CONSORTIUM

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ENVIRONMENTAL IMPACT ASSESSMENT REPORT

for Investment Proposal:

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

CHAPTER 11: TRANSBOUNDARY IMPACT

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11 TRANSBOUNDARY IMPACT

The ***Assessment Approach*** employed to establish the environmental impact of the Investment Proposal within the transboundary context incorporates:

- → Establishing the potential transboundary environmental impact within the territory of another state or states, resulting from the implementation of the investment proposal for building a new nuclear unit at the Kozloduy NPP site;
- → Devoting special attention to the aspects with potential transboundary impact and envisaging specific measures for their prevention and mitigation.

The present section is **aimed at presenting the environmental impact assessment within the transboundary context** in adherence to the procedure envisaged in the applicable Bulgarian legislation, and specifically in Art. 98, Par. 1 of the Environmental Protection Act and Art. 25 of the Regulation on the Conditions and Procedures for the Performance of EIA, as well as in accordance with the Convention on Environmental Impact Assessment in a Transboundary Context (the Espoo Convention). The convention was drawn up in 1991, at a moment when the European Communities had several years of experience with the application of Directive 85/337/EEC on Environmental Impact Assessment. The Convention envisages an expansion of the national EIA procedure with regard to the subject of assessment, the participating parties and the obligations of the competent authorities.

The Bulgarian national mechanisms for the implementation of the Espoo Convention have been defined in Art. 98 of the Environmental Protection Act (EPA) and in Chapter Eight (Art. 23-26) of the Regulation on the Conditions and Procedures for the Performance of EIA (OCPPEIA).

Art. 24 of the OCPPEIA specifies the Minister of Environment and Water as the Competent Authority for the EIA procedure in a transboundary context.

Art. 25 of the OCPPEIA outlines the steps for EIA in a transboundary context for the cases when Bulgaria is a Party of Origin, such as the present case.

In addition, the Competent Authority – the Minister of Environment and Water – has to assess whether the investment proposal is likely to cause a presumable significant adverse transboundary impact on the territory of another country / other countries. In this case, the investment proposal falls within the scope of Appendix I, item 2 of the Espoo Convention, and within the category of investment proposals for which the legislation envisages a mandatory EIA – item 2.2 of Appendix 1 to Art. 92, item 1 of the EPA. For the purposes of the EIAR, the Competent Authority has identified the Republic of Romania as an Affected Party, even more so because the specific investment proposal is situated near the Danube River, along which the border between the Republic of Bulgaria and the Republic of Romania passes. Taking a decision to notify other countries is entirely the prerogative of the Minister of Environment and Water – Art. 3 of the Espoo Convention.

11.1 SUMMARY OF THE IMPACT OF THE JOINT OPERATION OF EXISTING NUCLEAR CAPACITIES AND ONES PLANNED FOR COMMISSIONING AT THE KOZLODUY NPP SITE AND ITS VICINITY[1]

11.1.1 LOCATION OF THE ALTERNATIVE SITES FOR THE DEPLOYMENT OF NNU

The Kozloduy NPP site is situated on the right bank (at the 694-th km) of the Danube River, 3.7 km to the south of the midstream of the river and the state border with the Republic of Romania. In a straight line, it is situated about 120 km to the north of the capital – the city of Sofia, and via the national road network the distance is about 200 km.

It is situated in the north part of the first non-flooding terrace of the Danube River (at elevation level +35.0m, based on the Baltic height system) and has an area of 4471.712 decares.

To the north it borders on the Danubian Plain. To the south of the site, the slope of the watershed plateau is relatively high (100-110 m), to the west – about 90 m, and to the east it is lower and reaches down to 30 m above sea level.

The settlements situated the closest to Kozloduy NPP are the following: the town of Kozloduy – 2.6 km to the northwest, the village of Harlets – 3.5 km to the southeast, the village of Glozhene – 4.0 km to the southeast, the town of Mizia – 6.0 km to the southeast, the village of Butan – 8.4 km to the south, and the town of Oryahovo – 8.4 km to the east of the site.

The sites in the area of Kozloduy NPP that are considered suitable for the installation of a NNU are shown on **Figure 11.1-1**.

[1] A requirement of the MEW, pursuant a letter with outgoing № ОВОС-220/09.01.2013.

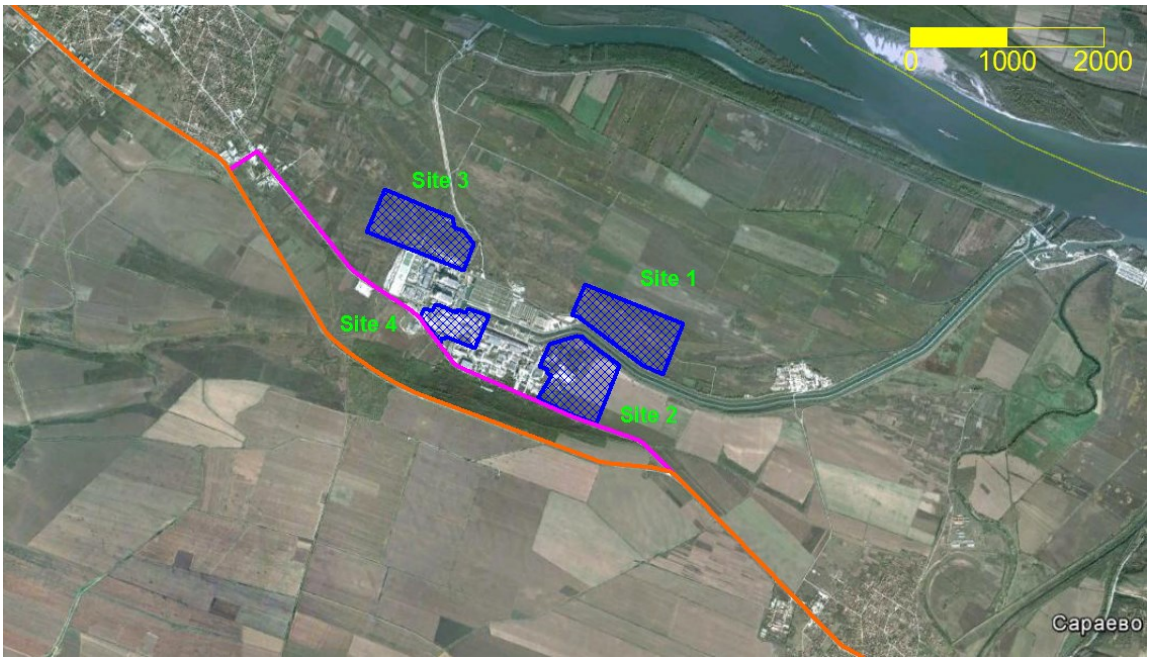

FIGURE 11.1-1: LOCATION OF THE POTENTIAL NNU SITES

On the figure above, the areas marked (in blue / ▬ /) show the potential NNU sites, as well as road II-11 from the national road network (the Harlets-Kozloduy section) – 11.6 km in length (in orange / ▬ /), and the internal south road (in pink / ▬ /) of the power plant, between the west and east checkpoint.

Provisionally named "Site 1" – The site is situated to the northeast of units 1 and 2 of Kozloduy NPP, between the ODF and the "Valyata", near the constructed cold (and hot channels – north of them. The area of the land is about 55 ha. The terrain is flat, with a light slope from the southeast to the northeast. In the vicinity of the site there are open drains, which need to be reconstructed. The loess humus layer of the arable land should be removed in advance.

The land envisaged for expropriation is being used for the cultivation of agricultural crops.

Provisionally named "Site 2" – The site is situated to the east of units 1 and 2 of Kozloduy NPP, in the direction of the village of Harlets, south of the constructed cold and hot channels. The area of the land is about 55 ha. The terrain is rolling, with a significant slope from the south to the north, most prominent in the southeast part of the site. In the vicinity of the site there are open drains, which need to be reconstructed. The area of the site houses a former agricultural yard. The remaining land is being used for the cultivation of agricultural crops.

Provisionally named "Site 3" – The site is situated to the northwest of units 5 and 6 of Kozloduy NPP, close to the bypass road of the existing power plant. The area of the land is about 53 ha. The terrain is flat, with a slight slope from the south to the north. In the vicinity of the site there are open drains, which need to be reconstructed. The loess humus layer of the arable land should be removed in advance.

Provisionally named "Site 4" – The site is situated to the west of units 3 and 4 of Kozloduy NPP and the SFSP, to the south of the cold (inlet) and hot (outlet) channels. The available area is about 21 ha, within the expropriated land of Kozloduy NPP. The envisaged terrain is situated on top of existing service facilities – Equipment Bureau, Vehicle Repair Facility and Assembly Facility. In order to utilize the site, the main underground communications of the NPP need to be reconstructed and displaced, and the aforesaid facilities need to be displaced to free up the area.

The area of the proposed sites will house all primary and auxiliary buildings and facilities, the equipment necessary for actual operation, as well as all local treatment facilities and WWTPs. The global plans with detailed structural solutions will be adjusted to reflect the function of the buildings and facilities, and specialized zones will be established.

The site selected to install the new nuclear unit on will be enclosed and secured in compliance with the Regulation on the Provision of Physical Protection for Nuclear Facilities, Nuclear Material and Radioactive Substances (SG, issue 44 of 9.05.2008) and a protected area, a PAZ and a UPAZ will be set up in adherence to the provisions of the Regulation on Emergency Planning and Emergency Preparedness for Nuclear and Radiation Accidents (Promulgated in SG, issue 94 from 29.11.2011).

Based on the completed assessment analyses on the maximum design-basis accidents and possible beyond-design-basis accidents with the existing units BBEP-440 (B-230) and BBEP-1000 (B-320), and on the radiological consequences, pursuant to risk categories I, II, III, and the dose limit criteria under the Regulation on Emergency Planning and Emergency Preparedness for Nuclear and Radiation Accidents (Promulgated in SG, issue 94 from 29.11.2011), the following emergency planning zones have been established, pursuant to Appendix 3.1-1 of the Emergency Plan of "Kozloduy NPP" EAD, separated into 16 sectors of 22.5° each and labelled with the first 16 letters of the Latin alphabet, starting from the north and going clockwise (A, B, C, D, E, F, G, H, J, K, L, M, N, P, R и S) – **Figure 11.1-2.** Depending on the emergency condition, different measures are envisaged for the protection of the personnel and the public within the emergency planning zones:

- **On-Site Emergency Planning Zone – *protected zone* № 1**, the site of "Kozloduy NPP" EAD;
- **Precautionary Action Zone (PAZ) – zone № 2**, with a radius of 2 km and a geometric centre between the ventilation ducts of units 5 and 6. The area of the zone is 12 566 decares, with 3 012 decares or 24% already occupied by the production facility of Kozloduy NPP and the facility for the storage and processing of radioactive waste, operated by the "RAW Kozloduy" SD. The purpose of this zone is to limit radioactive exposure during accidents – the small red circle (▬) on **Figure 11.1-2**.
- **Urgent Protective Action Zone (UPAZ)** [2] **– zone № 3**, with a 30 km nominal radius around "Kozloduy NPP" EAD and an area of 284 874 decares. Its role is to exercise the

[2] The 30 km UPAZ is defined for the purposes of emergency planning. The same zone is called "Monitoring Zone" (MZ) for the purposes of radiation monitoring.

necessary control for the purposes of radiological protection – the large outer red circle (▬) on **Figure 11.1-2**.

In the event of an accident, "Kozloduy NPP" EAD is obliged to conduct environmental monitoring within the 12 km zone – the pink circle (▬) on **Figure 11.1-2**.

FIGURE 11.1-2: EMERGENCY PLANNING ZONES

On the territory of the Republic of Bulgaria, this zone fully encompasses the municipalities: Kozloduy, Valchedram, Hayredin, Mizia, and partially includes the municipalities: Lom, Byala Slatina, Oryahovo, Boychinovtsi, Krivodol and Borovan. There are no large Bulgarian industrial or military sites within the zone.

On the territory of the Republic of Romania, the zone includes a total of 19 settlements[3] from the counties Dolj and Olt: Ostroveni, Gighera, Valea Stanciului, Călăraşi, Oraşul, Bechet, Oraşul Dăbuleni, Piscu Vechi, Sadova, Gângiova, Măceşu de Jos, Măceşu de Su, Bistreţ, Goicea, Bârca, Vela, Nedeia, Sarata, Listeava, Horezu Poenari.

The proximity of the alternative sites for the installation of a NNU to the Danube River, serving as the state border between the Republic of Bulgaria and the Republic of Romania,

[3] Current data for the territory of the Republic of Romania – a letter by "Kozloduy NPP-NC" EAD, 297/01.04.2013.

determines the possibility of expected indirect environmental impact on the territory of the neighbouring Romania, via the potential transfer of pollution resulting from the implementation of the investment proposal.

11.2 DESCRIPTION OF ENVIRONMENTAL COMPONENTS AND FACTORS RELEVANT TO THE TERRITORY OF THE REPUBLIC OF ROMANIA, WITHIN THE 30 KM ZONE

11.2.1 CLIMATIC PARAMETERS

Based on data provided by the office of the Ministry of Environment and Climate Change of the Republic of Romania, № 615/RP/15.03.2013, the meteorological parameters within the territory of the Republic of Romania have been analyzed and compared to those within the territory of the Republic of Bulgaria.

11.2.1.1 TEMPERATURE

Figure 11.2-1 presents a comparison between the average annual temperatures, based on measurements from the Bechet station for 1961-2011, the Lom station for 1961-1998, and the data provided by the Assigning Authority and collected by the local stations of Kozloduy NPP for the period 1997-2011. The figure shows that the average annual temperatures for Lom and Bechet have an equal trend, with those in Lom being higher than those in Bechet. The readings from Kozloduy NPP are also higher.

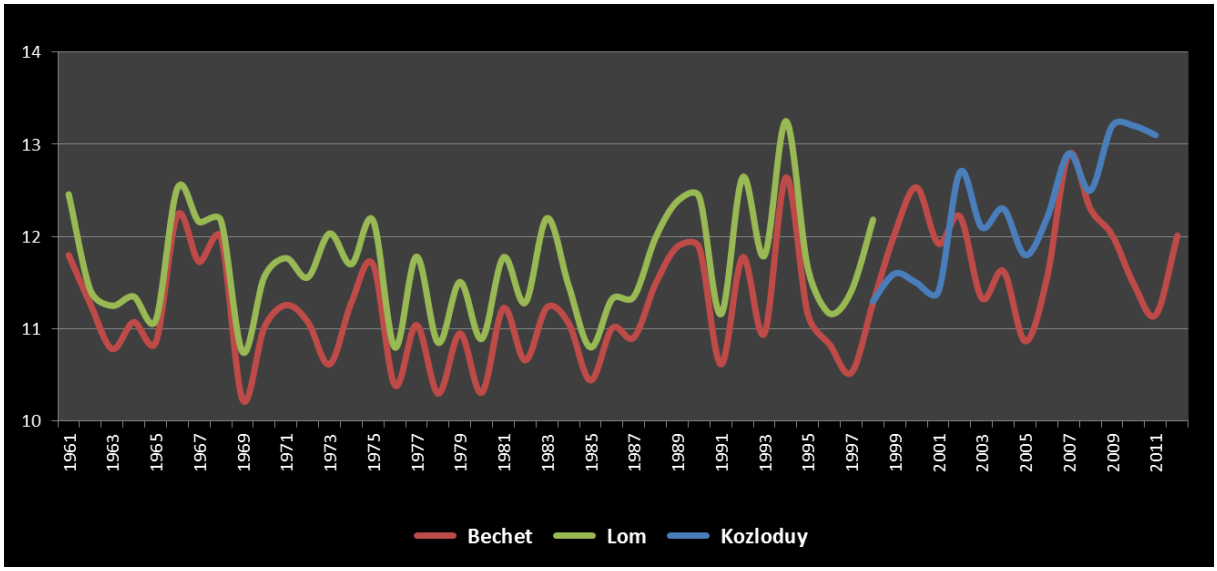

FIGURE 11.2-1: AVERAGE ANNUAL TEMPERATURES FOR BECHET, LOM AND KOZLODUY NPP

The World Meteorological Organization (WMO) has defined the climatic norm as the average value for a given climatic element for a fixed basic period of 30 years. The basic periods that have already been completed are: 1901-1930, 1931-1960, 1961-1990.

It is evident from **Figure 11.2-1** that for the last climatic period (1961-1990) the climatic temperature norm for Lom is 11.6°C, and for Bechet – 11.1°C, the difference being 0.5°C.

11.2.1.2 WIND

The dynamics of air transfer within the surface layer is characterized by the wind rose – wind speed, measured in 16 directions. The wind at a given place is one of the meteorological elements that are highly dependent on local conditions, and especially on topography. For an area such as the one under review, the proximity of a large water basin is significant – in this case the Danube River (aeration channel).

Figure 11.2-2 shows the wind rose for the Bechet station. The average wind speed, calculated on the basis of hourly data, recorded during the interval 2002-2012, is 2.0. The highest share is for winds below 3 m/s.

