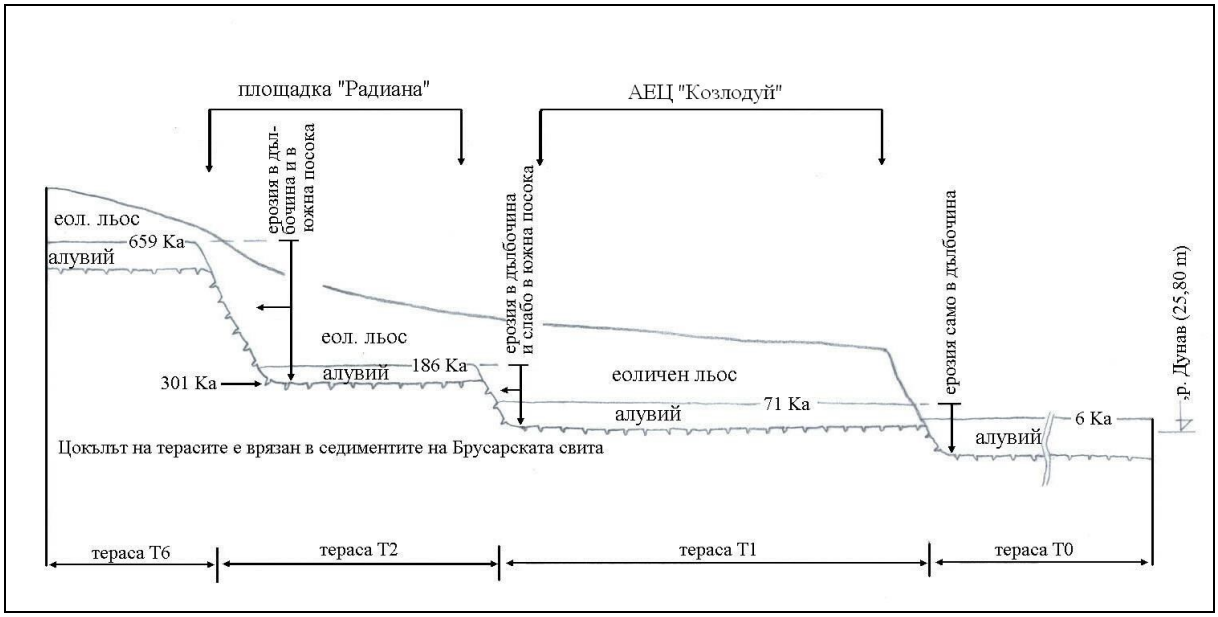


FIGURE 4.4-1: A SCHEME OF GEOLOGICAL-GEOMORPHOLOGICAL PROFILE OF THE TERRACES ALONG THE DANUBE RIVER AT KOZLODUY NPP WITH DATA ABOUT THE EROSION IN THE GEOLOGICAL PAST

The following conclusions can be made based on **Figure 4.4-1**:

- ✓ The alluvial sedimentation on terrace T_6 finished 659 000 years ago. In the following cold spell the river has cut into the land and the terrain has gradually become dry and finally turned into an area of loess accumulation;
- ✓ In the time interval 659-301 000 years Paleodanube has eroded the South bank resulting in washing away the terrace T_6 front and the whole terraces T5, T_4 and T_3. The erosion plinth of terrace $T_{2\ h}$ has been formed, on which alluvium has been accumulated – the surface alluvial layer is 186 000 years old;
- ✓ After the year 186 000, one of the ice periods had started during the guartern, the so called "abrupt climate change by temperature drop" (R_2), the river had cut into the land again and the terrace T_2 front had been washed away;
- ✓ The preservation of the younger terraces T_1 and T_0 proves that in the interval 71-6 000 years, the river erosion has occurred only in depth (the plinth of the low flooded terraces has been formed). The erosion southwards is insignificant which is proved by the comparatively great width of the river terraces – terrace T_1 width is 1.1 km, and that of terrace T_0 – 3.0 km;

- ✓ The present river bed was formed about 6000 years ago. Since then the river has not eroded the South bank which is evident by the great width of the low flooded terrace T_0.

On the grounds of the presented analysis the conclusion can be drawn that in the last 6000 years the Danube River has not eroded the non-flooded terrace T_1, on which Kozloduy NPP is located. On this basis the forecast can be made that such erosion will not occur in the following century.

4.4.1.1.3.2 Subsidence and sinking of the foundation

According to the legislative acts construction of nuclear plants is not allowed on sinking and strongly subsiding soils prior to eliminating these negative qualities. As stated before, the terrace T_1, on which Kozloduy NPP has been built, is covered by loess deposits 11-13 m thick. The loess is well explored by means of on-the-site and laboratory methods with regard to building the Kozloduy NPP energy units 1-6.

In conformity with Regulation No1/10.09.1996 on flat foundation designing (effected 08.01.1997), the loess sinking may be either of I or II type. The loess bed of II type when wet can sink more than 5 cm under its own weight. Depending on the loess layer thickness sinking may reach 1 m. This is a dangerous foundation which is not present at the potential sites for the new nuclear unit.

The loess bed of I type, such are the beds of Site 2 and Site 4, sinks practically only as a result of the additional loading of facilities. Sinking of its own weight when wet is less than 5 cm. The surface loess layer 5-7 cm sinks a lot; deeper layers are practically non-sinking but greatly subsiding.

The loess subsidence at Kozloduy NPP energy units 1÷4 is eliminated by deepening the excavations to non-subsiding layers and building of soil-cement insulation. At energy units 5 and 6, where loading of foundations is greater all the loess has been remover together with the surface sandy-clayey part of alluvia down to the gravels. Then to elevation of the foundation ballast and soil-cement insulation have been built.

No problems associated with foundation have been established during the long-term operation of Kozloduy NPP. The ongoing geodetic monitoring shows that subsidence occurrences coincide with the envisaged ones and are averagely 5.0 to 10.0 cm. The soil-cement insulation is proved to play also the role of protection barrier against the proliferation of the radionuclides to the ground waters.

4.4.1.1.3.3 Forming marshes

As in other Danube lowlands, marshy areas can be observed on terrace T_0 on which the potential Site 1 and Site 3 are located. Their area and depth change depending on the constructions built along the Danube River. In these sections organic soils have deposited, thick up to 1-2 m. They refer to the category of the weak water saturated soils with degree of saturation $Sr > 0.9$ and general deformation modulus $E_0 < 5.0$ MPa.

Should the new nuclear unit be constructed on terrace T_0, the weak water saturated soils will have to be removed and replaced with suitable materials.

4.4.1.1.3.4 Liquefaction of sands

The lack of danger of liquefaction during earthquake of the medium-compact and compact (in accordance with the SPT tests) alluvial sands on terrace T_1 is proved by explorations concerning the Kozloduy NPP operation safety. Since the Vratsa earthquake in 1977 no evidence of this phenomenon has been observed on the non-flooded terrace on the Danube.

Liquefaction due to seismic impact (as with the other lowlands along the Danube River) is possible to occur in the holocenic sands of the flooded terrace (Map of geological danger on the territory of Bulgaria, 1994). Should any of sites 1 and 3 located on terrace T_0, be chosen, these sands will have to be removed and replaced by compact ballast embankment.

4.4.1.2 IMPACTS DUE TO ENDOGENIC GEOLOGICAL PROCESSES

The geological structure in depth, as well as the tectonic and non-tectonic conditions on the four sites are the same, so no preference can be given to any of them with regard to this indicator. The same refers to the seismotectonic conditions. Differences can be observed in the secondary seismic effects. At sites 1 and 3 there is a real danger of liquefaction of the weak water saturated soils which makes their removal and replacement with suitable materials necessary.

4.4.1.2.1 Forecast of the impact on the sites during seismic activities

The characteristics of all sites during seismic impact are similar when comparing periods of construction, operation and decommissioning.

The sites have also similar characteristics with regard to seismic danger caused by the presence of active faults.

There are differences between Site 1 and Site 3, on one side, and Site 2 and Site 4, on the other side only with regard to their yielding to liquefaction during seismic impact, the first pair of sites being in greater danger.

4.4.1.3 FORECAST OF THE IMPACT DURING CONSTRUCTION, OPERATION AND POST-OPERATION PERIOD

4.4.1.3.1 Forecast of the impact on Site 2 and Site 4.

Site 2 and Site 4 have similar engineering-geological and hydro-geological conditions and for this reason similar impact is expected on the geological environment (bowels of the earth).