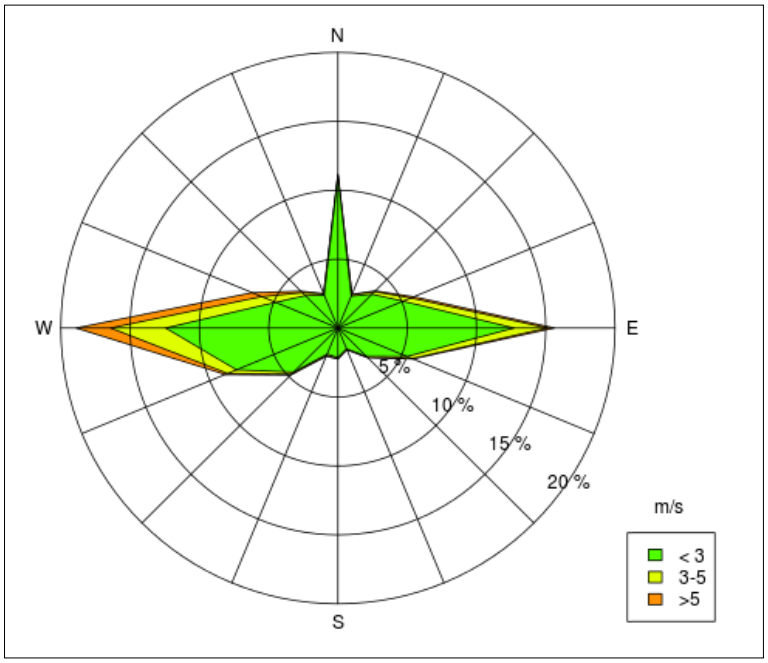

FIGURE 11.2-2: ANNUAL WIND ROSE – BECHET STATION.

The wind rose follows the zonal transfer from the west to the east, which is characteristic of our latitudes, with the predominant wind frequency being from the west (18.9%). The percentage of the so-called calm conditions – the number of cases with wind speed below 1 m/s – is 11.1% of the number of readings during this period, which corresponds to a low potential for air pollution of the surface boundary layer and it is due to the proximity of the Danube River.

11.2.2 WIND POTENTIAL

The company Meteosim Truewind[4], working in the area of renewable energy sources, has studied the wind energy parameters on the territory of Bulgaria and Romania in connection with assessing their wind potential.

[4] http://windtrends.meteosimtruewind.com/wind_anomaly_maps.php?zone=RBG

Figure 11.2-3 shows their maps of the average fields of wind speeds for 2008, 2009, 2010 and 2011. As evident from these maps, in the area around Kozloduy NPP the predominant average wind speeds are not higher than 3.7 m/s, which means that the potential of the wind field to spread pollutants over long distances is low.

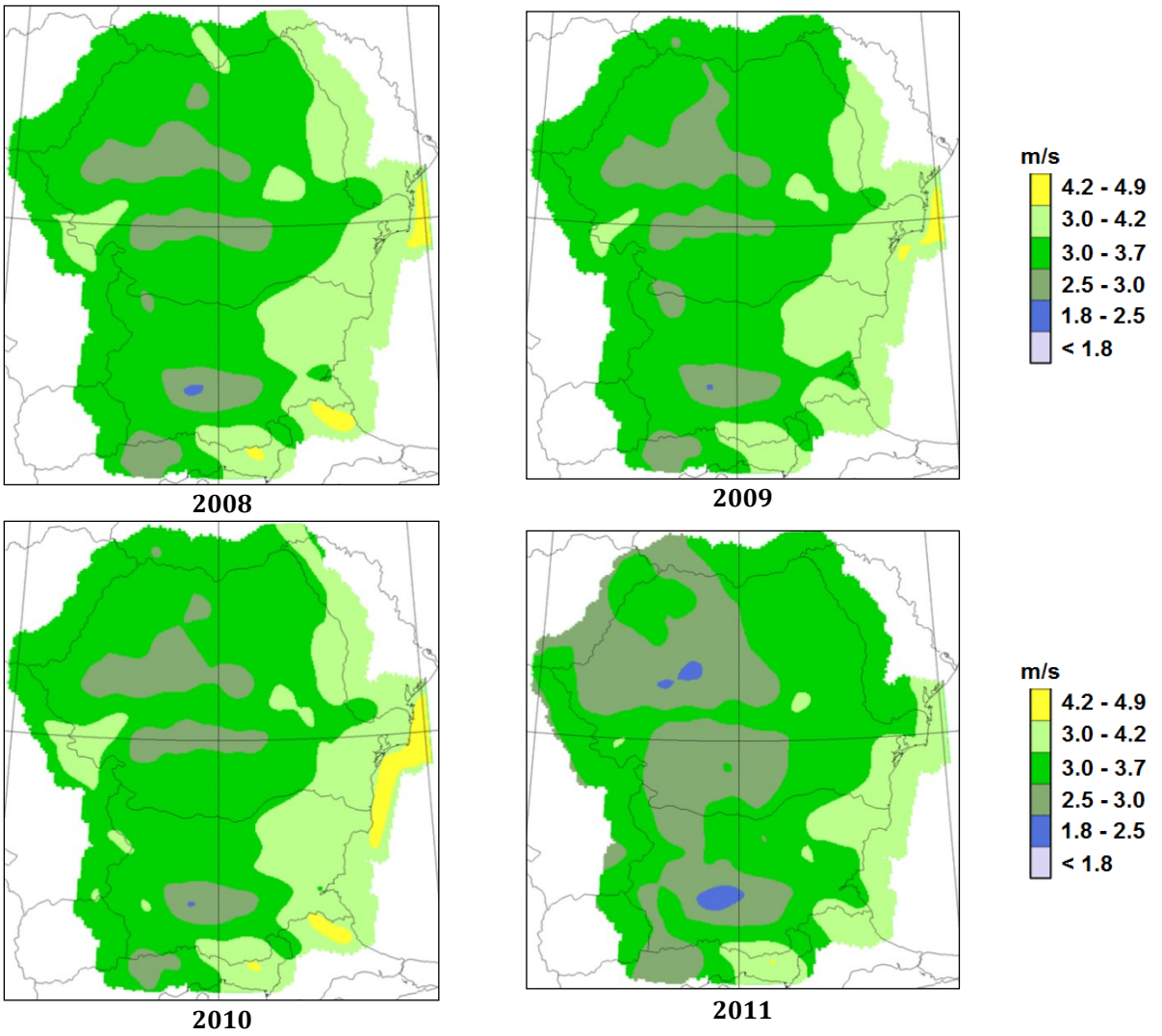

FIGURE 11.2-3: AVERAGE POTENTIAL WIND FIELDS FOR BULGARIA AND ROMANIA

We can conclude that there are no climatic prerequisites for transboundary pollution.

11.2.3 SURFACE WATER

The existing site of the Kozloduy NPP is situated on the right bank (at the 694-th km) of the Danube River, in the north part of the first non-flooding terrace of the Danube River (at elevation level +35.0m, based on the Baltic height system) and has an area of 4471.712 decares. **No natural water bodies pass through it.**

The Danube River passes north of the Kozloduy NPP site, serving as a border river between the two countries and a transboundary one for all countries in the international Danube Basin. Pursuant to the bilateral agreements between Romania and Bulgaria, the Danube

River has been defined as a heavily modified water body.

In this section of the left bank of within the Romanian territory, the Jiu River is flowing into the Danube – **Figure 11.2-4**.

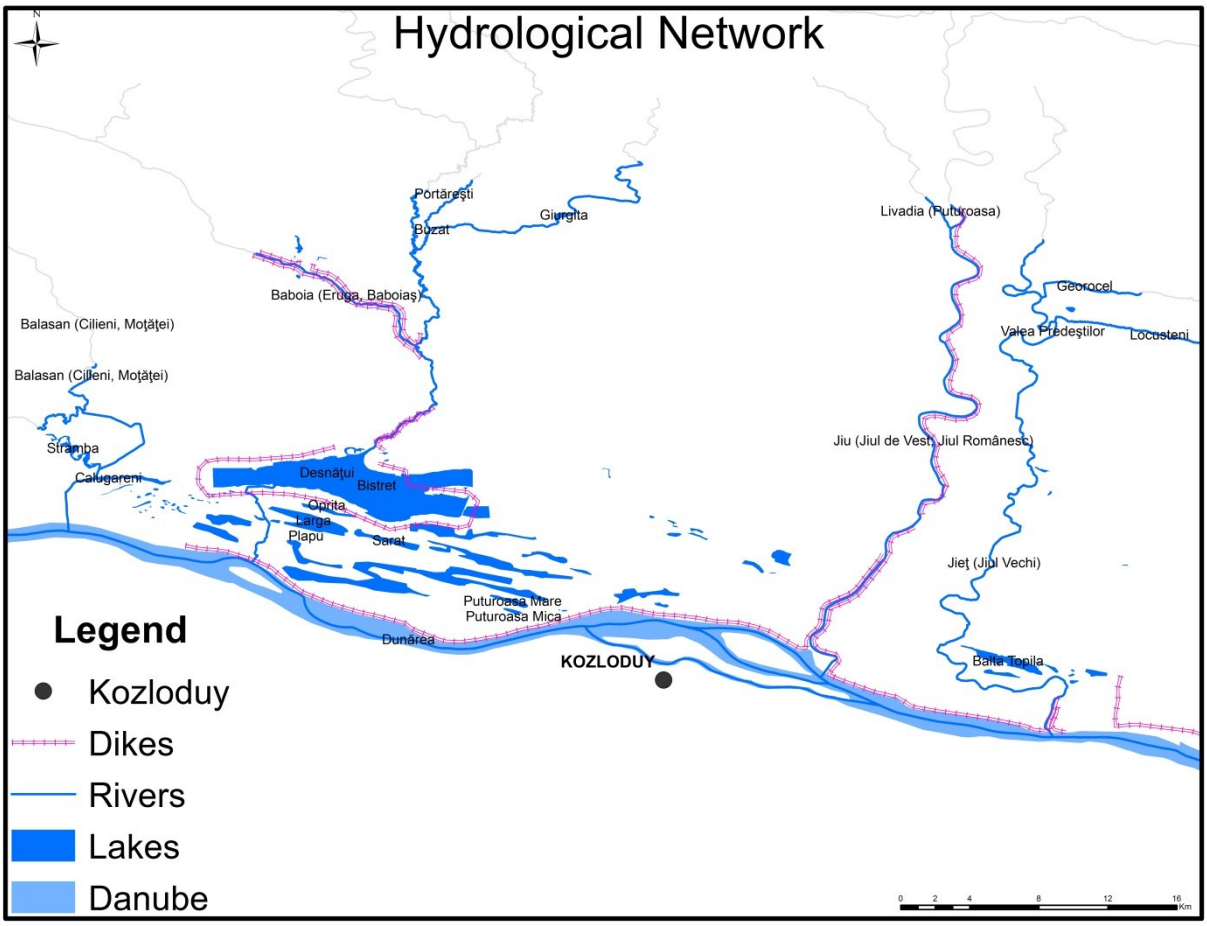

FIGURE 11.2-4: DIAGRAM OF THE HYDROLOGICAL NETWORK ON THE LEFT BANK OF THE DANUBE RIVER IN THE REPUBLIC OF ROMANIA ACROSS KOZLODUY NPP

The information sent by a letter from the MEF of Romania to the Assigning Authority and a letter by "Kozloduy NPP-NC" EAD, 297/01.04.2013, with data from the monitoring of the Danube River and the Jiu River, contains no data demonstrating an impact from the activity of the existing Kozloduy NPP on the waters on the territory of Romania.

11.2.4 LAND AND SOILS

The data[5] on the long-term use of the land within the 100-kilometer zone (**Figure 11.2-5**) encompassing six counties (DOLJ, GORJ, MEHEDINTI, OLT, TELEORMAN and VALCEA), covering a **1 452 589.55** ha area (**Table 11.2-1:**) has been divided as follows:

[5] Current data for the territory of the Republic of Romania – a letter by "Kozloduy NPP-NC" EAD, 297/01.04.2013.

- Agricultural areas, amounting to **1 123 950.75** ha or 77.38% of the 100 km zone. The breakdown into autonomous areas is the following: integrated cultivation areas (2.9%), areas occupied by fruit trees and berry plantations (1.5%), unirrigated agricultural lands (74.6%), agricultural lands with natural vegetation (4.6%), vineyards (7.7%), pastures (8.3%) and rice fields (0.4%);
- Airports, discontinuous urban structure, dam walls, green urban areas, industrial and commercial units, quarries, road and railroad networks, recreation land – sports and recreation – 6.55%
- Beaches, dunes, sands, deciduous forests, mixed forests, natural pastures, etc. – 12.65%
- Water bodies and river beds – 1.8%;
- Internal marshland – 1.62%.

The DOLJ county occupies the largest total area (739 811.43 ha). The next largest county is OLT, with a total area of 408 528.94 ha, which is agricultural. The MEHEDINTI county has a total area of 148 753.96 ha. The remaining three counties have relatively similar areas – about 20 648.95 ha (GORJ), 36 474.79 ha (VALCEA) and about 98 371.48 ha **(TELEORMAN**).

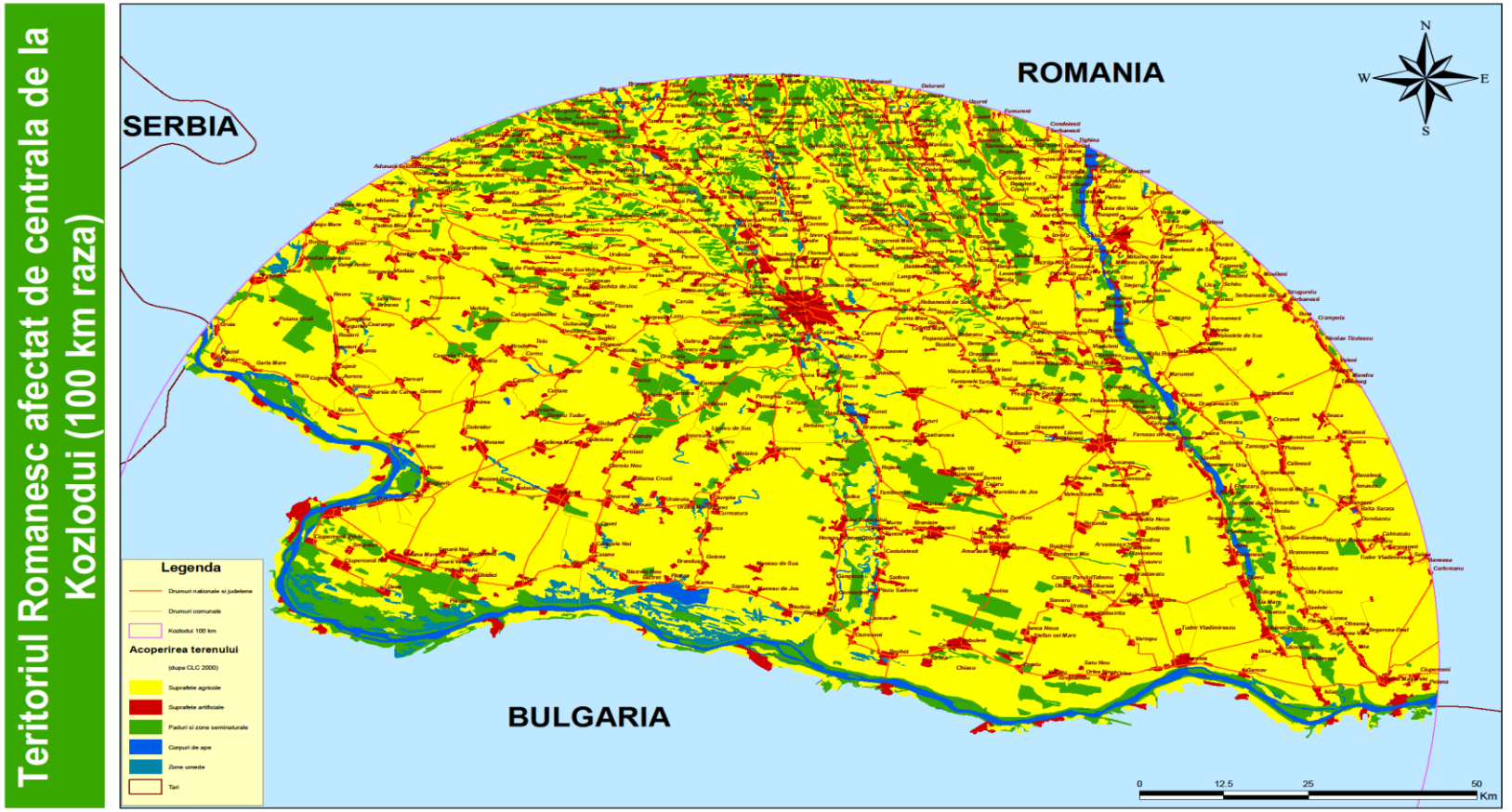

FIGURE 11.2-5: TERRITORIAL SCOPE OF THE 100 KM ZONE AND INFLUENCE OF THE NNU AND KOZLODUY NPP

TABLE 11.2-1: AREAS SUBJECT TO IMPACT WITHIN THE 100-KILOMETER ZONE

Counties	Agricultural land	Artificial surfaces	Forests and semi-natural areas	Water bodies	Wetlands
	ha				
Dolj Total	563 178.78	48 720.69	94 832.91	13 193.50	19 885.55
Gorj Total	10 328.13	1 706.40	7 701.76	340.18	572.47
Mehedinti Total	114 257.11	7 653.91	23 048.81	1 625.75	2 168.38
Olt Total	332 219.23	29 438.10	37 205.86	8 931.71	734.03
Teleorman Total	83 528.41	5 312.30	7 779.09	1 655.12	96.57
Valcea Total	20 439.09	2 378.91	13 175.43	463.81	17.55
TOTAL for the 100 km zone	**1 123 950.75**	**95 210.31**	**183 743.87**	**26 210.07**	**23 474.56**
in %	**77.38%**	**6.55%**	**12.65%**	**1.80%**	**1.62%**
			1 452 589.55		

The EIAR (section 3.3) presents detailed data on the radiological condition of the soils within the 30 km zone around the NPP on the territory of the Republic of Bulgaria. The established values for the contents of the two most biologically hazardous radionuclides, Sr-90 and Cs-137, **do not demonstrate any contribution resulting from the operation of the nuclear power plant.**

The information on soils, provided by Romania, does not make any mention of contamination of their lands due to the operation of the existing capacities of Kozloduy NPP – neither within the 30-km, nor within the 100-km impact zone. Due to the specific meteorological conditions and the direction of the winds in the region, the potential for pollution to the soils on the territory of the Republic of Romania as a result of the operation of the NPP is smaller than the one for the region within the territory of the republic of Bulgaria. The conducted analysis on the radiological condition of the soils within the 30-km zone around the NPP within the Bulgarian territory suggests that during normal operation there would be no impact on land use and agriculture on the territory of the Republic of Romania.

11.2.5 SUBSURFACE

The outline of the deep geological structure in the part "Subsurface" (section 3.4.1.4) shows that the Moesian Platform in the area of the NNU is characterized by sub-horizontal overlying geological formations without any significant tectonic and non-tectonic disturbances in the last 2.5 million years. The cover of the slightly undulating foundation of the platform consists of sedimentary rocks of various lithological composition, mostly clays and sands in the upper parts. They have demonstrated no significant manifestations of karstforming, diapirism (salt tectonics), as well as any potential for manifestations of volcanism. The geological data for the deep structure, provided by Romania, shows that the chronostratigraphy and lithostratigraphy of the Moesian Platform on both sides of the Danube River around Kozloduy NPP are very similar (**Figure 11.2-6** and **Figure 11.2-7**).

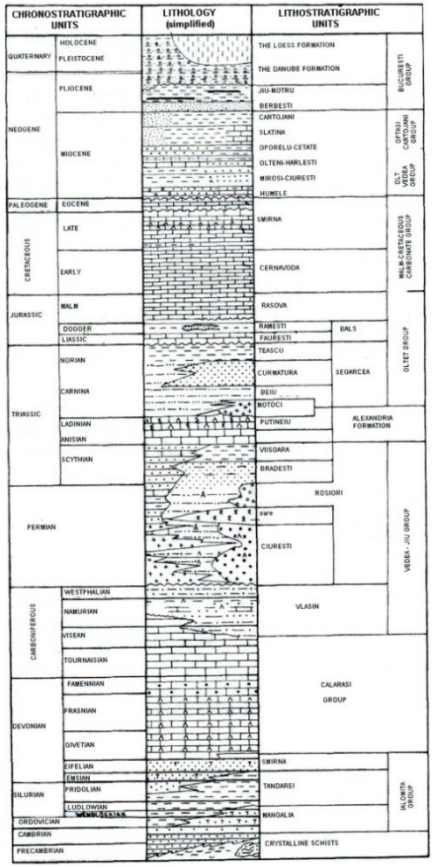

FIGURE 11.2-6: A COMBINED STRATIGRAPHIC COLUMN FOR THE WESTERN PART OF THE MOESIAN PLATFORM (BASED ON ENCIU, 2009[6])

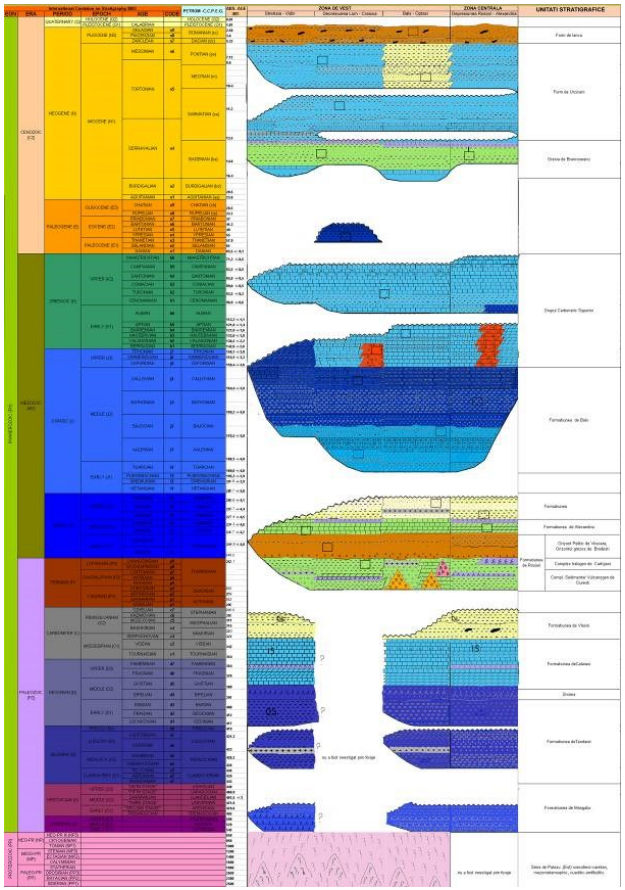

FIGURE 11.2-7: A COMBINED STRATIGRAPHIC COLUMN FOR THE WESTERN PART OF THE MOESIAN PLATFORM (BASED ON THE PETROM TEAM, 2003)

[6] Enciu, P. 2009. Pliocene and Quaternary of the western part of Dacian basin. Bucurest, Ed. Acad. Roman., 251 p.

In the sediments of Quaternary, Pliocene and Miocene positioned closest to the surface there are some clay formations serving as a geological barrier against potential surface contaminations. The data on the Romanian territory come mostly from hydrogeological drillings to depths between 160 and 460 m **– Figure 11.2-8**.

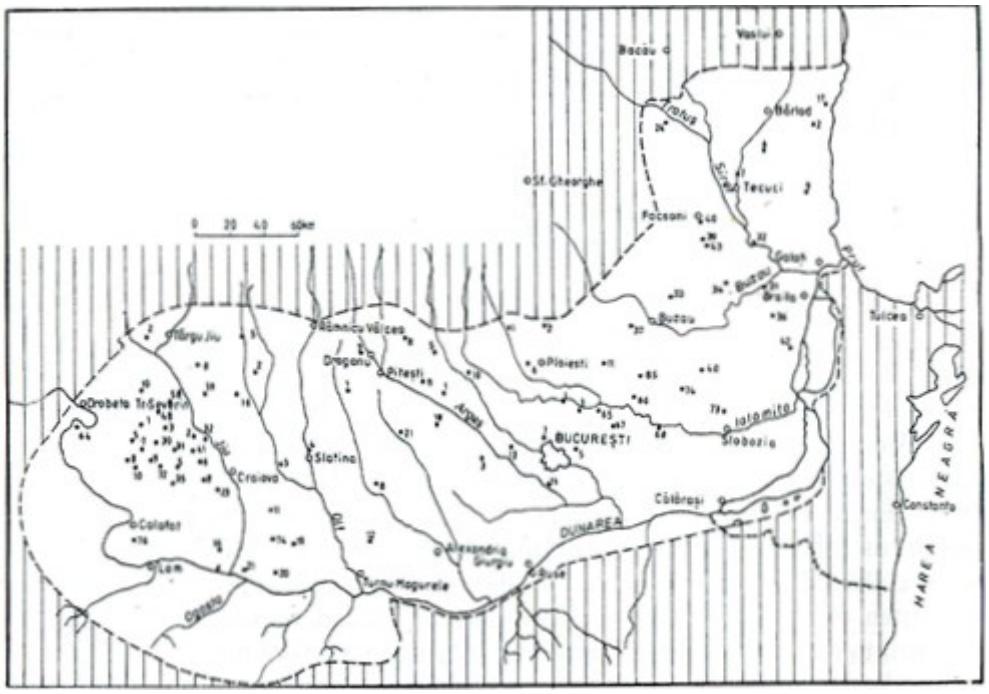

FIGURE 11.2-8: MAP OF THE SHALLOW HYDROGEOLOGICAL DRILLINGS ON THE TERRITORY OF ROMANIA WHERE THE UPPER PARTS OF THE GEOLOGICAL CROSS-SECTION HAVE BEEN STUDIED IN DETAIL (BASED ON ENCIU, 2009[7]).

The other potential transboundary impact could take place during the realization of a seismic event along active faults. The last geotectonic studies conducted for the area showed that the Bulgarian territory has no closely positioned active faults.

In conclusion, the deep geological structure within the 30 km zone around Kozloduy NPP is favorable, due to the presence of a number of natural barriers (clay formations) which would limit the migration of potential pollutants. This structure does not provide opportunities for any significant transboundary impact before and during the construction and operation of the NNU.

11.2.6 SEISMIC RISK

An additional analysis has been conducted on the seismicity in the local and the regional zone of Kozloduy NPP, based on the data on seismic hazards, coming from Romanian sources[8].

[7] Enciu, P. 2009. Pliocene and Quaternary of the western part of Dacian basin. Bucurest, Ed. Acad. Roman., 251 p.

[8] Current data for the territory of the Republic of Romania – a letter by "Kozloduy NPP-NC" EAD, 297/01.04.2013.

2 catalogues, mostly of Romanian earthquakes, have been analyzed – one composed of historical and contemporary earthquakes within the subregional 160 km zone around Kozloduy NPP **(Annex 1_Catalog Kozloduy.xls**[9]**)**, and the other one – containing historical and contemporary earthquakes within the Vrancea seismic zone, situated in the northeast periphery of the regional 320 km zone around Kozloduy NPP **(Annex 6_Catalog Vrancea.xls).**

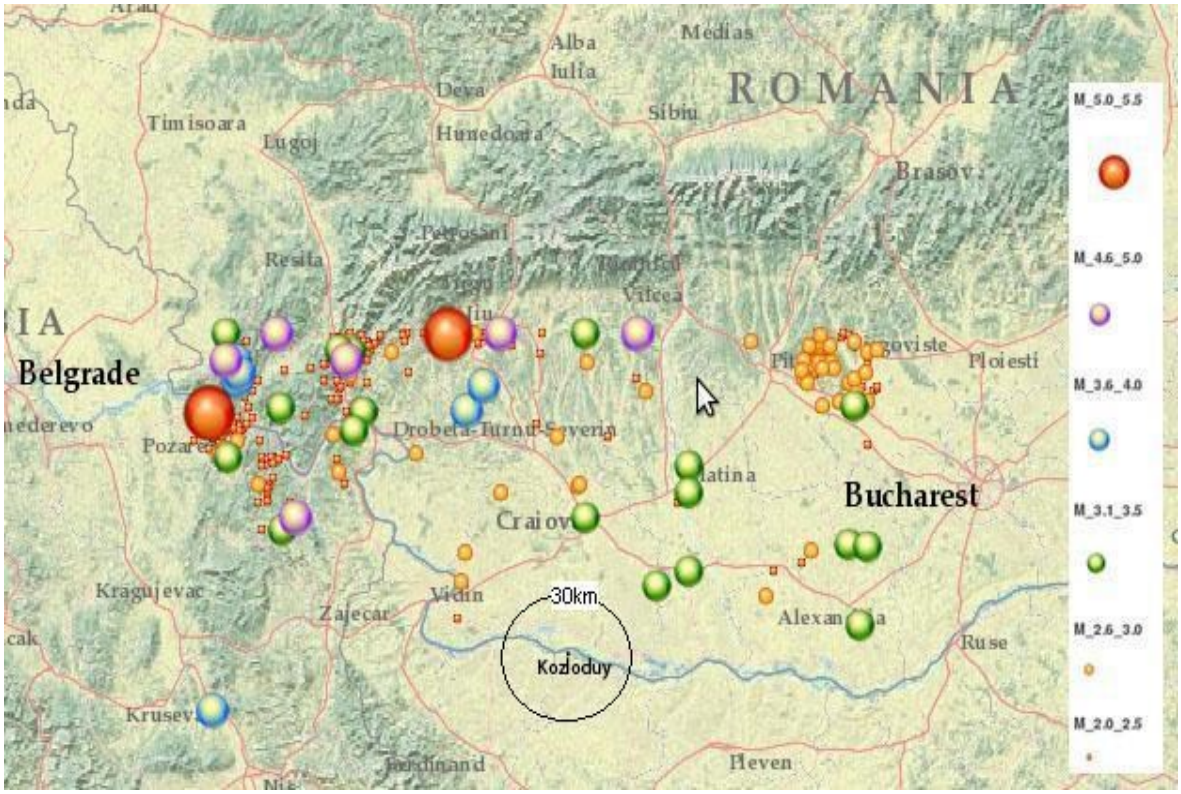

FIGURE 11.2-9: EPICENTRAL EARTHQUAKE DISTRIBUTION OF EARTHQUAKES WITHIN THE SUBREGIONAL 140 KM ZONE AROUND KOZLODUY NPP, BASED ON ROMANIAN DATA

The epicentral distribution of earthquakes from the first catalogue is presented on **Figure 11.2-9.** This catalogue contains data on 285 earthquakes occurring during the period 1665 – 2013. The minimum magnitude of earthquakes (M=2.0) has been instrumentally defined and refers to earthquakes registered in recent years, whereas the maximum magnitude (M=5.3) has been defined macroseismically and refers to the seismic activity realized back in 1879 in the Pojarevec region (Northeastern Serbia). The earthquakes generated within the 160 km area around the Kozloduy NPP site during the reviewed period have been realized in the upper part of the crust, at a depth primarily up to 20 km (there were only about twenty events at a greater depth – up to 42 km). The pattern of epicentral distribution on **Figure 11.2-9** shows that the Kozloduy NPP site is situated in the calmest part (in terms of seismic activity) of the Moesian Platform, and within the local 30-

[9] Current data for the territory of the Republic of Romania – a letter by "Kozloduy NPP-NC" EAD, 297/01.04.2013.

kilometer zone there have been absolutely no earthquakes. Up to the 50 km boundary there have been no Romanian earthquakes, earthquakes with a magnitude of M > 5.0 have been registered as far as the periphery of the 160-kilometer zone, and that is toward the Serbian border.

The outline of the spatial distribution of earthquakes with a magnitude above 4.0 within the 320 km region around the Kozloduy NPP site, which has been used for assessing the seismic hazard by the Geophysical Institute of the Bulgarian Academy of Sciences, is presented on **Figure 11.2-10**. The figure clearly shows the aseismic area, at the center of which the NPP site is situated.

The results from the analysis of the additional data provided by Romania can be considered as another confirmation of the existing conclusion that, from a seismological point of view, the local 30 km and subregional 50 km area around the Kozloduy NPP site belong to the calmest parts within the territory of the central Balkans.

The greater part of observed seismic events within the 320 km region (**Figure 11.2-10**) can be attached to well-known six seismogenic zones: Sofia, Maritsa, Gorna Oryahovitsa, Kresna, Negotinska Krajina (in Serbia, near the Romanian border) and Kampuling-Vrancea (in the northeastern periphery of the regional 320 km zone around Kozloduy NPP). All zones, with the exception of Vrancea, generate shallow crust earthquakes, mostly at depths up to 20 km. The Vrancea zone earthquakes are of intermediate focus and are generated within the depth range 60-190 km.

The Sofia seismic zone, situated at a minimum distance of 80 km from the Kozloduy NPP, is closest to the NPP site. The observed maximum effect on the area of the site by earthquakes from the Sofia zone is with an intensity of 3, based on the macroseismic scale of Medvedev, Sponheuer and Karnik (MSK) or I_{koz}=3 MSK. The observed maximum macroseismic effects on the Kozloduy NPP site of earthquakes realized in the other 4 crust seismic zones are: I_{koz}=6 MSK from Kresna, I_{koz}=6 MSK from Gorna Oryahovitsa, I_{koz}=5 MSK from Maritsa and I_{koz}=3 MSK from Negotinska Krajina. The macroseismic impact caused by the Dulovo earthquake in 1892 with M=7.0 was I_{koz}=5 MSK. The other shallow seismic sources, situated outside the defined seismic zones, have negligible macroseismic impact on the Kozloduy NPP site. The observed macroseismic effects on the site from these sources are smaller or equal to 3 MSK.