4.4.1.3.1.1 Impacts during construction

During construction the environment on the sites will suffer the following impacts:

- ✓ Removal of significant volume of earth from the sites during excavation works for foundation. At Site 2 the volume of excavation is 563 000 m^3, and at Site 4 – 310 000 m^3;
- ✓ Building embankments with the excavated earth at the indicated site;
- ✓ Vibrations during compacting and strengthening of the foundation bed;
- ✓ Dust emissions to the neighbouring territory during excavation works and noise of the operating equipment.

The previous experience of low construction of Kozloduy NPP shows that these impacts are manageable and have not caused any damages to the environment, the operation safety of existing facilities, as well as harm to people's health.

4.4.1.3.1.2 Impacts during NNU operation:

During the NNU operation under normal operation conditions the radionuclides migration into ground waters at Site 2 and Site 4 is very unlikely to occur. Such a migration might occur at damaging the engineering safeguards of nuclear facilities (reactor, stores, radioactive waste depots, radioactive waste treatment facilities, etc.), and also of insulation layer in the foundation bed (i.e. soil-cement insulation). On these sites there is a natural insulation barrier – the Brusartsi Formation clays underneath the surface.

The investigations conducted so far by the University of Mining and Geology (UMG) within the framework of exploring the potential sites and these of the Institute of Geology at the BAS and of UMG exploring the NDRAW at "Radiana" site show that even under the most adverse conditions only the most migrating nuclides (iodine and tritium) can penetrate in the waters of the flooded terrace of the Danube River.
In short, the following favourable geological features (geological safeguards) will prevent ground water pollution:

- ✓ the presence of thick pliocenic clay layer under the alluvial sands and gravels of the non-flooded terrace T_1 will be a sure barrier to the radionuclides migration towards the aquifer underlying the clays in the Archar Formation;
- ✓ the construction of an impermeable to water soil-cement insulation on the entire footprint of the nuclear facilities would prevent ground water pollution in case of any potential spills of liquid;
- ✓ the conditioned low-activity and average-activity waste will be disposed in the designated cells of the adjacent national facility at the "Radiana" site, which will be built on the second terrace of the Danube River, where the ground water level is below the T_1-level.

Therefore, the NNU is expected to have no negative impact on the geological environment, provided that the preliminary ground preparation and insulation is in place and the plant operates under normal conditions.

4.4.1.3.1.3 Impact during decommissioning

No such impact is expected after decommissioning. The forecasts concerning the national depot at "Radiana" site for a period of 300 years after its closure and at assuming that all safeguards of the depot will get ruined show that no pollution of ground waters will occur beyond the boundaries of the neighbouring zone of the low flooded terrace.

Forecast of impacts on Site 1 and Site 3.

Site 1 and Site 3 have similar engineering-geological and hydro-geological characteristics because they are situated on the contemporary flooded terrace on the Danube River. Should the NNU be built at this site, most probably the construction project will envisage preparation of the foundation bed, similar to that performed at "Belene" NPP. It will include removal of the weak layers down to the gravels and construction of a thick layer to elevation 34-35 m. That would eliminate the risk of weak soils liquefaction under seismic impact.

Site 1 and Site 3 have similar engineering-geological and hydro-geological features and therefore similar impact on the geological environment (bowels of earth) is expected.

Impacts during construction

During construction the site environment will be affected by the following impacts:

Excavation of the weak liquefying soils down to the level of the gravels, i.e. to 4-7m depth. The excavated material will be stored at a soil disposal facility designated by the Kozloduy Municipality. Excavation works at Site 3 amount to 3 440 000 m3;

✓ Excavation of a large volume of river gravel or any other suitable material for the construction of thick layer under the nuclear facilities. At Site 1 the embankment to elevation 0.00 is 4 420 000 m3, and at Site 3 – 3 650 000 m3. The excavation of such large quantities of materials may cause different ecological problems:

✓ Excavation works under the ground water level will require the building of a high-capacity dewatering system. It will lower the water level at a great distance, the impact on nearby wet areas being of little probability.

✓ Vibrations caused by the soil compaction of embankments;

✓ Dust emissions to the adjacent areas during excavation works and noise emissions from the construction machines.

The experience from the foundation preparation for the Belene Nuclear Power Plant (Belene NPP), realized under similar conditions, demonstrate that these impacts are manageable and have not caused any lasting damages to the environment.

Impacts during NNU operation

✓ The sites are situated at the flooded terrace of the Danube River, which ground waters have a hydraulic connection with the river. That increases the risk of radionuclide migration by the groundwater path compared to Site 2 and Site 4. Furthermore the natural ground layers of Site 1 and Site 3 are of higher permeability, which presents a higher risk of sharp rise of ground water levels.

✓ If the NNU is built on Site 1 and Site 3, the risk of floods during NNU operation will be a serious problem;

✓ In potential emergency situations caused by failure of the dam wall of Zhelezni Vrata, the result will be a short-term rise of the groundwater level, which may cause unfavourable impact on the nuclear facilities;

✓ The conditioned low-activity and average-activity waste will be disposed in the designated cells of the National facility at the "Radiana" site, which will be built on the second non-flooded terrace of the Danube River, where the ground water level is at greater depth compared to T_1-level;

✓ The results from the studies show that contrary to the other sites, the continuity of the clay layer under the alluvial gravels at Site 1 breaks in some sections of the site. In the Eastern part, the gravels together with the sands of the Brusartsi Formation have a hydraulic connection with the sands of the Archar Formation.

Therefore there is a higher probability of unfavourable environmental impact at Site 1 and Site 3 vs. Site 2 and Site 4

Post operation impacts

No such impacts are expected after decommissioning of the NNU.

4.4.1.4 CONCLUSIONS ON THE SITE SELECTION

Based on the analysis of the potential interaction between geological and seismological impact between the NNU and the environment, the conclusion can be drawn that the four potential sites have similar geological structure at depth and similar seismotectonic conditions.

The four sites have similar conditions concerning also the radioactive waste management. The short-lived, low-active and medium-active waste will be stored in the nearby depot "Radiana" which meets the international radiation safety requirements.

From an engineering-geological and hydro-geological point of view, Site 2 and Site 4 are preferable versus Site 1 and Site 3.

Their major advantages are as follows:

Site 2 and Site 4 involve no flood risk and rising ground water level;

The ground rock at Site 2 and Site 4 is more easily susceptible to improvements and will not require construction of thick base of gravel or any other material;

They are situated on the same non-flooded terrace of the Danube as the existing units of the Kozloduy NPP, therefore the future NNU construction process could use the previous experience in the construction of reliable foundations and ground water protection against radioactive contamination.

At Site 2 and Site 4, there is much lower risk of radionuclide migration to the Archar Formation aquifer, vs. the potential risk at Site 1 and Site 3, since a relatively thick clay layer with substantial retention capacity is underlying the surface of Site 2 and Site 4;

Based on the engineering-geological and hydro-geological conditions, Site 2 and Site 4 can be considered as equally suitable sites for the construction of the NNU.

4.4.1.5 ASSESSMENT OF THE IMPACT ON SITE 1 AND SITE 3

4.4.1.5.1 During construction

1. **Probability of impact occurrence** – expected;
2. **Territory coverage** of impact within the area of: the construction site;
3. **Type of impact** – negative, because some place for storing these soils will have to be found; direct impact, secondary;
4. **Degree (significance) of impact** in 5 levels: 3 – medium;
5. **Frequency –** temporary;
6. **Duration** – long-term;
7. **Cumulative effect –** lacking;
8. **Reversibility of impact –** irreversible.