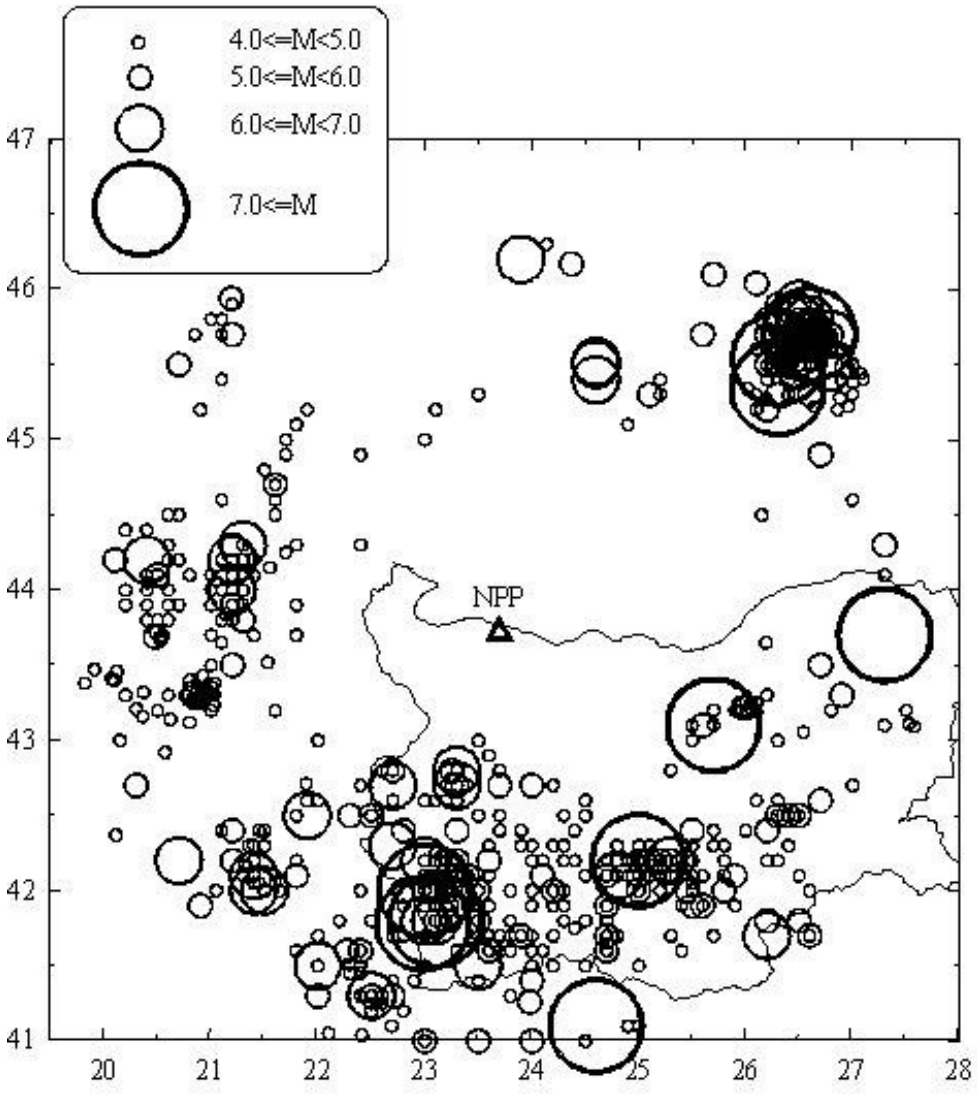

FIGURE 11.2-10: SEISMICITY WITHIN THE 320 KM REGION (M≥4.0)

11.2.7 LANDSCAPE

A part of the 30 km zone around the NPP falls within the territory of Romania. This zone encompasses a part of the Dolj and Olt counties, situated between the Danube River, the fields of Romantilor and Bailesti.

Depending on the leading landscape forming component, the landscapes in the Romanian part of this zone are classified as follows:

Agrarian Landscape. This landscape occupies the largest territory in the Romanian part of the 30 km zone around the NPP. The agrarian landscapes are formed by arable land with rotation crops, permanent crops and pastures.

Forest Landscape. It takes up a very small part of this zone. Its structure is composed of tree and shrub massifs in the form of forests, protective belts, forest nurseries, etc.

Aquatic Landscape. Surface water is a landscape-forming component. There are two subvarieties – "river aquatic landscape" and "lake aquatic landscape".

Anthropogenic Landscape. In the Romanian part of the 30 km zone around the NPP, anthropogenic landscapes are less common. Their structure is formed by settlements, roads, power lines, etc.

11.2.8 BIOLOGICAL DIVERSITY

11.2.8.1 INPUTS

Data from the following sources has been analysed in accordance with the methodology of the study in order to characterize the environmental quality of the territory of the Republic of Romania as a target of the impact, and to assess the degree of impact on that territory from the operation of NNU at the Kozloduy NPP:

1. Information provided by the Republic of Romania concerning the European environmental network Natura 2000 and other protected areas of the Republic of Romania and the Danube in the 30 km surveillance zone of Kozloduy NPP, presented in the Standard forms for Natura 2000 sites and other protected areas of the river Danube, available in Romanian language on the website of the Ministry of Environment and Climate Change[10, 11]. Four Protected zones fall in the 30 km surveillance zone of Kozloduy NPP:
   - ROSPA0010 Bistreț (Bistrets),
   - ROSPA0023 Confluență Jiu-Dunăre (Confluence of Jiu and Danube Rivers),
   - ROSPA 0135 Nisipurile de la Dăbuleni (Sands of Dabuleni),
   - ROSCI0045 Coridorul Jiului (Corridor of Jiu River).
2. Winter waterfowl count for the last 5 years between km 660 and 730 of the Danube and data for spring and autumn migrations.
3. Information on the census of waterfowl (e.g. IUCN protection categories, Important bird areas – IBA sites, etc.)[12, 13]
4. Presented are geographic data on breeding birds (30 km surveillance zone off Kozloduy NPP) and the information obtained from the implementation of the project "Cross-border model for conservation and sustainable use of natural resources in down the Danube ("Together for Danube"), completed in 2012 in partnership with the Romanian Ornithological Society, the Agency for the Protection of Olt, Romania, the Bulgarian Society for the Protection of Birds (BSPB) and Municipality Kozloduy,

[10] http://www.mmediu.ro/protectia_naturii/biodiversitate/2011-10-20_protectia_naturii_RO_SCI_SDF_2011.pdf
[11] http://www.mmediu.ro/protectia_naturii/biodiversitate/2011-10-20_protectia_naturii_RO_SPA_SDF_2011.pdf
[12] http://www.birdlife.org/datazone/sitefactsheet.php?id=24422
[13] http://www.birdlife.org/datazone/country/romania

Bulgaria[14] – Fish stocks and target species as per Annex 2 of Council Directive 92/46 in three Natura zones[15] – Report on ichthyofauna.

5. Red Data Book of species (30 km surveillance range off Kozloduy NPP) – Information on waterfowl (e.g. types of census IUCN protection categories, Important bird areas – IBA sites, etc.) [16, 17]. The management plans of the Romanian protected Natura 2000 sites in the 30 km surveillance zone and adjacent protected areas are under development and information on theme is not available.
6. Information about the flora and fauna of Romania 30 km surveillance zone off Kozloduy NPP.

Flora

In Dolj County (especially in the south) over 90% of the native vegetation has been replaced with agricultural crops, among which there are separate patches dominated by different species of oak (*Quercus*). Grasslands in this zone are steppe-type and are formed by a variety of drought-resistant species. Characteristic of the surveyed area is that after forest clearing, especially on sandy land, the impact of wind activates sand displacement by promoting the development of non-native plant species White locust (*Robinia pseudoacacia*) and White locust (*Amorpha fruticosa*). A protected forest band exists around the following populated settlements: Maglavit (Maglavit), Siuperseni (Ciuperceni), Poiana Mare, Desa, Squeak Vechi (Piscu Vechi), Dzidic (Ghidici) and the left side of the river Jiu in: Rozhisteya (Rojistea), Arele you (Apele Vii), Tselaru (Celaru), Amar (Amarasti), Bisku Sadovey (Piscu Sadovei), Beckett, Calarasi and Dabuleni (Dabuleni).

Vegetation in lowland areas around the rivers Danube and Jiu is adapted to sands, to the higher level of surface water and the presence of wet sediment. Present are separate groups of Willow (*Salix spp.*), Poplar (*Populus spp.*) Wicker (*Salix fragilis*) that create riparian coppice formations. Typical is the prevalence of different species of Oak (*Quercus spp.*), along with Hazel (*Corylus avelana*), Briar (*Rosa sp.*), Hawthorn (*Crataegus monogyna*) and the like. Close to lakes and wetlands there is developed hydrophilic vegetation of Bulrush (*Schoenoplectus lacustris*), Reed (*Fragmites australis*), White water lily (*Nymphaea alba*), Sedges (*Juncus spp*.), Duckweed (*Lemna minor*) and the like.

Fauna

The existence of grass, mainly cereals (*Graminaceae*) creates good habitats for the existence of the following species of petit mammals and rodents: Rodentia and Souslik (*Spermophilus citellus*), petit predators such as European polecat (*Mustela putorius*), Weasel (*Mustela nivalis*) and larger mammals such as Fox (*Vulpes vulpes*) And Brown Hare (*Lepus europaeus*).

[14] http://www.danubebiodiversity.info/publications/

[15] http://www.ddni.ro/index.php?page_id=84&siteSection=1&sectionTitle=Home

[16] http://www.birdlife.org/datazone/sitefactsheet.php?id=24422

[17] http://www.birdlife.org/datazone/country/romania

Avifauna of the area was studied by Ridiche (2011)[18], who has identified 170 species of birds in the area of the Calafat-Chupercheni and 126 species along the river Jiu up to its confluence in the Danube. Seven species classified as natural monuments were also identified: White Pelican (*Pelecanus onocrotalus*), Dalmatian Pelican (*Pelecanus crispus*), Great Egret (*Egretta alba*), Little Egret (*Egretta garzetta*), Spoonbill (*Platalea leucorodia*), Shelduck (*Tadorna tadorna*), Stilt (*Himantopus himantopus*).

Typical bird species in the region are: Quail (*Coturnix coturnix*), Partridge (*Perdix perdix*), Common Lark (*Alauda arvensis*), Common Starling (*Sturnus vulgaris*). In the meadows near rivers and reedbeds there are nesting wild ducks and geese and other birds that find their food in the wetlands – White Stork (*Ciconia ciconia)*, Common Tern (*Sterna albifrons*) and different types of herons.

A characteristic feature of the avifauna in the surveyed surveillance zone in both the Bulgarian and the Romanian part is the spatial distribution of waterfowl and daytime birds of prey. Species of these groups use for nesting, roosting and resting during migration and wintering Danubian uninhabited islands with sandy strips in the riverbed of the Danube and find their food in swamps, lakes, water dams, fish ponds and other wetlands with still or flowing water on both banks of the Danube. In search of food some species stray away from the river banks by tens of kilometers using as biocorridors the course of the rivers Jiu, Tsibritsa, Augusta, Skat. This scheme stands out most clearly in White-tailed Eagle (*Haliaeetus albicilla*), Dalmatian Pelican (*Pelecanus crispus*), Great Cormorant (*Phalacrocorax carbo*), Greater White-fronted Goose (*Anser albifrons*), Mallard (*Anas platyrhynchos*) and a number of other waterfowl.

Amphibians and reptiles

Herpetofauna in the Romanian part of the 30-kilometer surveillance zone is very similar to that in the Bulgarian part. According to Cogalniceanu et al. (2013) the following amphibian species were found in the UTM quadrants that fall within the 30-km zone were: Common newt (*Lissotriton vulgaris*), Northern crested newt (*Triturus cristatus*), Fire-bellied toad (*Bombina bombina*), Common Toad (*Pelobates fuscus*), Eastern spadefoot toad (*Pelobates syriacus*), Common toad (*Bufo bufo*), Green Toad (*Bufo viridis*), Tree frog (*Hyla arborea*), Agile Frog (*Rana dalmatina*), Marsh Frog (*Pelophylax ridibundus*) and Green Frog (*Pelophylax kl. esculentus*). Two species (Northern crested newt and Fire-bellied toad) are included in Annexes II and IV of Directive 92/43/EEC, 6 species are listed in Annex IV and the same Directive and two species are listed in Annex V. Reptiles are less explored and up-to-date publications of the species composition and distribution in this region of the country are not available. However, the maps provided in the works of Fuhn & Vancea (1961)[19] and Gasc et al. (1997)[20] suggest that in this region of Romania the following

[18] Ridiche M. 2011. Protection of the Avi fauna from the Danube floodplain in Calafat – the Jiu sector (Dolj county, Romania) Muzeul Olteniei Craiova. Oltenia. Studiişi comunicări.Ştiinţele Naturii. Tom. 27, No. 1/2011 ISSN 1454-6914 179.

[19] Fuhn, I.E., Vancea, Şt. (1961): The fauna of the People's Republic of Romania. vol. XIV, Fascicola II. Reptilia. Ed. Acad. R.P.R., Bucureşti. (in Romanian).

reptiles can be found: Plain pond turtle (*Emys orbicularis*), Hermann's Tortoise (*Testudo hermanni*), Green Gecko (*Lacerta viridis*), Crimean lizard (*Podarcis tauricus*), Great shooter (*Dolichophis caspius*), Blotched snake (*Elaphe sauromates*), Grass snake (*Natrix natrix*), Dice Snake (*Natrix tessellata*) and Rat snake (*Zamenis longissimus*). Three of these species (Ordinary pond turtle, Hermann's tortoise and Blotched snake) are included in Annexes II and IV of Directive 92/43/EEC, and 5 species are listed in Annex IV of the Directive.

11.2.8.2 CURRENT STATUS OF FLORA AND FAUNA

The characteristics of the "Flora and Fauna" component encompass an extensive geographical area of the territory of the Republic of Romania, which supposedly could be potentially affected by the operation of the NNU. The evaluation in the month of March 2013 was carried by on the basis of joint field observations in typical habitats in protected areas and their immediate surroundings – large ponds and small dams along the left bank in Romania in the surveillance area (within 30 km radius around Kozloduy NPP). More than half of this area is within the boundaries of Bulgaria, and the rest – in Romania.

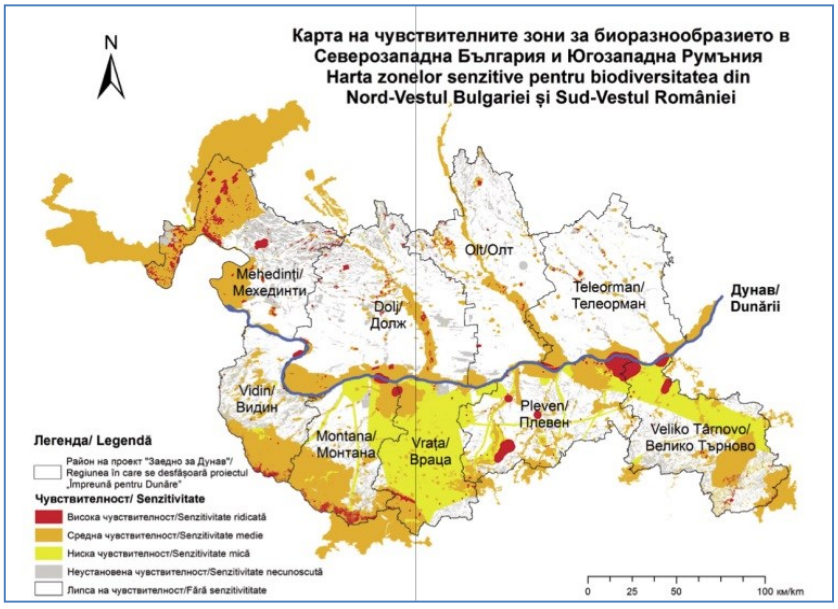

FIGURE 11.2-11: MAP OF THE SENSITIVE AREAS OF BIODIVERSITY IN NORTHWESTERN BULGARIA AND SOUTHWEST ROMANIA [21]

There are totally or partially drained lakes and marshes transformed into fishponds, Danube islands with floodplain forests, estuaries, old spills, quarry lakes, etc. All these determine the great wealth of plants and animals species in the area concerned. There are distinct and sensitive areas in terms of biodiversity, presented in **Figure 11.2-11**.

[20] Gasc, J.P., Cabella, A., Crnobrnja-Isailovic, J., Dolmen, D., Grossenbacher, K., Haffner, P., Lescure, J., Martens, H., Martínez-Rica, J.P., Maurin, H., Oliveira, M.E., So. anidou, T.S., Veith, M., Ziuderwijk, A. (Eds) (1997): Atlas of Amphibians and Reptiles in Europe. Paris, Societas Europaea Herpetologica and Muséum National d'Histoire Naturelle (IEGB/SPN).

[21] http://bspb.org/article_files/133234034543.pdf

As can be seen from the map, the area under consideration is characterized by medium to high sensitivity.

On the two banks of the Danube around Kozloduy there are several protected areas Natura 2000. On the Romanian bank there are the following protected areas under the Birds Directive 79/409/EEC, presented in **Figure 11.2-12**:

- ROSPA0010 Bistreț (Bistrets)
- ROSPA0023 Confluență Jiu-Dunăre și (Confluence of Jiu and Danube rivers)
- ROSPA 0135 Nisipurile de la Dăbuleni și (Sands of Dabuleni)

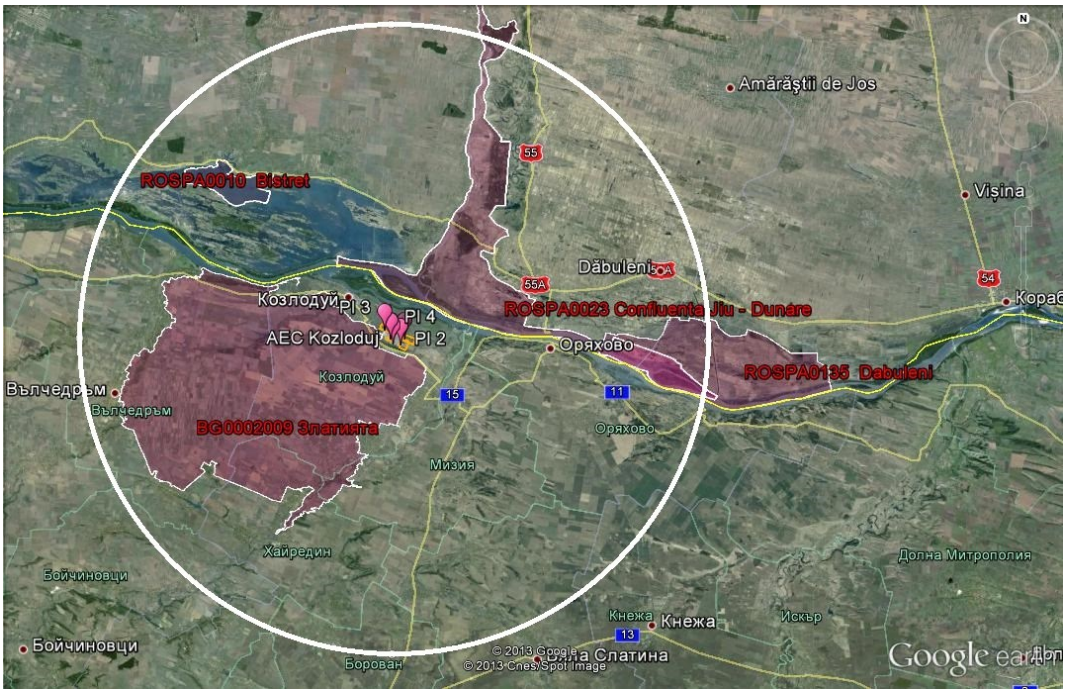

FIGURE 11.2-12: PROTECTED AREAS "BISTRETS", "CONFLUENCE OF JIU AND DANUBE RIVERS" AND "SANDS OF DABULENI" FALLING WITHIN THE 30 KILOMETER SURVEILLANCE RANGE

Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora encompasses the larger part of the PA: ROSCI0045 Coridorul Jiului (Jiu River Corridor), as presented at **Figure 11.2-13**.