4.4.1.5.2 During operation

1. **Probability of impact occurrence** – expected;
2. **Territory coverage** of impact: in the area around construction site;
3. **Type of impact** – negative and direct, primary;
4. **Degree (significance) of impact** in 5 levels: 3 – medium;
5. **Frequency –** temporary;
6. **Duration** – long-term;
7. **Cumulative effect** – slight;
8. **Reversibility of impact –** irreversible

4.4.1.5.3 Post operation – no impact is expected.

4.4.1.6 ASSESSMENT OF IMPACTS ON SITE 2 AND SITE 4

4.4.1.6.1 During construction

1. **Probability of impact occurrence** – expected;
2. **Territory coverage** of impact: in the area around construction site;
3. **Type of impact** – negative, because some place for storing these soils will have to be found, direct impact, secondary;
4. **Degree (significance) of impact** in 5 levels: 3 – medium;
5. **Frequency –** temporary;

6. **Duration** – long-term;
7. **Cumulative effect –** lacking;
8. **Reversibility of impact –** irreversible

4.4.1.6.2 During operation

1. **Probability of impact occurrence** – slight;
2. **Territory coverage** of impact: in the area around construction site;
3. **Type of impact** – negative and direct, primary;
4. **Degree (significance) of impact** in 5 levels: 2 – low
5. **Frequency –** temporary;
6. **Duration** – long-term;
7. **Cumulative effect** – slight;
8. **Reversibility of impact –** irreversible

4.4.1.6.3 Post operation – no impacts are expected

4.4.2 SEISMIC RISK

The evaluation of the potential seismic risk and its impact on the environment **is independent** of the NNU construction, operation and decommissioning stage. The seismotectonic impact upon the four sites based on the current seismic hazard calculation methods show equal results – there is no evidence of any active tectonic faults within the 30km zone, whereas the parameters of the seismic hazard (potential seismic impact) of the four sites (less than 1.5km distance) within the current models of the respective regional seismic sources should not differ substantially from the current hazard assessment results of the Kozloduy NPP site. Therefore, we could draw the conclusion that the implementation of the planned investment project is not expected to cause changes in the seismotectonic environment. The new nuclear unit project will ensure the new energy units safe operation during and after the forecast seismic impacts.

Definitely no change is expected at the investment intention realization of the endogenic (seismotectonic) parameters of geological environment in none of the stages of construction and operation of the new energy capacities (construction, operation, decommissioning).

4.4.3 NATURAL RESOURCES

4.4.3.1 UNDERGROUND RESOURCES

Due to the fact that no geological findings and operating sites under the Underground Resources Act have been registered, such an impact is not expected.

4.4.3.2 CONSTRUCTION MATERIALS /RIVER BALLAST AND SAND/

Production of aggregates from the dynamic reserves of water bodies – rivers in particular – has a substantial effect on the water body condition. For this reason permissions and

restrictions are set in Waters Act, Art.118h, also bans are introduced by the River Basin Management Plan for producing river ballast from river beds included in section Measures. Any investment proposal concerning river ballast production has first to follow a procedure under the Environmental Protection Act and subsequently follow the Water Act procedures.

The respective Basin Directorate can judge whether the selected location for production is allowed as per the River Basin Management Plan. The permit should strictly fix the annual production limit within the particular river section. Permits shall be issued for a period not exceeding the River Basin Management Plan term.

There is a lawful list of locations where no sand or ballast may be produced from river beds, and a regulated process of clearing riverbed depositions. The purpose of all those measures is to limit the impact on the aquatic ecosystem.

It should be noted that the NNU construction process is expected to involve substantial volumes of such materials to be used for construction solutions and for other specific construction activities.

According to information provided by the Ruse-based department the Executive Agency for Exploration and Maintenance of the Danube River8, which, under the Waters Act, is the competent authority to issue permits for such production from the Danube, a total of 28 permits have been issued for particular sections of the river.

Given the stringent regulation, permitting and control by the competent authorities, the potential impact is assessed as direct, local (of the specific river section) and reversible.

Table 4.4-1 is a list of issued permits for excavation depositions from the Danube riverbed.

On **Figure 4.4-2** and **Figure 4.4-3** the locations are indicated by the Ruse-based department the Executive Agency for Exploration and Maintenance of the Danube River from the preview of critical sections along the Danube River in Vratsa region and Montana region where engineering measures are possible for strengthening the Danube River banks and the fairway as per the Danube Council requirements. These measures will lead to limiting of locations, expanding the riverbed and respectively making it shallower which will be favourable for the planned NNU of Kozloduy NPP.

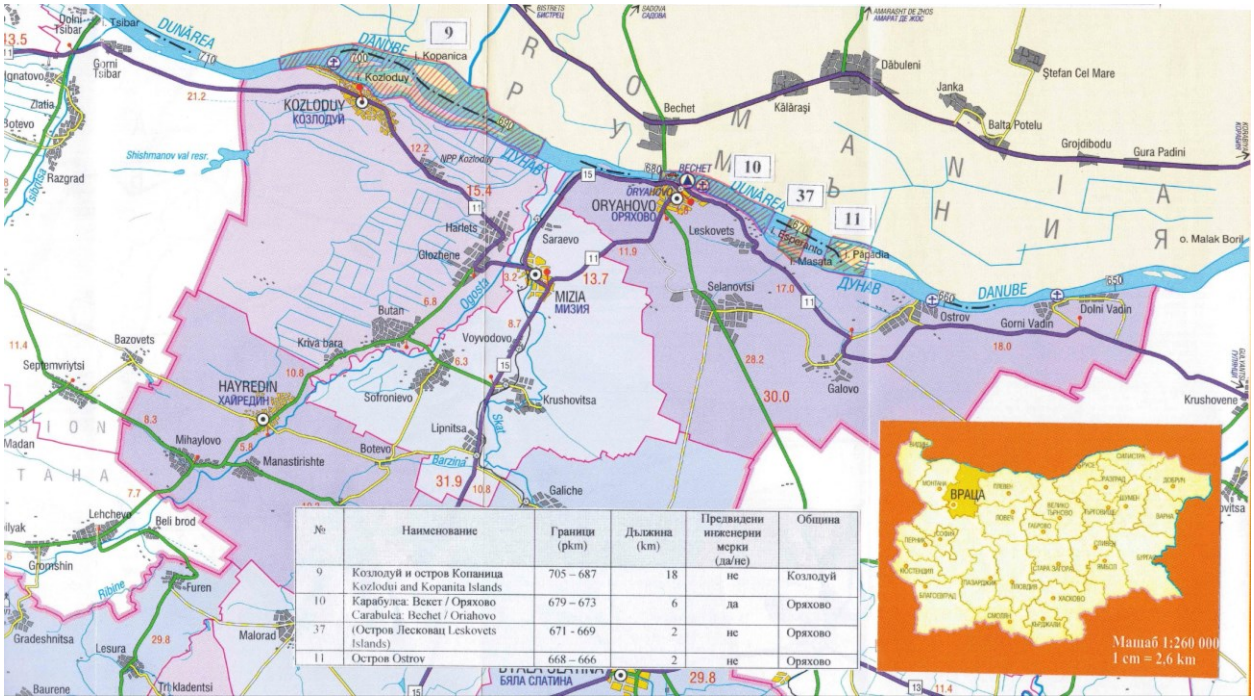
[8] Letter Ref. No VIII-2-204/18.02.2013

TABLE 4.4-1: REGISTER OF PERMISSIONS FOR EXCAVATION OF DEPOSITIONS FROM THE DANUBE RIVER, CODE: BG1DU000R001

No	Holder of permit	No and date of issue	Geographic description, settlement, municipality, region, UCATTU	River km		Area	Allowed annual excavation limit	Permit deadline
				from	to	[decare]	m^3x10^3/year	
1	„DREDGING "ISTAR" PLC	Permit-1/08.08.2011	Leskovets village Oryahovo Municipality, Vratsa district, 43400	675.0	672.0	971	no more than the renewable storage	31.12.2015
2	„DREDGING "ISTAR" PLC	Permit -2/08.08.2011 renewed by decision No71/03.10.2011	On the Bulgarian river bank is the land of Vardim village, Svishtov Municipality V.Tarnovo district, 10118	545.6	542.6	633	no more than the renewable storage	31.12.2015
3	„DREDGING" OOD	Permit -3/08.08.2011	Sandrovo village, Ruse Municipality, Ruse district, 65348	480.0	478.0	293	no more than the renewable storage	31.12.2015
4	„HIT PROEKT PLEVEN" EOOD	Permit -5/08.08.2011	Cherkvitsa village, Nikopol Municipality, Pleven district, 80697	599.4	599.0	50	4.1	11.08.2015
5	„HIT PROEKT PLEVEN" EOOD	Permit -6/08.08.2011	Dragash Voyvoda village, Nikopol Municipality, Pleven district, 23193	587.5	586.0	108	4.5	11.08.2015
6	„TECHNOENGINEERING" 2000" EOOD	Permit -7/08.08.2011	Leskovets village, Oryahovo Municipality, Vratsa district, 43400	676.6	675.4	189	3	13.08.2015
7	„TECHNOENGINEERING" 2000" EOOD	Permit -8/08.08.2011	Ostrov village, Oryahovo Municipality, Vratsa district, 54386	662.5	660.0	842	4	13.08.2015
8	„DANUBE DREDGING" – PLC	Permit -9/08.08.2011	Gomotartsi village, Vidin Municipality, Vidin district, 15998	815.0	812.0	135	no more than the renewable storage	31.12.2015
9	„DANUBE DREDGING" – PLC	Permit -10/08.08.2011	Dunavtsi village, Vidin Municipality, Vidin district, 24061	787.0	786.0	168	no more than the renewable storage	31.12.2015
10	DANUBE DREDGING" – PLC	Permit -11/08.08.2011	Archar village, Dimovo Kozloduy, Vidin district, 00672	770.0	768.0	476	no more than the renewable storage	31.12.2015

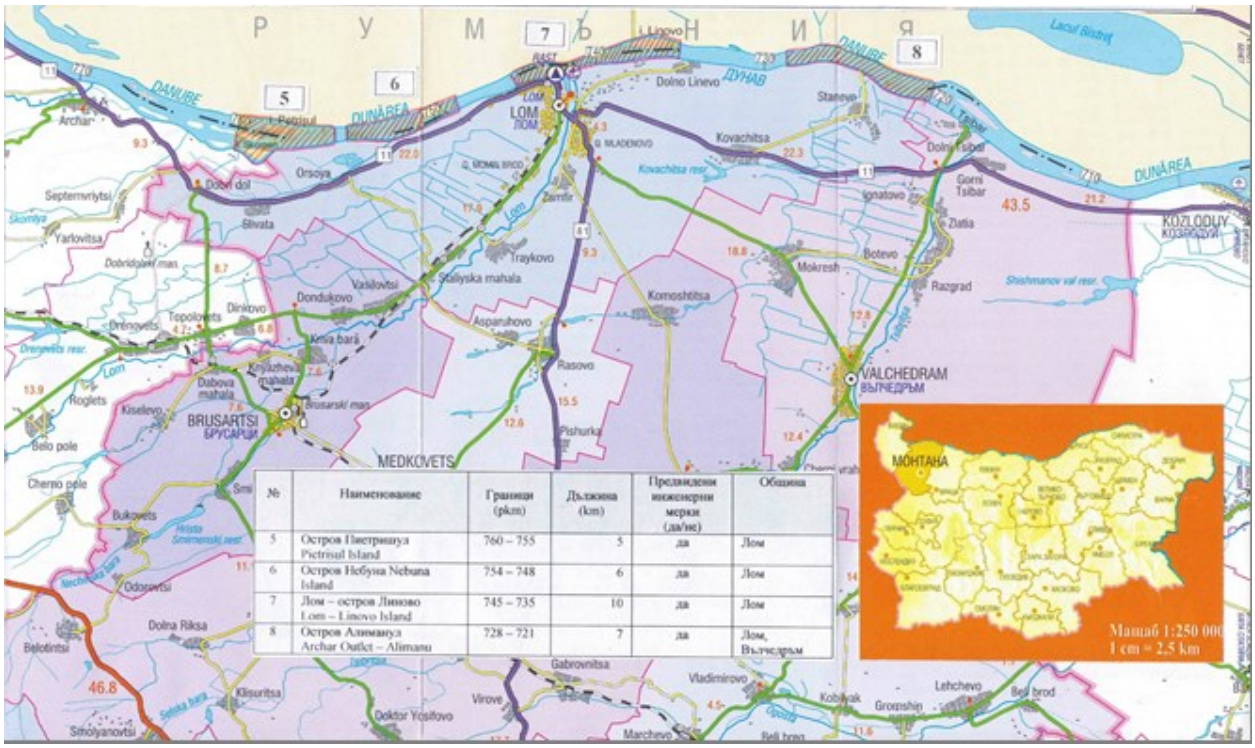
11	DANUBE DREDGING" – PLC	Permit -12/08.08.2011	Archar village, Dimovo Municipality, Vidin district, 00672	761.0	759.0	571	no more than the renewable storage	31.12.2015
12	„DDF" EAD	Permit -13/08.08.2011	Kozloduy , Kozloduy Municipality, Vratsa district, 37798	693.0	691.0	245	no more than the renewable storage	18.08.2015
13	„Zorka Vatova" ET	Permit -14/08.08.2011	Cherkvitsa village, Nikopol Municipality, Pleven district, 80697	601.5	600.7	206	no more than the renewable storage	31.12.2015
14	„Remo – Nikolay Toshev" ET	Permit -15/08.08.2011	Dolni Vadin village, Oryahovo Municipality, Vratsa district, 22321	653.0	651.0	186	no more than the renewable storage	31.12.2015
15	„INERT" OOD	Permit -16/08.08.2011	Pozharevo village, Tutrakan Municipality, Silistra district, 57090	426.0	422.5	735	no more than the renewable storage	28.02.2015
16	„DDF" EAD	Permit -17/08.08.2011	Kozloduy, Kozloduy Municipality, Vratsa district, 37798	690.0	689.0	132	no more than the renewable storage	18.08.2015
17	„POLY – KAMEN CHAKALOV" ET	Permit -18/08.08.2011	Mechka village, Ivanovo Municipality, Ruse district, 47977	521.0	519.3	283	33	31.12.2015
18	„Poly – Kamen Chakalov" ET	Permit -19/08.08.2011	Ruse, Ruse Municipality, Ruse district, 63427	503.5	502.7	79	100	31.12.2015
19	„ROCK MATERIALS" AD	Permit -20/08.08.2011	Zagrazhden village, Gulyantsi Municipality, Pleven district, 30199	629.1	626.0	543	330	31.12.2015
20	„Kaly 89 – Rumen Romanov" ET	Permit -21/08.08.2011	Vardim village, Svishtov Municipality, V.Tarnovo district, 10118	544.0	543.0	213	no more than the renewable storage	04.09.2013
21	„Inertstroy – Kale" AD	Permit -22/08.08.2011 Renewed by decision No76/03.10.2011	Dunavtsi village, Vidin Municipality, Vidin district, 10118	780.4	778.0	645	no more than the renewable storage	31.12.2015
22	„DANUBE DREDGING – VIDIN" PLC	Permit -23/08.08.2011	Dunavtsi village, Vidin Municipality, Vidin district, 24061	783.0	782.0	318	no more than the renewable storage	31.12.2015
23	"Milvina" EOOD	02150021/30.11.2010 MoEW	Dragash Voivoda village,	592.0	591.2	90	30	31.12.2015

			Nikopol Municipality, Pleven district, 23193					
24	"Milen Velikov" ET	Permit -24/11.10.2011	Ruse, Ruse Municipality, Ruse district, 63427	501.4	501.0	70	7	31.12.2015
25	ET "Minko Stilyanov – Detelina Ruse "	Permit -25/19.12.2011	Batin village, Borovo Municipality, Ruse district, 02854	525.1	523.0	103	22	31.12.2015
26	„DANUBE DREDGING" PLC – Ruse	Permit -26/27.01.2012	Ryahovo village, Slivo Pole Municipality Ruse district, 63668	468.0	464.0	753	no more than the renewable storage	31.12.2015
27	"Dredging Company Timok" OOD	Permit -27/03.04.2012	Koshava village, Vidin Municipality, Vidin district, 39147	806.2	808.5	241	no more than the renewable storage	31.12.2015
28	„DREDGING "ISTAR" PLC	Permit -28/11.01.2013	Svishtov, Svishtov Municipality V.Tarnovo district, 65766	556.0	553.5	1125	160	31.12.2015



№	Наименование	Граници (pkm)	Дължина (km)	Предвидени инженерни мерки (да/не)	Община
9	Козлодуй и остров Копаница Kozlodui and Kopanita Islands	705 – 687	18	не	Козлодуй
10	Карабулеа: Векет / Оряхово Carabulea: Bechet / Oriahovo	679 – 673	6	да	Оряхово
37	(Остров Лесковец Leskovets Islands)	671 - 669	2	не	Оряхово
11	Остров Ostrov	668 – 666	2	не	Оряхово