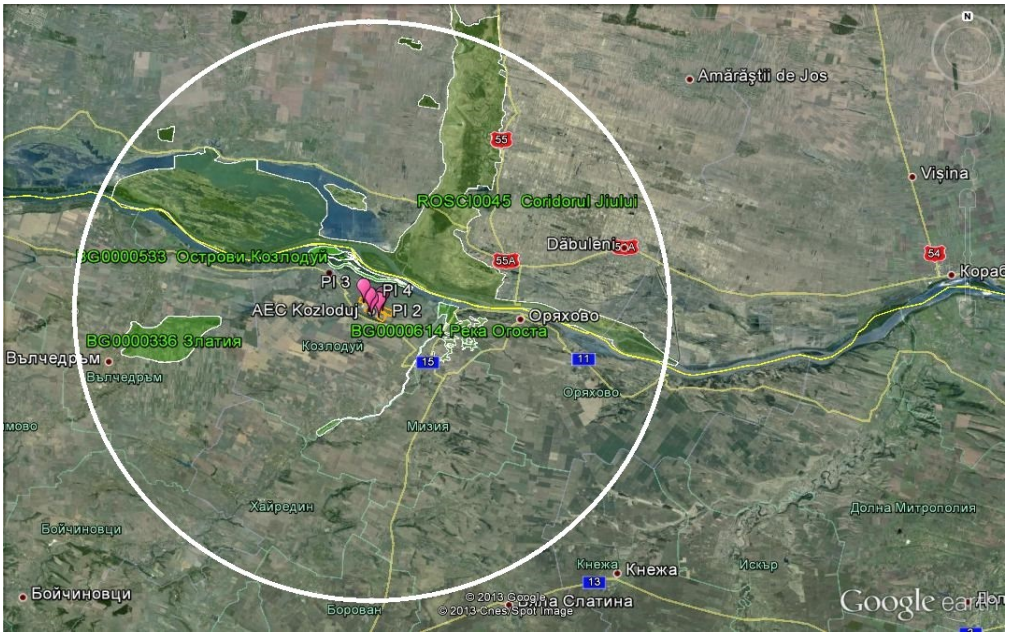

FIGURE 11.2-13: PROTECTED AREA "JIU RIVER CORRIDOR" WHICH FALLS WITHIN THE 30 KILOMETER SURVEILLANCE RANGE

11.2.8.2.1 Protected Area Bistrets ROSPA0010 Bistret

11.2.8.2.1.1 Description of the protected area

This protected area is located in the southwestern part of Romania, on the left bank of the Danube (Figure 11.6.2.1.1). It covers wetlands with a total area of 1915.6000 ha.

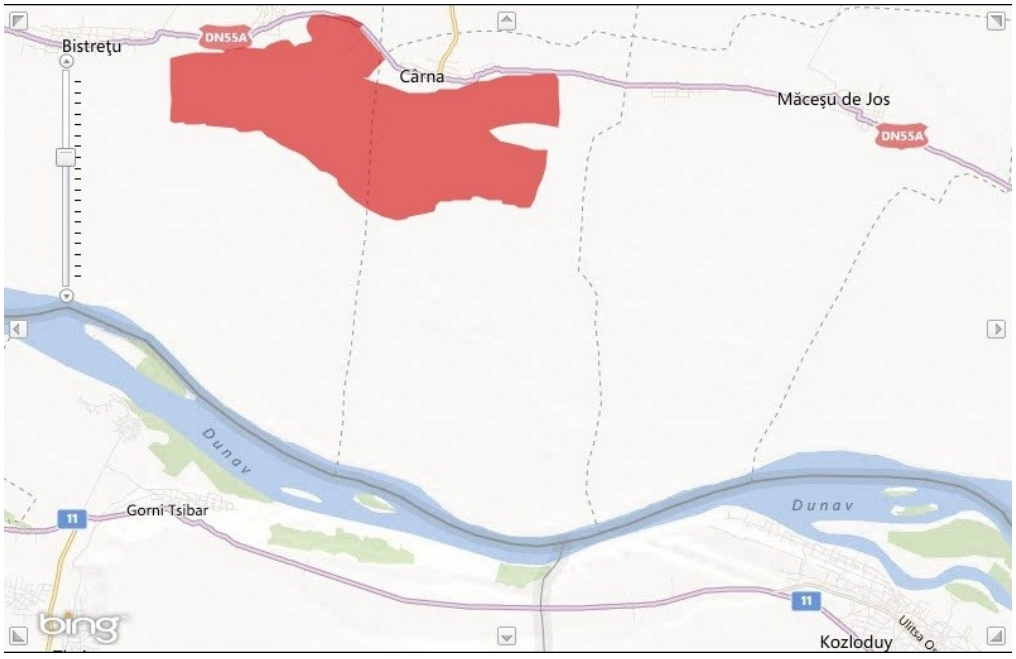

FIGURE 11.2-14: MAP OF PROTECTED AREA BISTRETS UNDER THE WILD BIRDS DIRECTIVE 79/409/EEC

This protected area is important for the breeding of Sandwich Heron (*Ardeola ralloides*), Ferruginous Duck (*Aytya nyroca*), Marsh Harrier (*Cyrcus aeruginosus*). The protected area

is important during migration for waterfowl species and wintering ducks and geese. During the migration zone hosts more than 20,000 waders. In 2012 the area was declared a Ramsar site.

The area includes the floodplain around the Danube, which is often flooded during high water. Still waters account for the majority of the area.

Types of land cover	% cover
Inland still waters, streaming waters	90.0
Bogs, swamps, vegetation on the pond banks	8.0
Improved pastures	2.0
Total	100.0

The area covers important bird species: 36 species in Appendix 1 of the Birds Directive and 79 other migratory species included in the Appendices of the Convention on Migratory Species (Bonn Convention).

Target bird species – **Table 11.2-2***:*

- Breeding: Corn Crake (*Crex crex*), White-tailed Eagle (*Haliaetus albicilla*), White Stork (*Ciconia ciconia*) and Stone Curlew (*Burhinus oedicnemus*);
- Migrating: Dalmatian Pelican (*Pelecanus crispus*), Spoonbill (*Platalea leucorodia*), Glossy Ibis (*Plegadis falcinellus*) and Wood Sandpiper (*Tringa glareola*);
- Wintering: Pygmy Cormorant (*Phalacrocorax pygmaeus*).

TABLE 11.2-2: BIRD SPECIES LISTED IN ANNEX 1 OF THE BIRDS DIRECTIVE 79/409/EEC IN PROTECTED AREA ROSPA0010 BISTRETS

Code	Name	Population				Rating of the location			
		Permanent	Migratory			Population	Protection	Isolation	Total
			Breeding	Wintering	Migration				
A229	Alcedo atthis		45-50p			C	B	C	B
A042	Anser erythropus			4 i	4 i	B	B	C	B
A255	Anthus campestris		P			D			
A029	Ardea purpurea		30-35p			B	B	C	B
A024	Ardeola ralloides		100-150p			B	B	C	B
A060	Aythya nyroca		25-34 p	75 i	15 i	C	B	C	B
A021	Botaurus stellaris		20 p			C	B	C	B
A396	Branta ruficollis				20 i	C	B	C	C
A133	Burhinus oedicnemus		8-12 p			C	C	C	B
A196	Chlidonias hybridus		50-60 p		100-150 i	C	B	C	C
A197	Chlidonias niger				100-200i	C	B	C	C

Code	Name	Population				Rating of the location			
		Permanent	Migratory			Population	Protection	Isolation	Total
			Breeding	Wintering	Migration				
A031	Ciconia ciconia		P		1500-2000i	C	B	C	B
A030	Ciconia nigra		P		40-60i	C	B	C	B
A080	Circaetus gallicus		P		10-15i	C	B	C	B
A081	Circus aeruginosus		12-24 p	4 i		C	B	C	B
A082	Circus cyaneus			5-9i	15-20i	C	B	C	C
A231	Coracias garrulus		20-50 p			C	B	C	B
A038	Cygnus cygnus				20 i	C	B	C	B
A429	Dendrocopos syriacus	P				D			
A027	Egretta alba		P	20-30i	50-80i	C	B	C	C
A026	Egretta garzetta		P		100-300i	C	B	C	B
A075	Haliaeetus albicilla		1 p	2-4 i		C	B	C	C
A131	Himantopus himantopus		30-40p		78-90i	B	B	C	B
A022	Ixobrychus minutus		30-40p			C	B	C	B
A338	Lanius collurio		P			D			
A068	Mergus albellus			3-i	20-30i	C	B	C	B
A023	Nycticorax nycticorax		P		120-150i	C	B	C	B
A020	Pelecanus crispus				50-360i	B	B	C	B
A019	Pelecanus onocrotalus				50-150 i	C	B	B	B
A393	Phalacrocorax pygmeus		P	240-240i		C	A	C	A
A151	Philomachus pugnax				1500-2000 i	C	B	C	B
A034	Platalea leucorodia		P		150-200i	C	B	C	B
A032	Plegadis falcinellus		50-100p		180-220i	B	B	C	B
A120	Porzana parva		7-10p			C	B	C	C
A132	Recurvirostra avosetta		25-40 p		50-250 i	B	B	C	B
A193	Sterna hirundo		P		1000-1500i	C	B	C	C

TABLE 11.2-3: REGULAR MIGRATORY BIRD SPECIES NOT LISTED IN ANNEX 1 OF THE BIRDS DIRECTIVE 79/409/EEC IN PROTECTED AREA ROSPA0010 BISTRETS

Code	Name	Population				Rating of the location			
		Perma-nent	Migratory			Popu-lation	Protection	Isola-tion	Total
			Breed-ing	Winter-ing	Migra-tion				
A086	Accipiter nisus			10-15 i		D			
A298	Acrocephalus arundinaceus		RC			D			
A296	Acrocephalus palustris		R			D			
A295	Acrocephalus		RC			D			

Code	Name	Population				Rating of the location			
		Perma-nent	Migratory			Popu-lation	Protection	Isola-tion	Total
			Breed-ing	Winter-ing	Migra-tion				
	schoenobaenus								
A297	Acrocephalus scirpaceus		RC			D			
A168	Actitis hypoleucos				60 i	D			
A247	Alauda arvensis				RC	D			
A054	Anas acuta			100-120 i		D			
A056	Anas clypeata				4500-4500i	C	B	C	B
A051	Anas crecca			300 i	1200-1500 i	D			
A050	Anas penelope				80-250 i	D			
A053	Anas platyrhynchos		20-20p	1200-1200i	5000-7000i	D			
A055	Anas querquedula				150-400 i	D			
A041	Anser albifrons				2000-7000 i	C	B	C	B
A043	Anser anser				30 i	D			
A028	Ardea cinerea		90-100 i	11 i	30 i	D			
A221	Asio otus		R			D			
A059	Aythya ferina		90-120 p			D			
A061	Aythya fuligula				8-14 i	D			
A067	Bucephala clangula			5-21 i		D			
A215	Buteo buteo			3 i		D			
A144	Calidris alba				56 i	C	B	C	B
A149	Calidris alpina				1400 i	C	B	C	B
A147	Calidris ferruginea				460 i	C	B	C	B
A145	Calidris minuta				332-404 i	C	B	C	B
A146	Calidris temminckii				3 i	C	B	C	B
A366	Carduelis cannabina				RC	D			
A364	Carduelis carduelis				P	D			
A363	Carduelis chloris				P	D			
A136	Charadrius dubius				240-300 i	C	B	C	B
A137	Charadrius hiaticula				121-144 i	C	B	C	B
A212	Cuculus canorus		RC			D			
A036	Cygnus olor				50-100 i	D			
A253	Delichon urbica				C	D			
A269	Erithacus rubecula				C	D			
A096	Falco tinnunculus		3-5 p	5-10 i	5-10 i	D			
A359	Fringilla coelebs				P	D			
A125	Fulica atra		250-250p	500-1000i	2000-3000i	D			
A153	Gallinago gallinago				90-200 i	C	B	C	B

Code	Name	Population				Rating of the location			
		Perma-nent	Migratory			Popu-lation	Protection	Isola-tion	Total
			Breed-ing	Winter-ing	Migra-tion				
A251	Hirundo rustica				RC	D			
A459	Larus cachinnans				600-2500 i	C	B	C	C
A812	Larus canus				180-300 i	D			
A183	Larus fuscus				2-40 i	D			
A179	Larus ridibundus				2000-10000 i	C	B	C	B
A150	Limicola falcinellus				2-10i	D			
A157	Limosa limosa		15-20 p		1500-3000 i	C	B	C	B
A292	Locustella luscinioides		RC			D			
A271	Luscinia megarhynchos				C	D			
A230	Merops apiaster		10-15 p			D			
A383	Miliaria calandra				RC	D			
A262	Motacilla alba		RC			D			
A260	Motacilla flava		P			D			
A381	Muscicapa striata				RC	D			
A337	Oriolus oriolus		P		C	D			
A391	Phalacrocorax carbo			500-500i	4000-5000i	C	B	C	B
A273	Phoenicurus ochruros				RC	D			
A141	Pluvialis squatarola				200-300 i	C	B	C	B
A005	Podiceps cristatus		50 i			D			
A008	Podiceps nigricollis				24 i	D			
A118	Rallus aquaticus			2 i		D			
A336	Remiz pendulinus		RC			D			
A249	Riparia riparia		1500-2000p		C	B	B	C	B
A275	Saxicola rubetra				RC	D			
A381	Saxicola torquata				RC	D			
A283	Sturnus vulgaris		C		C	D			
A004	Tachybaptus ruficollis		4 p		30 i	D			
A048	Tadorna tadorna		2-12 p	100 i	20-25 i	C	B	C	B
A161	Tringa erythropus				440-600 i	C	B	C	B
A164	Tringa nebularia				200 i	C	B	C	B
A165	Tringa ochropus				90 i	D			
A163	Tringa stagnatilis				20-30 i	D			
A162	Tringa totanus				1200-2000 i	C	B	C	B
A285	Turdus merula				RC	D			
A285	Turdus philomelos				RC	D			
A232	Upupa epops				RC	D			
A142	Vanellus vanellus		30-50 p		2100-3000 i	C	B	C	B

Expansion of areas transformed my man and water pollution has a negative impact on birds in the area.