FIGURE 4.4-2: PRELIMINARY SURVEY OF THE LOCATION OF CRITICAL SECTIONS ALONG THE DANUBE RIVER AND POSSIBILITIES FOR ENGINEERING MEASURES ALONG THE RIVER BANKS AND FAIRWAY, VRATSA REGION



№	Наименование	Граници (pkm)	Дължина (km)	Предвидени инженерни мерки (да/не)	Община
5	Остров Пиетришул Pietrisul Island	760 – 755	5	да	Лом
6	Остров Небуна Nebuna Island	754 – 748	6	да	Лом
7	Лом – остров Линово Lom – Lincovo Island	745 – 735	10	да	Лом
8	Остров Алиманул Archar Outlet – Alimanu	728 – 721	7	да	Лом, Вълчедръм

FIGURE 4.4-3: PRELIMINARY SURVEY OF THE LOCATION OF CRITICAL SECTIONS ALONG THE DANUBE RIVER AND POSSIBILITIES FOR ENGINEERING MEASURES ALONG THE RIVER BANKS AND FAIRWAY, MONTANA REGION

4.5 LANDSCAPE

4.5.1 DURING CONSTRUCTION

The construction works required for the new nuclear facilities on Kozloduy NPP territory, that might impact the landscape components, will be assessed individually for each of the four sites.

4.5.1.1 SITE 1

The site's territory is part of an agricultural and anthropogenic landscape. The construction of the investment project will gradually turn the initial agricultural landscape into anthropogenic landscape. The construction will impact the landscape components including the geological properties, soils and vegetation. As a result of the excavation works, the construction process will have a direct impact on the geological properties of the site. This impact is assessed as direct, negative, primary, irreversible, low to medium degree, small in range within the area of the IP construction site.

The impact on the landscape components soils and vegetation is assessed as direct, primary, negative, reversible, low-degree impact, small in range within the area of the IP construction site.

As a result of the earth works, soils will be subjected to mechanical impact. The excavated humus will be stored at a temporary depot at the selected site. The vegetation will be destroyed at the sections where construction will take place on the site. There will be visual changes to the landscape, both in terms of aesthetics and in terms of volumes and space.

At the investment proposal construction stage the social and economic functions of the landscape will not change.

4.5.1.2 SITE 2

During the construction period of Site 2, impact is expected on the landscape, including its geological properties, soils and vegetation. The impact on the geological properties will result from the excavation works. That impact is assessed as direct, negative, primary, irreversible, low to medium degree, small in range within the construction site area.

The impact on soils will be primarily mechanical. The excavated humus will be temporarily stored within the selected site. The site's vegetation will be destroyed. The social and economic functions of the landscape will change from natural environment to industrial environment. The visual perception of the landscape will also change, both in terms of aesthetics and in terms of volumes and space.

During construction the landscape will change, as it will cease to exist as agricultural and forest type of a landscape. The anthropogenic landscape will continue to exist as such and will expand in size, but its sustainability will depend entirely on the human activity.

4.5.1.3 SITE 3

During construction the landscape vertical structure will be affected by negative impact of limited range. Excavation works will directly impact the geological properties. Impact is assessed as primary, irreversible, low to medium degree, within the construction site area.

The excavated humus will be stored at the respective site; the impact on the soils is assessed as direct, negative, reversible, low-degree, small in range.

The vegetation, which is part of the agricultural landscape, will be removed. The impact is assessed as direct, negative, reversible, low-degree, and small in range. As a result, the current agricultural landscape will cease to exist and will become anthropogenic. The visual perception of the landscape will change, but its social and economic functions will remain unchanged.

4.5.1.4 SITE 4

The site territory is part of an anthropogenic landscape, which is part of the NPP. As the setting-up of the construction site progresses, the existing buildings and facilities, which are part of the anthropogenic landscape, will be removed. As a result, there will be a direct impact on the geological properties of landscape components and soils.

The impact on the geological properties is assessed as negative, primary, irreversible, low to medium degree and small in range. The impact on the soils is assessed as insubstantial, as the greater part of them is sealed. The humus will be temporarily removed and disposed within the respective site, and therefore the impact is assessed as direct, negative, reversible, low-degree and small in range, within the construction site.

The anthropogenic landscape of this site includes volunteer vegetation – stray trees and shrub on very small areas, which will be destroyed during the investment project construction. The social and economic functions of the landscape of Site 4 will remain unchanged.

The construction stage of the project at any of the four construction sites is not expected to cause chemical pollution of the landscape components. The only source of pollution and potential impact could be the exhaust gas generated by the construction machines, including CO, NOx, CH4, SO2, and hydrocarbons. There will be a limited amount of emissions within the working hours, temporarily, by the completion of all construction woks on the sites.

The construction stage of the four proposed sites will involve no chemical pollution of the landscape.

The construction at any of the four proposed sites will have no impact on landscapes within the adjacent Romanian territories.

The preferred option at the implementation stage of the investment project is Site 4, as the construction on that site will not change the social and economic functions and purpose of

the landscape. There will be the most insignificant impact on the soils. No arable land will be affected.

4.5.2 DURING OPERATION

The operation stage of the investment project and its impact on the landscape are assessed as identical of all 4 sites:

The investment proposal operation period is not connected with negative impact on landscape components. No pollutants are expected to impact the landscape components.

Local pollution of waters and soils is possible at unforeseen accidents.

The investment proposal operation stage is not connected with impact on the landscape components.

No impact on the environment is expected within the 30km zone around Kozloduy NPP and the adjacent Romanian territories.

4.5.3 IMPACT DURING COMMISSIONING

At this stage no negative impact is expected on the structure of the landscape at any of the 4 sites in question. Rehabilitation of the destroyed land will have a positive effect on the landscape. Depending on the planned use of the respective site, the anthropogenic landscape may be replaced by a new one.

4.5.4 CONCLUSIONS

The construction stage will involve a direct, negative impact on the landscape components including the geological properties, soils and vegetation. The impact on the geological properties of all four sites is assessed as direct, negative, primary, irreversible, low to medium degree, small in range, within the construction site of the proposed investment project. The impact on the landscape components soils and vegetation is assessed as direct, primary, negative, reversible, low-degree and small in range, within the construction site of the proposed investment project.

Gradually in the course of the construction works, the agricultural landscape of sites 1, 2 and 3, together with forest landscape of Site 2 will become anthropogenic.

No chemical pollution of the landscape components is expected at the construction stage on the territory of the four sites. A source of pollution and potential impact could only be the exhaust gas from the internal combustion engines of the construction machines, including CO, NOx, CH4, SO2 and hydrocarbon emissions. A limited volume of such emissions is anticipated, within the working hours, temporarily, by the completion of the construction works at the sites. No chemical pollution of the landscape components is expected.

The **construction** stage at any of the proposed sites will not involve impact on the landscapes of the adjacent Romanian territories.

Site 4 is the preferred site for the implementation stage of the proposed investment project, as the construction works there will not change the social and economic functions and purpose of the landscape. The impact on soils will be most insignificant. No arable land will be affected.

The **operation** stage of the investment project will involve no impact on the landscape components. Unforeseen accidents may cause local pollution of water and soils.

No pollution of the environment is expected within the 30km zone around the Kozloduy Nuclear Power Plant and the adjacent Romanian territories at the operation stage.

The **decommissioning** stage is not expected to have any negative impact on the landscape structure. The rehabilitation of the disturbed land will have a positive effect on the landscape. Depending on the planned use of the site area, a new landscape may replace the anthropogenic one.

4.6 BIODIVERSITY

4.6.1 VEGETATION

4.6.1.1 IMPACT DURING THE STAGE OF NNU CONSTRUCTION

4.6.1.1.1 Direct impact:

4.6.1.1.1.1 Site 1

Worsening of the status of plant communities of no preservation significance is possible in the immediate vicinity of IP (taking into consideration the fact that no rare plant communities have been established on the territory of the IP) and the potential subsequent spread of weeds, ruderal and invasive plant species. Elimination is possible of individual medical plants, found at the site. The impact degree is low (degree 2) because these plants are widely spread all over the country and are not the object of collection on the Kozloduy NPP territory.

4.6.1.1.1.2 Site 2

This site presents arable or ex-arable areas under constant anthropogenic impact or unstable succession. Poor communities grow on them, the species changing often (even every year). Therefore no habitats and species of preservation significance exist there and the direct impact degree is minimal (degree 1) at the IP stage of realization.

4.6.1.1.1.3 Site 3

Worsening of the status of plant communities of no preservation significance is possible in the immediate vicinity of IP (taking into consideration the fact that no rare plant communities have been established on the territory of the IP) and the potential subsequent spread of weeds, ruderal and invasive plant species. Elimination is possible of individual medical plants, found at the site. The impact degree is low (degree 2) because these plants

are widely spread all over the country and are not the object of collection on the Kozloduy NPP territory.

The South-West part of the site is a half-natural wet area with significant diversity of species. Drainage, strengthening (by means of filling, etc.) and building up of the site will eliminate the habitats of communities of preservation significance, characteristic for wet areas along the Danube River. On the IP location the habitats will be replaced by an artificial landscape.

4.6.1.1.1.4 Site 4

Due to the entirely technogenic character of the site no direct impact on habitats and communities of terrestrial flora is expected.

4.6.1.1.2 Indirect impact

Worsening of the status of plant communities of no preservation significance is possible in the immediate vicinity of IP and the potential subsequent spread of weed, ruderal and invasive plant species.

4.6.1.2 IMPACT DURING NNU OPERATION

4.6.1.2.1 Site 1

- ✓ Direct impacts – not expected.

Indirect impact – worsening of the status of plant communities of no preservation significance is possible in the immediate vicinity of IP and the potential subsequent spread of weed, ruderal and invasive plant species.

4.6.1.2.2 Site 2

- ✓ Direct impact – not expected.

Indirect impact – worsening of the status of plant communities of no preservation significance is possible in the immediate vicinity of IP and the potential subsequent spread of weed, ruderal and invasive plant species.

4.6.1.2.3 Site 3

- ✓ Direct impact – not expected.
- ✓ Indirect impact – negative cumulative impacts on species habitats under the Biodiversity Act are possible.

4.6.1.2.4 Site 4

- ✓ Direct impact – not expected.
- ✓ Indirect impact – no additional impact is expected.

4.6.1.3 DECOMMISSIONING OF THE NNU

Impact on the alternative Sites 1, 2, 3, and 4 will be similar as at NNU construction stage.

4.6.1.4 IMPACTS FROM NNU CONSTRUCTION BEYOND SITES, IN THE 30KM ZONE OF MONITORING

4.6.1.4.1 NNU construction stage

4.6.1.4.1.1 Direct impacts:

The region neighbouring the IP site is dominated by subjected to frequent change habitats, as well as change of the quantitative and qualitative composition of plant and animal communities. The remaining habitats are greatly ruderalized. In such habitats species with too wide ecological adaptability can be met, which explains their high stress resistance.

At places there are secondary forest communities or grassland formations of secondary origin, part of them being natural habitats of European significance and covered by the national ecological network NATURA 2000. Neither direct, nor indirect impacts on them are expected. Within the 30 km zone there grow 55 species of medical plants. Their picking, buying and sustainable use is regulated by the Medical Plants Act. All the species of medical plants but 2 of them (Nuphar lutea and Galanthus elwesii) are widely spread. No direct or indirect negative impacts are expected on the quality or quantity of these species.

4.6.1.4.2 NNU operation stage

- ✓ Direct impact – not expected.
- ✓ Indirect impact – neither negative nor positive impact is expected on habitats and communities due to their character as described in “Direct impact”.

4.6.1.4.3 NNU decommissioning stage

Impact at this stage within the 30 km zone will be similar t as at NNU construction stage.

4.6.1.5 CONCLUSION

At construction stage direct negative impact on terrestrial flora is expected at Site 1 and Site 3. The impact finds expression in annihilation of plant species. Annihilation of individual medical plants found on the two sites is possible to occur.

No direct negative impact is expected on habitats and communities of terrestrial flora on Site 2 and Site 4.

The impact degree is negligibly low (degree 1), because the plants are widely spread all over the country and are not an object of collection on the territory of Kozloduy NPP.

4.6.2 ANIMAL KINGDOM

4.6.2.1.1 NNU construction stage

4.6.2.1.1.1 Direct impact

Site 1

Drainage, strengthening (by means of filling, etc.) and building up of the site will eliminate the habitats of communities of preservation significance characteristic for the wet areas along the Danube River. On the IP location the habitats will be replaced by an artificial landscape.

Terrestrial invertebrates

The change to occur in the species habitats will lead also to change of the species, resulting in replacement of the specialized species (including those of preservation significance) by widely spread ones. Thus, the species of preservation significance will be replaced by such of little significance.

Aquatic invertebrates

Drainage and filling up of the site with construction materials might lead to elimination of temporary living in the channels representatives of the aquatic invertebrates, such as Danube crayfish (*Astacus leptodactylus*), seeking food and new basins at night.

No indirect impact on the aquatic invertebrates is expected.

Herpetofauna

Direct annihilation is expected of a great part of the representatives of all species on the site territory. Draining of the territory and building up of the site will destroy habitats of significant for conservation amphibian and reptile species (such as Danube crested newt, European fire-bellied toad, European pond turtle and other).

No indirect impact on the amphibians and reptiles is expected.

Mammals

The site territory is widely inhabited by small rodents of the *Microtus* and *Apodemus* kind, of relatively small number. They will be directly annihilated during construction works.

The NNU construction on the Site 1 territory will have indirect negative impact on the presence of the following predatory mammals: Fox (*Vulpes vulpes*), Jackal (*Canis aureus*) and Marten (*Martes foina*), depriving them of food and dwelling places.

Chiropterofauna

As a result of removing the perennial vegetation from the site potential daily habitats will be destroyed of the forest kind of bats of the species Nyctalus and *Pipistrellus*. In case this activity is performed during the bats reproduction period (April – June) that might lead to the death of the newly born ones. The site building up will permanently change the present

natural conditions of the favourable hunting habitat and its potential as such will be greatly reduced.

The investment intention project realization will lead to lasting reduction of bats number and their hunting activity on Site 1.

Ornitofauna

Building up the site will lead to annihilation of the habitats of 11 kinds of birds, some of them of preservation significance such as Syrian wood-pie (*Dendrocopus syriacus).*

The NNU realization on the territory of Site 1 will indirectly impact the ornitofauna composition of species. As a result, the species of preservation significance will be replaced by synanthropic ones like sparrows, larks, pigeons, etc.

Site 2

Terrestrial invertebrates

A significant part of the site is built-up or strengthened which makes the development of sustainable and permanent communities of terrestrial invertebrates impossible. The change to occur in the habitats of the species will lead to change in their composition by replacing the specialized (including these with preservation significance) species by widely spread general ones. As a result there will be replacement of the species with preservation significance by such of little significance.

Terrestrial vertebrate fauna

The indirect impact in immediate vicinity of IP is not expected to affect much the habitats and species due to the present status of temporary habitats of poor quality, i.e., it is not expected that the impact can be greater than the present one (this concerns all biological species).

Site 3

The South-West part of the site is a half-natural wet area with significant diversity of species. Drainage, strengthening (by means of filling, etc.) and building up of the site will eliminate the habitats of communities of preservation significance, characteristic for wet areas along the Danube River. On the IP location the habitats will be replaced by an artificial landscape.

Terrestrial invertebrates

Direct annihilation of parts of all species on the site territory is expected.

Aquatic invertebrates

Drainage and filling up of the site with construction materials might lead to elimination of temporary living in the channels representatives of the aquatic invertebrates, such as Danube crayfish (*Astacus leptodactylus*), seeking food and new basins at night.

Herpetofauna

Direct annihilation of great number of all species on the site territory is expected. The drainage of the terrain and building up of the site will annihilate the habitats of amphibians

and reptiles of preservation significance (Danube crested newt, European fire-bellied toad, European pond turtle and other).

Mammals

The site territory is widely inhabited by small rodents of the *Microtus* and *Apodemus* kind, of relatively small number. They will be directly annihilated during construction works.

Chiropterofauna

On Site 3 there exist single old trees presenting potential dwelling places of bats and clearing vegetation prior to construction works may lead to the death of young bats in the habitats during the reproduction period (April – June). During the remaining part of bats active life cycle (July – mid November) construction works may chase away the migrating species using old trees as places of daytime dwellings.