11.2.8.2.1.2 Own observations

Ornithological field observations in zone Bistrets were conducted by the team of experts on biodiversity, and the results are presented in **Table 11.2-4**:

TABLE 11.2-4: BIRD SPECIES FOUND IN THE ROMANIAN PART OF THE SURVEILLANCE ZONE (WITHIN 30 KM) DURING 6-8 MARCH 2013

No/	Scientific name	Specie – common name	ROSPA0010 Bistrets	Rice fields W of Nedeia	ROSPA0023 Confluence Jiu-Danube	ROSPA Dabuleni	Total
1	Podiceps cristatus	Great Crested Grebe	45				45
2	Phalacrocorax carbo	Great Cormorant	90		2		92
3	Pelecanus crispus	Dalmatian Pelican					0
4	Botaurus stellaris	Great Bittern	1				1
5	Egretta alba	Great Egret	96	6	7		109
6	Ardea cinerea	Grey Heron	25				25
7	Cygnus olor	Nam Swan			6		6
8	Anser anser	Gray goose	2	7			9
9	Anas penelope	Coupon		280	120		400
10	Anas strepera	Gadwall		18	30		48
11	Anas crecca	Teal		200	140		340
12	Anas platyrhynchos	Mallard		65	42		107
13	Anas acuta	Pintail		55	20		75
14	Anas clypeata	Northern Shoveler		25	10		35
15	Anas querquedula	Garganey		1	8		9
16	Aythya ferina	Pochard	170				170
17	Bucephala clangula	Common Goldeneye	2				2
18	Mergus serrator	Red-breasted Merganser					0
19	Fulica atra	Shuffler	60	50			110
20	Vanellus vanellus	Lapwing	40	30	219	8	297
21	Philomachus pugnax	Ruff			21		21
22	Larus ridibundus	Gull	200		4		204
23	Larus canus	Mew					0
24	Larus mich./cachinn.	Yellow-legged Gull					0
25	Circus cyaneus	Hen-harrier	1				1
26	Accipiter gentilis	Goshawk					0
27	Buteo buteo	Common Buzzard			1	1	2
28	Buteo rufinus	Long-legged Buzzard					0
29	Buteo lagopus	Rough leg		2			2
30	Haliaeetus albicilla	White-tailed Eagle	1				1
31	Falco tinunnculus	Kestrel				3	3

No/	Scientific name	Specie – common name	ROSPA0010 Bistrets	Rice fields W of Nedeia	ROSPA0023 Confluence Jiu-Danube	ROSPA Dabuleni	Total
32	Falco peregrinus	Peregrine Falcon					0
33	Phasianus colchicus	Pheasant					0
34	Columba livia dom.	Rock dove					0
35	Columba palumbus	Ringdove					0
36	Streptopelia decaocto	Dove				35	35
37	Picus viridis	Yaffil					0
38	Dendrocopus major	Great Spotted Woodpecker					0
39	Dendrocopus minor	Lesser Spotted Woodpecker					0
40	Melanitta callandra	Calandra Lark					0
41	Galerida cristata	Crested Lark					0
42	Alaudaarvensis	Skylark					0
43	Anthus spinoletta	Water Pipit					0
44	Motacilla alba	White Wagtail					0
45	Delichon urbica	Martin					0
46	Turdus merula	Common Blackbird					0
47	Turdus philomelos	Song Thrush					0
48	Turdus pilaris	Fieldfare	50				50
49	Erithacus rubecula	Robin					0
50	Acrocephalus melanopogon	Bearded Warbler	1				1
51	Parus caeruleus	Blue Tit					0
52	Parus major	Great Tit					0
53	Sitta europea	Nuthatch					0
54	Certhia brachydactila	Short-toed Treecreeper					0
55	Lanius excubitor	Great Grey Shrike					0
56	Garrulus glandarius	Jay					0
57	Pica pica	Magpie					0
58	Corvus monedula	Daw			470		470
59	Corvus frungilegus	Rook			410	20	430
60	Corvus cornix	Hoodie			10		10
61	Sturnus vulgaris	Common Starling			20		20
62	Passer domesticus	House Sparrow					0
63	Passer montanus	Tree Sparrow					0
64	Fringuila coelebs	Greenfinch					0
65	Fringuila montifringilla	Mountain finch					0
66	Carduelis carduelis	Goldfinch					0
67	Coccotrauistes coccothraustes	Grosbeak					0
68	Emberiza schoeniculus	Reed Bunting					0
69	Emberiza calandra	Bunting				1	1
70	Emberiza citrinella	Yellow-headed Bunting				30	30
		Total number of birds	784	739	1540	98	3161
		Total number of species	15	12	18	7	34

70 species were identified during the observation period in total. These include two endangered species – Dalmatian Pelican (*Pelecanus crispus*) and White-tailed Eagle (*Haliaeetus albicilla*).

Dalmatian Pelican (*Pelecanus crispus*) in Bulgaria is a permament, migratory and wintering species. In the research area, there are significant concentrations outside the breeding season (February to July). Only one two years old pelican was found during this survey near the Onshore Pump Station (OPS).

Osprey (*Haliaeetus albicilla*) in Bulgaria is a permanent, migratory and wintering species whose breeding population is mainly along the Black Sea and the Danube River. During the study period the species was found on the cape of the island under v. G. Tsibar and southwest of the v. Bistrets – Romania (in each case, an adult bird) – **Figure 11.2-15**.

FIGURE 11.2-15: OBSERVATIONS OF WHITE-TAILED EAGLES ON THE TWO BANKS OF THE DANUBE IN THE AREA OF KOZLODUY NPP

Supposedly the White-tailed Eagle has a nest on the Romanian island Gatanul (near Island Ibisha), which was also confirmed by the Romanian experts.

The survey also found a breeding colony of Great Cormorant (*Phalacrocorax carbo*) and Grey Heron (*Ardea cinerea*) in the lower part of the island Tsibar (Ibisha).

Overall, the survey period identified the end of the wintering season of species such as Common Goldeneye (*Bucephala clangula*), Teal (*Anas crecca*), Fieldfare (*Turdus pilaris*); the begginging of the migration of species such as Garganey (*Anas querquedula*), Gadwall (*Anas strepera*) and Pintail (*Anas acuta*) as well as the beginning of the breeding cycle by building nests by Great Cormorant (*Phalacrocorax carbo*) and Grey Heron (*Ardea cinerea*) – in the colony on the island of Ibisha, mating behavior in all species of woodpeckers and permanent birds as Greenfinch (*Fringilla coelebs*), Bunting (*Miliaria calandra*), Great Tit (*Parus major*), Blue Tit (*Parus coeruleus*) and Nuthatch (*Sitta europaea*).

This report includes for comparison results from own observations conducted in the same area during the breeding season of 2010 (8-10 July 2010).

The results of the visual observation are presented in the next **Table 11.2-5**.

TABLE 11.2-5: SPECIES AND NUMBER OF BIRDS FOUND IN THE SWAMPS OF BISTRETS DURING THE BREEDING SEASON OF 2010 (8-10 JULY 2010)

No.	Specie – common and scientific name	Rice fields W of Beket	Lake Bistrests and fish ponds	Total (specimens)
1	Little Grebe, *Tachybaptus ruficollis*		2	2
2	Great Crested Grebe, *Podiceps cristatus*		115	115
4	Grebe, *Podiceps nigricollis*		2	2
5	Great Cormorant, *Phalacrocorax carbo*		1000	1000
6	Pygmy Cormorant, *Phalacrocorax pygmeus* *		20	20
7	Pink Pelican, *Pelecanus onocrotalus**		19	19
8	Dalmatian Pelican, *Pelecanus crispus**		52	52
9	Great Bittern, *Botaurus stellaris*			0
10	Little Bittern, *Ixobrychus minutus*		2	2
11	Night Heron, *Nycticorax nycticorax**		1	1
12	Squaco Heron, *Ardeola ralloides**		2	2
13	Little Egret, *Egretta garzetta**	6	34	40
14	Great Egret, *Egretta alba**		5	5
15	Grey Heron, *Ardea cinerea*	8	3	11
16	Purple Heron, *Ardea purpurea**	1	6	7
18	White Stork, *Ciconia ciconia*	2	36	38
19	Glossy Ibis, *Plegadis falcinellus**			0
20	Spoonbill, *Platalea leucorodia* *	40		40
21	Mute swan, *Cygnus olor*		1	1
22	Grey Goose, *Anser anser*		132	132
23	Widgeon, *Anas penelope*			0
24	Gadwall, *Anas strepera*		1	1
26	Mallard, *Anas platyrhynchos*		810	810
27	Moorhen, *Gallinula chloropus*			0
28	Coot, *Fulica atra*		1130	1130
29	Oystercatcher, *Haematopus ostralegus**			0
30	Stilt, *Himantopus himantopus**	3		3
31	Lapwing, *Vanellus vanellus*	30		30

No.	Specie – common and scientific name	Rice fields W of Beket	Lake Bistrests and fish ponds	Total (specimens)
32	Big red Sandpiper, *Tringa erythropus*	100		100
33	Small red Sandpiper, *Tringa totanus*			0
34	Small green Sandpiper, *Tringa stagnatilis*	2		2
35	Common Sandpiper, *Actitis hypoleucos*		4	4
36	Gull, *Larus ridibundus*		2250	2250
37	Yellow-legged Gull, *Larus cachinnans*		121	121
38	Whiskered Tern, *Chlidonias hybridus*		130	130
39	Black Tern, *Chlidonias niger*		1	1
40	Kingfisher, *Icedo atthis*			0
41	Bee-eater, *Merops apiaster*		10	10
42	European Roller, *Coracias garrulus*			0
43	Hoopoe, *Upupa epops**	1	1	
44	Crested Lark, *Galerida cristata*		2	
45	Skylark, *Alauda arvensis*			0
46	Sand Martin, *Riparia riparia*		5150	5150
47	Swallow, *Hirundo rustica*			0
48	Martin, *Delichon urbica*			0
49	Reed Warbler, *Acroceph. arundinaceus*		1	1
50	Daw, *Corvus monedula*			0
51	Rook, *Corvus frugilegus*		3	3
52	Hoodie, *Corvus corone cornix*		11	11
	Total number of birds	195	11057	11252
	Total number of species	11	32	38

The survey identified concentrations of wintering or early spring migrants returning among waterfowl in the total number of 750 specimens such as: Target species – Great Egret (*Egretta alba*) – 96 specimens, White-tailed Eagle (*Haliaeetus albicilla*) – 1 adult specimen as well as Pochard (*Aythya ferina*) – 170 specimens, Northern Lapwing (*Vanellus vanellus*) – 40 specimens, Coot (*Fulica atra*) – 60 specimens. The observations also captured the beginning of nesting periods in Gull (*Larus ridibundus*) – 200 birds altogether.

The target species found were Great Bittern (*Botaurus stellaris*) and Greyleg Goose (*Anser anser*) – 2 specimens.

In conclusion it must be stated that:

1. The surveyed area is characterized by extraordinary biodiversity of birds, as evidenced by the 7 Protected Areas declared in it under the Birds Directive and our observations during this survey.
2. In that period (early March) and within the 30 km range around Kozloduy NPP, the survey found occurances of two globally endangered species – Dalmatian Pelican (*Pelecanus crispus*) and White-tailed Eagle (*Haliaeetus albicilla*).

FIGURE 11.2-16: GREAT CORMORANTS (PHALACROCORAX CARBO) NEAR ZAVAL

Flora

The periphery of Bistrets Lake is overgrown in Reed (*Phragmites australis*), Cattail (*Typha angustifolia*), Bulrush (*Schoenoplectus lacustris*), Flowering Rush (*Butomus umbelatus*), Cocklebur (*Xanthium strumarium*). The area between the lake and the river is flat and is subjected to intensive grazing. There have been findings of Twitch (*Cynodon dactylon*), Sliding window (*Potentilla reptans*), Strawberry Clover (*Trifolium fragiferum*), Green foxtail (*Setaria viridis*), Rushes (*Juncus sp.*), Buttercup (*Ranunculus sp.*), Russian thistle (*Salsola ruthenica*), Prickly liquorice (*Glycyrrhiza echinata*), Black locust (*Amorpha fruticosa*), Slat Cedar (*Tamarix sp.*), White Willow (*Salix alba*), flowering specimens of Coltsfoot (*Tussilago farfara*) and the like.

Fauna

- ✓ Fish

The following fish species have been found in the area: Common haddock (*Gymnocephalus cernuus*), Roach (*Rutilus rutilus*), Gibel carp (*Carassius gibelio*), Carp (*Cyprinus carpio*) Whitefish (*Sander lucioperca*) and Bleak (*Alburnus alburnus*).

Desnacuy river (43°53'38.9"N, 23°34'35.8"E): Massive spawning migration of Bleak (*Alburnus alburnus*) has been found upstream the river – **Figure 11.2-17**.

FIGURE 11.2-17: FISH CAUGHT IN BISTRETS LAKE (07.03.2013).

- ✓ Mammals

The protected area provides conditions for the existence of a variety of common species of terrestrial vertebrates, and the visual observations established European polecat (*Mustela putorius*) and Fox (*Vulpes vulpes*).

11.2.8.2.2 Protected area ROSPA0023 – Confleunce of Jiu and Danube rivers (Confluența Jiu – Dunăre) under the Birds Directive 79/409/EC

11.2.8.2.2.1 Description of the Protected area

The protected area is located in the southwestern part of Romania, on the left bank of the Danube (**Figure 11.2-18**). It consists of the lower stream of Jiu river and its confluence with the Danube. Its total surface area is 19799.8000 ha.

FIGURE 11.2-18: MAP OF PROTECTED AREA ROSPA0023 „CONFLUENCE OF JIU AND DANUBE RIVERS"

The following classes of land cover have been described in this area:

Classes of land cover	% cover
Coastal sand dunes, beaches	2.0
Inland waters (standing ponds, flowing waters)	16.0
Bogs, swamps, vegetation along the banks of ponds, marshes	2.0
Extensive cereal crops (including rotary crops)	23.0
Improved pastures	10.0
Other arable land	4.00
Broadleaf deciduous forest	38.0
Forest habitats (total)	5.0
Total	100.0

The area is habitat of the following endangered species: 36 species in Annex 1 of the Birds Directive and 79 other migratory species included in the Appendices of the Convention on Migratory Species (Bonn).

- Breeding: Corn Crake (*Crex crex*), White-tailed Eagle (*Haliaetus albicilla*), White Stork (*Ciconia ciconia*) and Stone Curlew (*Vurhinus oedicnemus*).
- Migrating: Dalmatian Pelican (*Pelecanus crispus)*, Spoonbill (*Platalea leucorodia),* Glossy Ibis (*Plegadis falcinellus)*, Wood Sandpiper (*Tringa glareola*).
- Wintering: Pygmy Cormorant (*Phalacrocorax pygmaeus*).

TABLE 11.2-6: BIRD SPECIES LISTED IN ANNEX 1 OF THE BIRDS DIRECTIVE 79/409/EEC[22]

Code	Name	Population				Rating of the location			
		Perma-nent	Migratory			Popu-lation	Protection	Iso-lation	Total
			Nesting	Winter-ing	Mig-ration				
A229	Alcedo atthis		50-60p			C	B	C	B
A255	Anthus campestris		10-20 p			D			
A089	Aquila pomarina		2-2p			D			
A029	Ardea purpurea				10-30 i	D			
A021	Botaurus stellaris		2-4 p			C	B	C	C
A133	Burhinus oedicnemus		10-20 p			B	B	C	B
A403	Buteo rufinus		2-4p			C	B	C	B
A224	Caprimulgus europaeus		120-150 p			C	B	C	B
A196	Chlidonias hybridus				200-300 i	D			
A197	Chlidonias niger				50-100 i	C	B	C	C
A031	Ciconia ciconia		P		500-800i	C	B	C	C
A030	Ciconia nigra		2-3p			C	B	C	B
A081	Circus aeruginosus		6-10 p			C	B	C	B
A231	Coracias garrulus		46-50 p			C	B	C	C
A122	Crex crex		100-150 p			C	B	C	B
A238	Dendrocopos medius		100-130 p			C	B	C	B
A429	Dendrocopos syriacus		90-120 p			C	B	C	C
A027	Egretta alba				20-30 i	D			
A026	Egretta garzetta				150-200 i	D			
A321	Ficedula albicollis				300-400i	D			
A075	Haliaeetus albicilla		1-2 p			C	B	C	B
A131	Himantopus himantopus				20-30 i	D			
A022	Ixobrychus minutus		12-20 p			C	B	C	C
A338	Lanius collurio		C			D			
A177	Larus minutus				100-150 i	C	B	C	B
A246	Lullula arborea		RC			D			
A073	Milvus migrans		2-4 p			C	B	C	C
A020	Pelecanus crispus				30-70 i	C	B	B	B
A072	Pernis apivorus		12-20 p			D			
A393	Phalacrocorax pygmeus			40-70 i		C	B	C	B
A034	Platalea leucorodia				150-200 i	C	B	C	B
A032	Plegadis falcinellus				750-	D			

[22] http://natura2000.eea.europa.eu/Natura2000/SDFPublic.aspx?site=ROSPA0023#7

Code	Name	Population				Rating of the location			
		Perma-nent	Migratory			Popu-lation	Protection	Iso-lation	Total
			Nesting	Winter-ing	Mig-ration				
					1000 i				
A132	Recurvirostra avosetta				30-40 i	D			
A195	Sterna albifrons				70-140 i	C	B	C	C
A193	Sterna hirundo				150-250 i	C	B	C	C
A166	Tringa glareola				1000-2000 i	C	B	C	B

TABLE 11.2-7: REGULARLY MIGRATING BIRD SPECIES NOT LISTED IN ANNEX 1 OF THE BIRDS DIRECTIVE 79/409/EEC[23]

Code	Name	Population				Rating of the location			
		Perma-nent	Migratory			Popu-lation	Protection	Iso-lation	Total
			Nesting	Winter-ing	Mig-ration				
A298	Acrocephalus arundinaceus		RC			D			
A296	Acrocephalus palustris		R			D			
A295	Acrocephalus schoenobaenus		RC			D			
A297	Acrocephalus scirpaceus		RC			D			
A247	Alauda arvensis		RC			C	C	C	C
A056	Anas clypeata				R	D			
A051	Anas crecca				4000-6000i	D			
A050	Anas penelope				1000-1200i	C	C	C	C
A053	Anas platyrhynchos				2000-3000i	D			
A055	Anas querquedula				1500-2000i	D			
A051	Anas strepera		RC		R	D			
A041	Anser albifrons				R	D			
A043	Anser anser				R	D			
A258	Anthus cervinus				R	D			
A257	Anthus pratensis				RC	D			
A259	Anthus spinoletta				R	D			
A256	Anthus trivialis		RC			D			
A028	Ardea cinerea				500-600i	D			
A221	Asio otus				R	D			
A059	Aythya ferina				RC	D			
A061	Aythya fuligula				R	D			
A147	Calidris ferruginea				RC	D			
A145	Calidris minuta				R	D			