Ornitofauna

The building up of the site will lead to the annihilation of the habitats of 7 species of birds, among them such of preservation significance like the Red-backed Shrike (*Lanius collurio).*

4.6.2.1.1.2 Indirect impact

Terrestrial invertebrates

The change to occur in the species habitats will lead to change in their kinds, i.e. replacement of the specialized (including those of preservation significance) species by widely spread general ones. As a result the communities of preservation significance will be replaced by such of little significance.

Aquatic invertebrates – no indirect impact on aquatic invertebrates is expected.

Herpetofauna

No indirect impact on amphibians and reptiles is expected.

Mammals

The presence of the predatory species of mammals – Fox (*Vulpes vulpes*), Jackal (*Canis aureus*) and Marten (*Martes foina*), will be threatened by depriving them of food and dwelling places.

Chiropterofauna

The realization of the investment proposal project will cause a lasting change of the natural conditions for favourable hunting for bats due to drying up of swampy low areas of the terrain and of water channels. The change of water regime on this site, together with the lasting changes in the plant communities will reduce the abundance of insects which will lead to significant lowering of the territory potential as hunting habitat for migrating and local bat species. There will be a slight fragmentation effect on the wet territories used as nutritional habitat of migrating populations of bats along the Danube River.

Ornitofauna

No indirect impact on birds is expected.

Site 4

Due to the entirely technogenic character of the site, no direct impact on the habitats and terrestrial fauna communities is expected.

4.6.2.2 NNU OPERATION STAGE

4.6.2.2.1 Site 1

- ✓ Direct impact – not expected.
- ✓ Indirect impact – neither negative, nor positive impact is expected on the habitats and species habitats.

4.6.2.2.2 Site 2

- ✓ Direct impact – not expected.
- ✓ Indirect impact – neither negative, nor positive impact is expected on the habitats and species habitats.

4.6.2.2.3 Site 3

- ✓ Direct impacts – not expected.
- ✓ Indirect impacts – neither negative, nor positive impact is expected on the habitats and species habitats.

4.6.2.2.4 Site 4

- ✓ Direct impact – not expected.
- ✓ Indirect impact – no additional impact is expected.

4.6.2.3 NCC DECOMMISSIONING STAGE

The impact on the alternative Sites 1, 2, 3 and 4 will be similar to that at the NNU construction stage.

4.6.2.4 CONCLUSION

On Site 1 and Site 3 direct negative impact on the terrestrial fauna is expected at the construction stage. It will find expression mainly in annihilation of the species dwelling places, possible mortality of individuals if the construction activities are not complied with animals' important life cycles (reproduction period being the most important). Indirect impact will find expression in chasing away individuals, scaring and fragmentation followed by occurring change of the population structure of plant and animal communities on the two sites.

On the territories of Sites 1, 2, 3 and 4, identified for the assessment and construction of the NNU, no species of preservation significance have been established. On the territory of Sites 3 and 1 (especially 3) there exist wet areas on the territory of some remaining parts of

the former Kozloduy marsh which present a habitat for species of preservation significance.

4.6.2.4.1 Aquatic invertebrates

On the territories of the sites designated for assessment and realization of IP no species of aquatic invertebrates of preservation significance have been established. On the territory of Sites 1 and 3 there exist wet areas and canals where at enough water quantity the temporary stay of Danube crayfish (*Astacus leptodactylus*), seeking food and new basins at night.

4.6.2.4.2 Ichthyofauna

No ichthyofauna has been established on the sites. Only on Site 1 there are suitable habitats for the existence of weather loach.

4.6.2.4.3 Herpetofauna

The populations of most amphibians and reptiles (also these of the highest nature protection status) within the 30 km zone of monitoring are strongly fragmented due to the anthropogenic activity (intensive agriculture, drying-up of wet zones, riverbed corrections, urbanization, etc.). Therefore, every new damaging or destroying of natural habitats (like these on Sites 1 and 3 territories) will have a strong negative impact on the herpetofauna in general.

4.6.2.4.4 Mammals

The results of the inspection of the alternative sites territories, designated for the NNU realization give the grounds to draw the conclusion that Sites 1 and 3 are located on terrains of dominating wet areas providing suitable habitats of certain groups of mammals, the three of which are protected under the Biodiversity Act –European polecat and Marten. On Site 2 mammal fauna is less diverse and is of no interest from nature protection point of view.

4.6.2.4.5 Ornitofauna

As a result of the inspection of the four sites, we can draw the conclusion that sites 3 and 1 (especially 3) are located within the area of the former Kozloduy marsh and present a nutritional habitat for species of conversation significance. Construction works would impede also the potential partly restoration of this swamp.

The Site 4 terrain is most urbanized and is the poorest of ornitofauna. Site 2 seems to be the most perspective one from the point of view of ornitofauna.

4.6.2.5 CHOOSING AN ALTERNATIVE SITE FOR NNU REALIZATION

After analyzing the results from the conducted investigations of the individual alternative sites proposed for the NNU realization and also based on the established on their

territories potential habitats, habitats of target, rare or protected species, presented in numbers in **Table 4.6-1,** the following conclusion can be made:

- ✓ Sites 1 and 3 provide habitat for 70 animal species in total.
- ✓ Site 2 is populated only by 7 animal species in total.
- ✓ Site 4 is populated by 4 species of birds.

TABLE 4.6-1: OBSERVED OR REGISTERED POTENTIAL HABITATS OF TARGET, PROTECTED, RARE OR ENDANGERED OF EXTINCTION BIOLOGICAL SPECIES

Alternative sites	Habitats	Fish	Invertebrates (terrestrial and aquatic)	Herpetofauna	Mammals (and bats)	Birds
	species	Number of species				
Site 1	0	0 (1)	1 + 1	17	1 + 6	11
Site 2	0	0	0	5	0	2
Site 3	0	0	1 + 1	17	2 + 4	7
Site 4	0	0	0	0	0	4

In view of the complex assessment based on the total number of observed species and individual infrastructures, from the point of view of biological diversity, **Site 2** is the most suitable one for the NNU realization.

4.6.2.6 IMPACTS OF NNU REALIZATION BEYOND THE SITES IN THE 30 KM SONE OF MONITORING

4.6.2.6.1 NNU construction stage

4.6.2.6.1.1 Direct impacts

The earth works may disturb the species due to the noise, vibrations and dust formation.

Hydrobionts

Direct impact is expected of emerging or existing invasive (alien) aquatic species on native species of aquatic invertebrates and fish through predation, competition (for food resources, habitats), which will lead to their reduction, destruction or changes in the structure of their populations.

Herpetofauna

No direct impact is expected on the amphibians and reptiles.

Mammals

No direct impact is expected on the mammals.

Chiropterofauna

No direct impact is expected on the bats as the activities beyond the construction site do not affect their habitats.

Ornitofauna

No direct impact is expected on the ornitofauna.

4.6.2.6.1.2 Indirect impacts

Hydrobionts

It is expected that construction works will create favorable conditions for the introduction and establishment of new invasive alien species (aquatic and terrestrial) – due to movement of equipment, people, transportation of goods, excavation, transportation and disposal of masses of soil, sand, water, aggregates, construction of new surfaces on the terrain, etc.

Introduction of new, invasive alien species is expected via ships and water transport serving the construction of the NNU.

Herpetofauna

No indirect impact on amphibians and reptiles is expected.

Mammals

No indirect impact on mammals is expected.

Chiropterofauna

Possible indirect impact on forest bat species only in dwelling places in the immediate vicinity to the selected site for the construction of NNU in terms of noise disturbance caused by the construction and transportation equipment, and light effects directly affecting the activity of insect species, which they hunt.

Ornitofauna

No indirect impact on the ornitofauna is expected.

4.6.2.6.2 NNU operation stage

4.6.2.6.2.1 Direct impacts

Hydrobionts

Mortality of hydrobionts is possible caused by intake of larvae or juvenile specimens in maintaining circulating, technical and household water supply.

Direct impact is expected of invasive alien species of fish on the local species of plankton- and benthos-feeding fish and invertebrates through predation, competition (for food resources, habitats), which will lead to their reduction, annihilation or changes in the structure of their populations.

Direct impact is expected of invasive alien species of invertebrates on the local species through predation, competition (for food resources, habitats) and formation of fouling on

them (from bio-sessile mussels), which will lead to their reduction, annihilation or changes in the structure of their populations.

Herpetofauna

No direct impact is expected on the amphibians and reptiles.

Mammals

No direct impact is expected on the mammals.

Chiropterofauna

The expected low levels of background radiation during operation of the NNU and low noise levels in immediate vicinity to the realized unit shall not cause direct impact on bats.

Ornitofauna

No direct impact expected on the ornitofauna.

4.6.2.6.2.2 Indirect impact

Hydrobionts

It is expected that the slightly increased water temperature of the Danube River below the warm channel discharge will adversely affect cryophilic invertebrates and fish and they will be replaced by thermophilic species, including invasive alien species.

No significant negative impact on the Clupeidae, genus Alosa. These are anadromous species, which spend most of their life in the Black Sea and spawn in the big rivers flowing into the sea, including the Danube. During the spawning migrations the species are subject of industrial and recreational fishing in the whole Bulgarian-Roumanian area of the river. The analysis of the catches by now does not show concentration of individuals in the area of river kilometers 687 – 688, where the heat pollution caused by the discharge of the warm channel coming from Kozloduy NPP, is the most significant. It is due to a great extent to the fact that during the spawning migrations of the species (they live in the area of Kozloduy in May-June) the water temperature in the Danube is high enough (around 18-20 degrees), which reduces the impact of the heat pollution by the channel. There are good reasons to consider that the situation will not change after the new units of Kozloduy NPP start operating. By now no special studies related to the possible concentration of larvae of these species have been carried out.

It is expected that the slightly increased water temperature of the Danube River below the warm channel discharge will be favourable to the growth, development, reproduction and stabilization of the populations of the thermophilic, invasive alien species in the Danube River which will increase their impact.

Changes in the physical and chemical parameters of the water are expected, of the composition and structure of phytoplankton and zooplankton as a result of the filtering action of invasive alien species of mussels (*Dreissena, Corbicula*), which will lead to changes in the composition and structure of populations of aquatic invertebrates and fish.

As a result of the impact of the water invasive alien species (intensified filtration and mussel colonies), competition, rapacity, changes in the species composition of the fish host etc.) and the worsen ecological conditions the environment features will change (physical and chemical parameters of the water, substratum etc.) the local species of hydrobionts will be directly affected, which may lead to disturbance in the structure of their populations and habitat loss.

Herpetofauna

No direct impact is expected on the amphibians and reptiles.

Mammals

No direct impact on mammals is expected, except for the Otter. The slightly increased water temperature of the Danube River below the warm channel discharge point has an indirect positive impact on the nutritional base (fish and shellfish) of this associated with water mammal.

Chiropterofauna

There are no factors to cause indirect impacts on bats.

Ornitofauna

Indirect negative impact on ornitofauna is not expected. Indirect positive impact however is expected on hibernating ichthyphagous birds (pelicans, cormorants, herons, etc.) as a result of increased numbers of fish populations in the warm channel outflow. At present these species form winter concentrations present in the outflow and below it.

4.6.2.6.3 NNU decommissioning stage

Impact in the 30 km zone of monitoring will be similar to the impact during the NNU construction.

4.6.2.6.4 Conclusion

Permanent, indirect negative impact on hydrobionts is expected as a result of the slightly increased water temperature of the Danube River below the discharge of the warm channel. For example, more cryophilic invertebrates and fish may be ousted by thermophilic species, including invasive alien species. It is possible favourable conditions for penetration of new alien species to be created or the negative impact of existing ones to be enhanced. This will lead to permanent slight direct negative impact of invasive species on aquatic invertebrates and fish.

Indirect positive impact is also expected on mammals associated with water bodies (Otter), on hibernating ichthyphagous birds (pelicans, cormorants, herons, etc.) due to the increased numbers of fish populations in the outflow of the warm channel.

Neither direct nor indirect impact is expected on species of preservation significance of plants and habitats within the 30 km range of influence.

For the development of this EIA Report and for assessment and forecast of the impact of the implementation of NNU, monitoring was performed on individual environmental factors to determine the current state of natural background radiation and radioactivity in the air in the region of the 30 km studied area around Kozloduy NPP before commencement of construction.

4.6.2.7 ESTIMATED NOISE VALUES

Values are calculated based on the distances from the NPP center to the borders of PA (Chapter 4.9.1):

BG0002009 Zlatiyata	1.2 km and 1.9 km
BG0000533 Kozloduy islands	3.03 km
BG0000614 Ogosta River	6.09 km
BG0000336 Zlatiya	15.3 km

4.6.2.7.1.1 Noise level during construction (Sites 1, 2, 3, 4)

The expected highest equivalent noise level reaching the border of the protected area (PA), which is nearest to the NPP – "Zlatiyata" (1.2 km) during construction machines operation to the nearby from the side of the PA borders of Sites 3 and 4 is about 35 dBA, which decreases with the receding of the machines. At a greater distance deeper into area (1.9 km), the expected noise level is 30 dBA. These levels are in the range of the natural low background noise (without pronounced sounds such as birds singing, the sound of the river, of strong wind, etc.). Construction activities carried out on the remoter Sites 1 and 2 will not be a source of noise for PA Zlatiyata because of the great distances and the shielding effect on noise propagation in this direction by the existing buildings at the NPP site. Construction activities will not be a source of noise for the other protected areas in the region due to the great distances to them (over 3 km) for all four alternative locations of the site of the new nuclear unit.

4.6.2.7.1.2 Noise level during operation

At the operation stage of the new nuclear unit the expected equivalent noise level reaching the border of the nearest to the protected area (PA) site – "Zlatiyata" is about 39 dBA in case the selected site is closer to the PA – (Site 3 or 4). At a greater distance and deeper into area (1.9 km), the expected noise level is about 34 dBA. At the more distant sites (1 and 2) these levels will be about 4 dBA lower. Expected equivalent noise level reaching the border of PA " Kozloduy Islands" is about 29 dBA in case of choosing the closest to the protected area Site 3. For the other alternative sites the expected noise level is lower. Noise levels of up to 35 dBA are in the range of the natural low background noise (without pronounced sounds such as birds singing, the sound of the river, of strong wind, etc.). It is expected that these indicated noise levels will not change the existing background noise in these areas by more than 1.5 dBA. The operation of Kozloduy NPP after the expansion will not be a source of noise for the other protected areas in the region due to the great distances to them (over 3 km) for all four alternative locations of the site of the new nuclear unit.

4.6.2.7.1.3 Noise level during decommissioning

The noise levels within the 30-kilometer zone of monitoring will be similar to these during the NNU construction.

4.6.2.8 ZERO ALTERNATIVE

"Zero alternative" is a description of the present status and the subsequent consequences in case the investment proposal is not realized. In this case, the realization of the "zero alternative" would preserve the present status and parameters of the environmental components.

As per item 8 of the additional provisions of the Regulations on assessment of plans and programmes compliance with the objectives of the protected areas, the "zero alternative" presents a description of the present status and the subsequent consequences of it in case the investment intentions which are applied cannot be realized.

At "zero alternative" no changes are expected in the natural processes of development of habitats and species in the region. Due to the remoteness from the Protected areas and lack of unique characteristics of the potential sites envisaged for the construction of the new nuclear unit, they are of no importance as habitats and habitats of species, object of preservation. As for vertebrates and birds in particular, the "zero alternative" will be of positive impact due to the limited presence of people and lack of disturbing noise, light, etc. Agricultural works will be developed as before, and the arable and non-arable lands will not change their designation.

4.6.3 PROTECTED AREAS

The four alternative sites of the IP do not fall into the protected areas within the 30-km area of monitoring: **Maintained Reserve "Ibisha", Protected area "Kozloduy"**, **"Kochumina"**, **"Gola bara", "Kalugerski grad – Topolite" "Koritata", "Daneva Mogila" and "Tsibar Island".**

4.6.3.1 NNU CONSTRUCTION STAGE

No direct or indirect impact on the Protected areas is expected.

4.6.3.2 NNU OPERATION STAGE

No direct or indirect impact on the Protected areas is expected.

4.6.3.3 NNU DECOMMISSIONING STAGE

No direct or indirect impact on the Protected areas is expected.