[23] http://natura2000.eea.europa.eu/Natura2000/SDFPublic.aspx?site=ROSPA0023#7

Code	Name	Population				Rating of the location			
		Perma-nent	Migratory			Popu-lation	Protection	Iso-lation	Total
			Nesting	Winter-ing	Mig-ration				
A146	Calidris temminckii				R	D			
A366	Carduelis cannabina		RC			D			
A364	Carduelis carduelis		C			D			
A136	Charadrius dubius				R	D			
A137	Charadrius hiaticula				R	D			
A007	Columba oenas		RC			D			
A208	Columba palumbus		RC			D			
A347	Coturnix coturnix		R			D			
A212	Cuculus canorus		RC			D			
A253	Delichon urbica		RC		RC	D			
A269	Erithacus rubecula				RC	D			
A099	Falco subbuteo		RC			D			
A096	Falco tinnunculus		RC			D			
A359	Fringilla coelebs		RC		C	D			
A125	Fulica atra		RC		2000-2500i	D			
A153	Gallinago gallinago				1000-1200i	D			
A251	Hirundo rustica		C		C	D			
A340	Lanius excubitor				RC	D			
A459	Larus cachinnans				800-1000i	D			
A179	Larus ridibundus		R		2000-3000i	C	C	C	C
A157	Limosa limosa				2000-3000i	C	B	C	B
A291	Locustella fluviatilis		RC			D			
A292	Locustella luscinioides		C			D			
A270	Luscinia luscinia		V			D			
A271	Luscinia megarhynchos		C			D			
A230	Merops apiaster		R			D			
A383	Miliaria calandra		C			D			
A262	Motacilla alba		C		C	D			
A260	Motacilla flava				C	D			
A381	Muscicapa striata		RC		C	D			
1360	Oenanthe oenanthe		RC			D			
A337	Oriolus oriolus		RC			D			
A391	Phalacrocorax carbo				RC	D			
A273	Phoenicurus ochruros		RC			D			
A377	Phoenicurus phoenicurus				RC	D			
A315	Phylloscopus collybita		C		C	D			
A005	Podiceps cristatus				C	D			
A336	Remiz pendulinus		RC			D			
A249	Riparia riparia				RC	D			
A275	Saxicola rubetra		RC			D			

Code	Name	Population				Rating of the location			
		Perma-nent	Migratory			Popu-lation	Protection	Iso-lation	Total
			Nesting	Winter-ing	Mig-ration				
A283	Sturnus vulgaris		C		P	D			
A311	Sylvia atricapilla		RC			D			
A310	Sylvia borin		R			D			
A309	Sylvia communis		RC			D			
A308	Sylvia curruca		RC			D			
A004	Tachybaptus ruficollis				C	D			
A161	Tringa erythropus				600-800i	C	B	C	B
A164	Tringa nebularia				500-600i	C	B	C	B
A165	Tringa ochropus				RC	D			
A285	Turdus merula		RC			D			
A285	Turdus philomelos		RC			D			
A232	Upupa epops		RC			D			
A142	Vanellus vanellus				RC	D			

11.2.8.2.2.2 Own observations

Flora

The periphery of the spills is mainly overgrown in Reed (*Phragmites australis*). The slopes are made up of grasslands with Bulbous bluegrass (*Poa bulbosa*), Spring greedy (*Erophilla verna*), Field eryngo (*Eryngium campestre*), Yellow Hayne (*Gagea sp.*), Twitch (*Cynodon dactylon*) Thyme (*Thymus sp.*), Teasel clover (*Trifolium retusum*), Common chicory (*Cichorium inthybus*) Kraglolisten geranium (*Geranium rotundifolium*) Conical campion (*Silene conica*), Moss (*Syntrichia ruralis*).

Fauna

- ✓ Birds

Concentrations of wintering waterbird species or the first returning spring migrants totaling over 1,500 specimens were found: Great Egret (*Egretta alba*) – 7 specimens, Teal (*Anas crecca*) – 140 specimens, Gadwall (*Anas strepera*) – 30 specimens, Widgeon (*Anas penelope*) – 120 specimens, Northern Shoveler (*Anas clypeata*) – 10 specimens, Lapwing (*Vanellus vanellus*) – 219 specimens, Spotted Ruff (*Philomachus pugnax*) – 21 specimens.

- ✓ Mammals

The protected area provides conditions for the existence of many common species of terrestrial vertebrates, and the observations established numerous burrows of Badger (*Meles meles*) and Fox (*Vulpes vulpes*) as well as tracks of wild boar (*Sus scrofa*).

11.2.8.2.3 Protected area ROSPA00135 Sands of Dabuleni under the Birds Directive 79/409/EEC

11.2.8.2.3.1 Description of the Protected area

The area is located in the eastern part of the confluence of the Danube and the river Jiu Meadow: west to the locality Sărata, north of the former tailings pond Potelu (currently being converted into agricultural area) and the populatd settlements Dabuleni and Ianca, east of the locality Hotaru, south of the Danube. Its total area is 11034.9 ha.

Land cover classes: 48% large grain fields, 16% improved pastures, 12% forest habitats, 10% of inland sites (standing water, streaming water), 10% broadleaf deciduous forest, 4% other farmland.

It mainly includes agricultural land, tree plantations, orchards, river banks, permanent and temporary wetlands. Sandy alluvial sediments and wind deflation are the cause of the predominance of sandy soils at different stages of development. This leads to the formation of sand dunes. These sandy soils do not retain water, which leads to drought and even desertification (disappearance of vegetation).

The site fisters important breeding populations of Red-footed Falcon (*Falco vespertinus*), Ortolan Bunting (*Emberiza hortulana*), European Roller (*Coracias garrulus*) and Red-backed Shrike (*Lanius collurio*). Noteworthy waterfoul species include breeding populations of Ferruginous Duck (*Aythya nyroca*), Sandwich Heron (*Ardeola ralloides*) and Spoonbill (*Platalea leucorodia*) during the migration migration periods.

In the protected area, the species Rook (*Corvus frugilegus*) is a host of the breeding population of Red-footed Falcon (*Falco vespertinus*).

TABLE 11.2-8: BIRD SPECIES LISTED IN ANNEX 1 OF THE BIRDS DIRECTIVE 79/409/EEC [24]

A026 Egretta garzetta	50-100 i C B C B
A023 Nycticorax nycticorax	50-100 i C B C B
A031 Ciconia ciconia	10-15 p C B C B
A097 Falco vespertinus	25-40 p B C B B
A307 Sylvia nisoria	20-50 p C B C B
A060 Aythya nyroca	24-31 p 130-240 i C B C B
A024 Ardeola ralloides	600-1000 i C B C B
A034 Platalea leucorodia	120-140 i C B C B
A255 Anthus campestris	30-50p D
A224 Caprimulgus europaeus	10-20p D
A231 Coracias garrulus	30-60p B B C B

[24] http://www.mmediu.ro/protectia_naturii/biodiversitate/2011-10-20_protectia_naturii_RO_SPA_SDF_2011.pdf

A339 Lanius minor	80-120p D
A379 Emberiza hortulana	80-120 p C B C B
A338 Lanius collurio	200-300p D

TABLE 11.2-9: REGULAR MIGRATORY BIRDS NOT LISTED IN ANNEX 1 OF THE BIRDS DIRECTIVE 79/409/EEC

A348 Corvus frugilegus	300-400 p C B C B
A438 Hippolais pallida	10-30 p C B C B

11.2.8.2.3.2 Own observations

Flora

Almost the entire territory is occupied by arable land and vineyards. The pastures between the crop fields are dominated by twitch (*Cynodon dactylon*).

Fauna

- ✓ Birds

The existing marsh in Google Maps 2006 is now drained and transformed in arable fields and accordingly no waterfowl species were found. Numerous specimens of Dove (*Streptopelia decaocto*) were observed in populated settlements – 35 ind., and a pair of Kestrels (*Falco tinunnculus*) – 3 ind. and Common Buzzard (*Buteo buteo*) – 1 ind. were seen around the crop fields and the forest band, likely to nest. The other types are included in **Table 11.2-9** (98 specimens of 7 species).

- ✓ Mammals

The Protected area provides conditions for the existence of common and widespread species of terrestrial vertebrates, and the visual inspections established burrows of Badger (*Meles meles*), Common hamster (*Cricetus cricetus*) and the target species Souslik (*Spermophilus citellus*), which is not reported in the Standard form.

11.2.8.2.4 Protected area ROSCI0045 "Corridor of Jiu river" under Directive 92/43/EEC on the conservation of natural habitats and of wild flora and fauna

11.2.8.2.4.1 Description of the Protected area

The protected area is situated along the river Jiu (**Figure 11.2-19**) and its confluence with the Danube. Its total surface area is 71451.9000 ha. Habitats as well as flora and fauna species of priority for the European Community, and flora and fauna representatives of the continental biogeographic region are being preserved in the area.

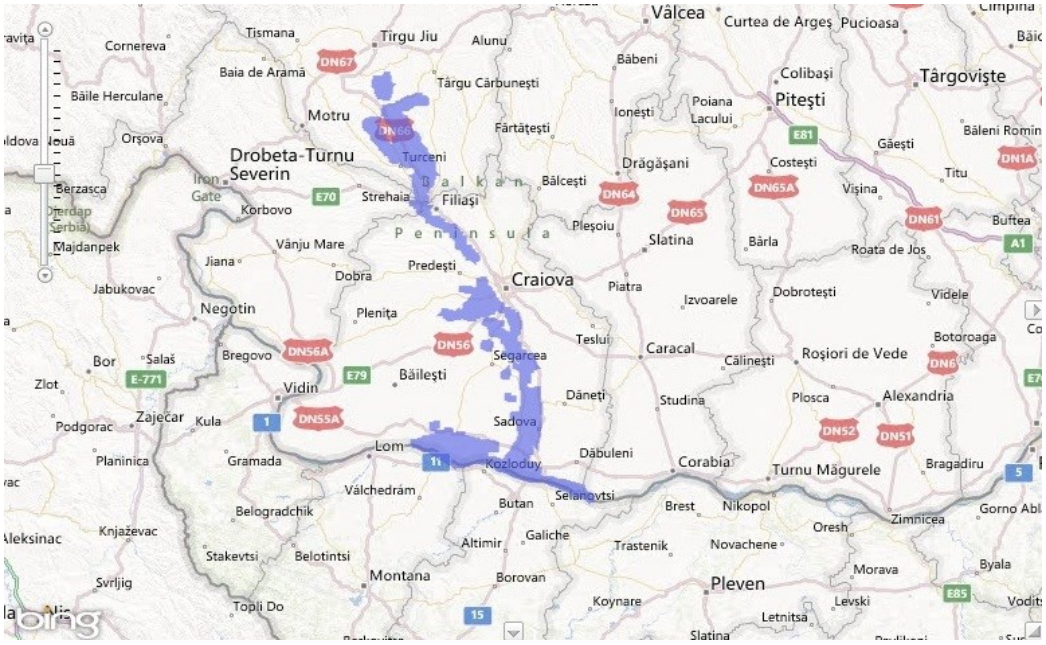

FIGURE 11.2-19: MAP OF PROTECTED AREA ROSCI0045 "CORRIDOR OF JIU RIVER"

Land cover classes: 48% broadleaf deciduous forest, 13% extensive crops, cereals, 13% improved pastures, 12% inland water bodies (standing water, streaming water), 9% bogs, swamps, vegetation, wetlands, 3% forest habitats (total), 2% other farmland.

14 types of habitats are being preserved in the area: 3130 Oligotrophic to mesotrophic standing waters with vegetation of Littorelletea uniflorae and / or Isoeto-Nanojuncetea (0.5%); 3270 Rivers with muddy banks with Chenopodion rubri and Bidention RR (0.1%); 6260 Pannonian sand steppes (0.1%); 6440 Alluvial meadows of unions Cnidion dubii in river valleys (1%); 6510 Lowland hay meadows (1%); 1530 Pannonian salt steppes and salt marshes (3%); 9130 Beech forests of type Asperulo – Fagetum (1.7%); 9170 oak-hornbeam forests of type Galio – Carpinetum (0.4%); 91E0* Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno – Padion, Alnion incanae, Salicion albae) (0.1%); 91I0 * Euro-Siberian steppe forests with Quercus spp. (1%); 91M0 Balkan-Pannonian Fagus orientalis – Quercus polycarpa forests (6.8%); 91Y0 Dacian oak-hornbeam forests (3%); 92A0 Riparian galleries of Salix alba and Populus alba (3.7%) and 91F0 Riparian mixed forests of Quercus robur, Ulmus laevis, Fraxinus excelsior or Fraxinus angustifolia, along the largest rivers (Ulmenion minoris) (0.5%).

The rerritory located in the middle and lower stream the river Jiu includes one of the rarest and most representative samples of European relict meadows drastically changed and nearly disappeared. The area encompasses four (27%) of the 15 continental biogeographic ecoregions in Romania (Gath plateau, Plane Cevat Burdeya (Găvanu-Burdea), Plane Silvostepe (Sylvosteppe), Danubian meadows).

Although it occupies only 0.5% of Romania's forests and 0.6% of the national territory, the Area concentrates: 8 (32%) of the 28 types of natural forest habitats protected by the Romanian and European legislation (91E0*, 91F0, 91I0*, 91M0, 91Y0, 9130, 9170, 92A0);

two (33%) of the six priority conservation forest habitats of the European community (91E0*, 91I0*) and four (36%) of the eleven phyto-climatic areas of Romania (hilly areas with Quercus petraea, Q. cerris, Q. frainetto; hilly areas with Quercus robur, Q. cerris, Q. frainetto, Quercus petraea; forests in the plains and forest steppes); 56 (26%) of the 212 forest resorts, 22 (44%) of the 50 forest formations with 97 (32%) of the 306 types of forests identified for Romania.

The area features high concentration of plant associations of bio-historical value, reflecting the influence of the southern and central thermophilic and Central European elements; it protects preserved fragments of relict forests located on the rim of biogeographic region (Fagus forests at Dâlga, Suglui, Bucovăţ) or man-mande isolating forests (eg the forest of oak Quercus Quercus pedunculiflora at Braniştea Bistreţului) and maintains sustainable populations of plant and animal species regulated by law, the definition of SCI and SPA, etc.

TABLE 11.2-10: MAMMALS LISTED IN ANNEX OF DIRECTIVE 92/43/EEC (P – PRESENT)

Code	Specie	Population				Integrated rating			
		Local	Migratory			Popu-lation	Protec-tion	Iso-lation	Total
			Breed-ing	Winter-ing	Stage				
1355	Lutra lutra	P				C	B	C	B
1335	Spermophilus citellus	P				C	B	C	B

✓ Amphibians and reptiles

TABLE 11.2-11: AMPHIBIANS AND REPTILES LISTED IN ANNEX II OF DIRECTIVE 92/43/EEC (P – PRESENT)

Code	Specie	Population				Integrated rating			
		Local	Migratory			Popu-lation	Protec-tion	Iso-lation	Total
			Breed-ing	Winter-ing	Stage				
1188	Bombina bombina	P				B	B	C	B
1220	Emys orbicularis	P				C	B	C	B
1166	Triturus cristatus	P				B	B	C	B

TABLE 11.2-12: FISH SPECIES LISTED IN ANNEX II OF THE HABITATS DIRECTIVE 92/43/EEC AND INCLUDED IN THE STANDARD FORM OF THE AREA. P – THE SPECIES IS ENCOUNTERED, R – THE SPECIA IS RARE

Code	Specie	Population				Integrated rating			
		Local	Migratory			Popu-lation	Protec-tion	Iso-lation	Total
			Breed-ing	Winter-ing	Stage				
4125	Alosa immaculata	P	R			C	B	B	B
1130	Aspius aspius	P				B	B	C	B
1149	Cobitis taenia	P				C	B	C	B
1124	Gobio albipinnatus	P				C	B	C	B

Code	Specie	Population				Integrated rating			
		Local	Migratory			Popu-lation	Protec-tion	Iso-lation	Total
			Breed-ing	Winter-ing	Stage				
2555	Gymnocephalus baloni	P?							
1157	Gymnocephalus schraetzer	P				C	B	B	B
1145	Misgurnus fossilis	P				C	B	C	B
2522	Pelecus cultratus	P				C	B	C	B
1134	Rhodeus sericeus amarus	P				C	B	C	B
1146	Sabanejewia aurata	P				C	B	C	B
1160	Zingel streber	P				B	B	C	B
1159	Zingel zingel	P				B	B	C	B

✓ Terrestrial invertebrates

TABLE 11.2-13: TERRESTRIAL INVERTEBRATES LISTED IN ANNEX II OF THE HABITATS DIRECTIVE 92/43/EEC (P – PRESENT, R – RARE)

Code	Specie	Population				Integrated rating			
		Local	Migratory			Popu-lation	Protec-tion	Iso-lation	Total
			Breed-ing	Winter-ing	Stage				
4013	Carabus hungaricus	R				C	B	B	B
1044	Coenagrion mercuriale	R				B	B	C	B
4045	Coenagrion ornatum	R				B	B	C	B
4048	Isophya costata	P				B	B	C	B
1042	Leucorrhinia pectoralis	P				A	B	C	B
1083	Lucanus cervus	P				C	B	C	B
4054	Pholidoptera transsylvanica	P				B	B	A	B

✓ Aquatic invertebrates

Although aquatic invertebrate animals are not included in the Standard form of the area "Corridor of Jiu River" (ROSCI0045), there are suitable habitats (oligotrophic standing waters, oligo-mesotrophic lakes, eutrophic lakes, rivers) for the development of certain protected species. Can assume a probability of existence of 3 protected species included in the Standard forms of areas located under or above 30 km zone in Danube River: Striped nerite (*Theodoxus transversalis*), Thick shelled mussel (*Unio crassus*), Ramshorn snail (*Anisus vorticulus*).

TABLE 11.2-14: FLORA SPECIES LISTED IN ANNEX II OF THE HABITATS DIRECTIVE 92/43/EEC

Code	Specie	Population				Integrated rating			
		Local	Migratory			Popu-lation	Protec-tion	Iso-lation	Total
			Breed-ing	Winter-ing	Stage				
1428	Marsilea quadrifolia	V				C	C	C	C

One protected plant species of European importance is preserved in the Area – Four-leaf marsilea (*Marsilea quadrifolia L.*). This species belongs to the group of ferns – an ancient group of plants particularly sensitive to anthropogenic pressure and climate change, listed by IUCN as Near Threatened (NT). In some countries in Europe and Asia (such as China) it is widespread. The four-leaf marsilea can be easily distinguished by its similarity with clover with four leaves arranged on a long stalk. It occurs in wet places, sometimes dry in summer, and dwells in the shallow edge of lakes and rivers; can be immersed except the floating leaves or floating on the surface of the water. The species is encountered in mesotrophic or eutrophic waters and is reported in several habitats in southern Romania (Doniţă et al. 2005)[25]:

- ✓ R2203 Danubian communities with Salvinia natans, Marsilea quadrifolia, Azolla caroliniana and A. filiculoides

  Characterization: In the shallows of water bodies at 10-200 m above sea level, water temperature 11-9.5 °C; rainfall 450-650 mm. Permanent ponds, slow-flowing channels of water.

  Structure: Salvinia natans, Azolla caroliniana, A. filiculoides. Plant communities are optimally developed during the second half of the growing season when Salvinia natans covers 90% of the water surface. As a second floor, fully immersed in the water are Ceratophyllum demersum and Myriophyllum spicatum.

  Conservation value: High and very high in habitats with Marsilea quadrifolia.

  Composition of the flora: Salvinia natans, Azolla caroliniana, Lemna gibba, Wolffia arrhiza; characteristic species: Azolla caroliniana, A. filiculoides, Salvinia natans, Spirodela polyrhiza, Ceratophyllum demersum, Utricularia vulgaris, Myriophyllum spicatum, Potamogeton pectinatus. Heliophylic species include: Phragmites australis, Typha angustifolia, Sagittaria sagittifolia, Alisma plantagoaquatica.

  Conformity: Natura 2000 (code 3150) Natural eutrophic lakes with vegetation type Magnopotamion or Hydrocharition.

- ✓ R2205 Danubian communities with Hydrocharis morsus-ranae, Stratiotes aloides and Utricularia vulgaris.

[25] Doniţă N, A.Popescu, M.Paucă-Comănescu, S. Mihăilescu, I. Adrian Biriş.2005, HABITATELE DIN ROMÂNIA Editura Tehnică Silvică Bucureşti.

Characterization: Water bodies (40-50 cm deep) and channels with stagnant or slowly flowing water, organic debris at: 5-300 m above sea level, temperature = 11-9.5 °C; rainfall 350-650 mm.

Structure: Hydrocharis morsus-ranae, Stratiotes aloides, Salvinia natans, Marsilea quadrifolia, Utricularia vulgaris. Compact, but small phytocenoses are formed near Phragmites australis, Typha latifolia, T. angustifolia. The layer of floating plants is dominated by Hydrocharis morsus-ranae or Stratiotes aloides, and Spirodela polyrhiza, Lemna minor, Wolffia arrhiza, Salvinia natans.

Conservation value: moderate.

Composition of the flora: Hydrocharis morsus-ranae, Stratiotes aloides, Utricularia vulgaris; characteristic species: Hydrocharis morsus-ranae, Stratiotes aloides, Lemna minor, Utricularia vulgaris. Trapa natans, Nuphar luteum, Salvinia natans, Vallisneria spiralis, Najas minor, Myriophyllum spicatum, Potamogeton crispus, P. pectinatus, Ceratophyllum demersum, Phragmites australis, Butomus umbellatus, Alisma plantago-aqautica, Sagittaria sagittifolia, Polygonum amphibium.

Conformity: Natura 2000 (code 3150) Natural eutrophic lakes with vegetation type Magnopotamion or Hydrocharition.

✓ R2206 Danubian communities with Potamogeton perfoliatus, P. gramineus, P. lucens, Elodea canadensis and Najas marina.

Characterization: 3-350 above sea level, temperature 11-9.5 °C; rainfall 350-650 mm; waterways: lakes, ponds, canals.

Structure: Potamogeton lucens, P. perfoliatus, P. gramineus, Elodea canadensis, Myriophyllum spicatum, Ceratophyllum demersum, growing well in lakes, canals and other water bodies with slow-flowing water rich in nutrients. During the period of mass flowering the water surface to provides conditions for development of small submerged plants such as: Lemna minor, Salvinia natans, Marsilea quadrifolia, Azolla caroliniana, Spirodela polyrhiza.

Conservation value: Moderate.

Composition of the flora: Potamogeton gramineus, P. lucens, P. perfoliatus, Ceratophyllum demersum, Najas marina; characteristic species: Potamogeton lucens, P. perfoliatus, P. gramineus, Ceratophyllum demersum. Elodea canadensis, Ceratophyllum submersum, Hydrocharis morsus-ranae, Utricularia vulgaris, Vallisneria spiralis, Najas minor, Myriophyllum spicatum, Trapa natans, Nuphar luteum, Nymphaea alba, Polygonum amphibium, Lemna minor, L. trisulca, Salvinia natans, Azolla filiculoides.

Conformity: Natura 2000 (code 3150) Natural eutrophic lakes with vegetation type Magnopotamion or Hydrocharition.

- ✓ R2207Danubian communities with Nymphaea alba, Trapa natans, Nuphar luteum and Potamogeton natans.

  Characterization: Permanent ponds with standing or slow water; absolute altitude 5-150 m; temperature 10.5-9.5 °C; rainfall 350-450 mm.

  Structure: Floating species: Nymphaea alba, Trapa natans, Nymphoides peltata, Potamogeton natans. These species grow in shallow water (0.5-2 m), low in nutrients and neutral reaction (pH = 7.5-8). Species of Lemnion minoris often develop as part of the floating community. Submerged species: Myriophyllum verticillatum, Ceratophyllum demersum, Potamogeton crispus, P. pectinatus.

  Conservation value: high.

  Composition of the flora: Potamogeton natans, Nuphar luteum, Nymphaea alba, Nymphoides peltata, Trapa natans, Nymphaea alba, Nuphar luteum, Nymphoides peltat, Ceratophyllum demersum, Myriophyllum spicatum, Potamogeton crispus, P. pectinatus, Hippuris vulgaris, Elodea canadensis, Lemna minor, Wolffia arrhiza, Spirodela polyrhiza, Azolla caroliniana, Salvinia natans, Marsilea quadrifolia.

  Conformity: Natura 2000 (код 3160) Natural dystrophic lakes

- ✓ R5305 Danubian communities with Typha angustifolia and T. latifolia

  Characterization: Shallow water bodies (0.5-0.8 m), channels with constant water; absolute altitude 0-250 m; temperature 10,5-9,5 °C; rainfall 350-600 mm.

  Structure: Phytocenoses with: Typha angustifolia, T. latifolia и Schoenoplectus lacustris, Glyceria maxima, Oenanthe aquatica, Sparganium erectum, Iris pseudacorus, Butomus umbellatus, Alisma plantago-aquatica. Floating or submerse species that can be encountered include: Lemna minor, Spirodela polyrhiza, Marsilea quadrifolia, Myriophyllum spicatum, Ceratophyllum demersum, Vallisneria spiralis, Najas marina.

  Conservation value: low.

  Composition of the flora: Typha angustifolia, T. latifolia, Schoenoplectus lacustris, Glyceria maxima, Typha angustifolia, T. latifolia, Phragmites australis, Lythrum salicaria, Carex acutiformis, C. riparia, Bolboschoenus maritimus, Lysimachia vulgaris, Symphytum officinale, Myosotis scorpioides, Solanum dulcamara, Polygonum hydropiper, Epilobium hirsutum, Galium palustre, Lycopus europaeus, Alisma plantago-aquatica, Mentha aquatica, Stachys palustris, Rumex hydrolapathum, Ranunculus lingua.

- ✓ R5307 Dacian-Danubian communities with Glyceria maxima and Schoenoplectus palustris

  Characterization: These communities are established near the plant communities of reed (Phragmites); absolute altitude 2-250 m; temperature 11-9 °C; rainfall 350-700 mm.

Structure: Phytocenoses dominated by Glyceria maxima, with Schoenoplectus lacustris, Iris pseudacorus, Butomus umbellatus, Typha latifolia, Phragmites australis. The mezzanine floor includes Phalaris arundinacea, Bolboschoenus maritimus, Stachys palustris, Lycopus europaeus, Carex acutiformis, Lythrum salicaria, Lysimachia vulgaris, Myosotis scorpioides, Polygonum lapathifolium. The following species grow on the surface of the water: Nymphoides peltata, Marsilea quadrifolia, Lemna minor, Spirodela polyrhiza, Wolffia arrhiza etc.

Conservation value: Moderate.

Composition of the flora: Glyceria maxima, Schoenoplectus lacustris; characteristic species: Glyceria maxima, Schoenoplectus lacustris, Typha angustifolia, T. latifolia, Oenanthe aquatica, Rorippa amphibia, Sparganium erectum, Phalaris arundinacea, Phragmites australis, Lycopus europaeus, Alisma plantago-aquatica, Mentha aquatica, Butomus umbellatus, Glyceria fluitans, Cicuta virosa, Ranunculus lingua, Bolboschoenus maritimus, Galium palustre, Stachys palustris, Rumex hydrolapathum, Eleocharis palustris, Sium latifolium, Poa palustris, Symphytum officinale.

11.2.8.2.4.2 Own observations

Flora

The territory located along the middle and lower stream of Jiu includes one of the rarest and most representative samples of European relict meadows drastically changed and virtually disappeared.

Although it occupies only 0.5% of Romania's forests and 0.6% of the national territory in the Area concentrates: 8 (32%) of the 28 natural forest habitat types protected by Romanian and European legislation (91E0 *, 91F0, 91I0 *, 91M0, 91Y0, 9130, 9170, 92A0).

Much of the territory is occupied by arable land and vineyards. The pastures between the crop fields are dominated by Twitch (Cynodon dactylon).

Fauna

- ✓ Mammals

Otter (*Lutra lutra*) – (IUCN NT – Near Threatened), due to a steady decline in count, but in an amount not more than 30% over the last 3 generations. Species occurs in natural rivers and captive waters with length of at least 15-20 km: old flooded rivers and abundant coastal vegetation – dense forests, shrubs and reeds (low banks), diverse fish fauna and a minimum mass of 40 kg / ha, abundance of crabs, frogs, vertebrates, molluscs.

Specie counts for the area are not available. The population is defined as local. The area provides numerous suitable habitats for the existence of the species.

Ground squirrel (*Spermophilus citellus*) – (IUCN VU Vulnerable) – It has been established that the counts of this species are decreasing across the entire area of proliferation, particularly in the southern, northwestern and northern regions where the counts over the

last ten years have dropped by more than 30%. The species settles in uncultivated land (brownfield, pastures, meadows, etc.) covered with low herbaceous vegetation on homogeneous, loose and permeable soils. Does not settle in farmland, although enters there in search of food. Specie counts for the area are not available. The population is defined as local. The area provides numerous suitable habitats for the existence of the species.

The field surveys of Jiu River established a huge colony of Souslik (*Spermophilus citellus*) in a pasture with an area of 20 ha. An approximate colony count using the transect method (length of the transect – 100 m and width 2 m) established 27 active holes:

43°58'38.9"N 23°52'53.7"E 51 m above sea level (asl)

43°58'37.2"N 23°52'52.1"E 50 m asl

43°58'36.7"N 23°52'52.0"E 51 m asl

43°58'35.9"N 23°52'51.8"E 51 m asl

43°58'35.4"N 23°52'51.7"E52 m asl

FIGURE 11.2-20: SOUSLIK

Although the overall numbers of the species count is deceasing, the observed population does have the potential to maintain good count and the habitats are in good condition.

- ✓ Chiropterofauna

By the beginning of 2013 the bat fauna inhabiting the Romanian territory within the 30 km surveillance zone was completely unexplored. The scientific literature lacks any information on the species composition of bats, their seasonal activity, migration and availability of summer and winter roosts here. This group of mammals is not included in

the target and purpose of protection in the Romanian Natura 2000 protected areas that exist here.

This insufficiency of information made it necessary to conduct field studies with Romanian zoologists during the early spring period (7 and 8 March) of 2013.

The larger part of the Romanian territory in the 30 km surveillance zone, namely the west of the river Jiu along car road no. 561 is occupied by open arable agricultural areas. Natural potential bat shelters are virtually non-existent here and the value of the area as a habitat of food is too low due to intensive mechanized agriculture and pesticide use, decreasing abundance of insects – a key factor for the presence of bats in their active years of life. There may be synanthropic bat species of the genus Rhinolophus, Pipistrellus, Myotis, Eptesicus and Nyctalus in buildings in the settlements Bercea (Bârca), Goychea (Goicea), Cherna (Cârna), Shepta (Săpata), Macesu de Jos (Măceşu de Jos), Macesu de Sus (Măceşu de Sus), Comoteni (Comoteni), etc.). Forest vegetation and the spills of the Jiu and Jiec rivers and the left bank of the Danube, provide particularly favorable conditions as shelters for forest Pipistrelle bats (*Pipistrellus pipistrellus*), Nathusius' pipistrelle (*Pipistrellus nathusii*), Midnight Bat (*Eptesicus serotinus*), Leisler's Bat (*Nyctalus leisleri*) and Noctule bat (*Nyctalus noctula*) and their hunting habitats (**Figure 11.2-21**).

FIGURE 11.2-21: SPILLS OF JIU RIVER, EXCEPTIONALLY FAVOURABLE HUNTING HABITAT OF BATS

The protected oak forest near the village of Javal (Figure 11.6.5.2.2-3) provides very shelters to the above-cited species of forest bats.

FIGURE 11.2-22: THE FOREST NEAR THE VILLAGE OF JAVAL

- ✓ Amphibians and reptiles

Northern crested newt (*Triturus cristatus*). The species is widespread in the northern part of the country and much rarer in the Danubian valley, practically its area does not reach the Danube. Inhabits standing and (less commonly) slow-flowing water bodies – ponds, lakes, spills and other canals.

Fire-bellied toad (*Bombina bombina*). The species is widespread in the plains and hilly areas of the country, generally below 500 m asl. Inhabits standing and slow-flowing water bodies – ponds, lakes, canals, slow-flowing rivers and the like.

Plain pond turtle (*Emys orbicularis*). The species is widespread in lowlands and mountain regions of the country (absent in the higher parts of the Carpathians). Occurs in standing and slow-flowing water bodies – ponds, lakes, rivers, canals and the like.

- ✓ Fish

Danube mackerel (Alosa Sp.)

Conservation status: Annex II of the Habitats Directive 92/43/EEC; IUCN: VU – vulnerable.

The species is included in the Standard form of area ROSCI0045 Corridor of Jiu River (724-661 river km). Its presence in the 30 km zone off NPP was also confirmed by Romanian fishermen responding to a questionnaire (Fish Fauna Report, Romania, Grigore Davideanu 2013). The species is a throughfare one and enters the Danube for breeding in May by moving in large passages in the upper layers of the water. In the past it was a valuable commercial species and has fished extensively in the Danube. In recent years, a reduction of spawning grounds and migration routes has been observed, which causes reduction of populations of Danube mackerel. In 2000, catches are considerably lower than in 1970-

1980 and even from 1990-1998, the reasons are waterworks and strong variations in the water level of the Danube River, overfishing and pollution (Tatole et al. 2009).

Asp (Aspius aspius)

Conservation status: Annex II of the Habitats Directive 92/43/EEC; IUCN: LC.

Reported in the Romanian part of Danube River (Drobeta Turnu Severin – Galati) as a common one by Banarescu (1964). During the Joint Danube Survey 2 (2007) low counts were established at the two stations above and below the area – at Calafati and above the delta of the river Olt (Fish Fauna Report, Romania, Grigore Davideanu 2013). The species is included in the Standard form of area ROSCI0045 Corridor of Jiu River (724-661 river km). Its presence in the 30 km zone off NPP was also confirmed by Romanian fishermen responding to a questionnaire (Fish Fauna Report, Romania, Grigore Davideanu 2013). Threats to the species are waterworks, pollution and overfishing (Tatole et al. 2009)[26].

White-finned Gudgeon (Gobio albipinnatus)

Conservation status: Annex II of the Habitats Directive 92/43/EEC.

Reported in the Romanian part of Danube River (Drobeta Turnu Severin – Galati) as a numerous one by Banarescu (1964)[27]. The species is included in the Standard form of area ROSCI0045 Corridor of Jiu River (724-661 river km). Its presence in the 30 km zone off NPP was also confirmed by Romanian fishermen responding to a questionnaire (Fish Fauna Report, Romania, Grigore Davideanu 2013). Threats to the species are waterworks and pollution (Tatole et al. 2009).

Sabrefish (Pelecus cultratus)

Conservation status: Annex II of the Habitats Directive 92/43/EEC; IUCN: LC.

The species is included in the Standard form of area ROSCI0045 Corridor of Jiu River (724-661 river km). Its presence in the 30 km zone off NPP was also confirmed by Romanian fishermen responding to a questionnaire (Fish Fauna Report, Romania, Grigore Davideanu 2013). The main threats are population and overfishing (Tatole et al. 2009).

European bitterling (Rhodeus amarus)

Conservation status: Annex II of the Habitats Directive 92/43/EEC. Reported in the Romanian part of Danube River (Drobeta Turnu Severin – Galati) as a common one by Banarescu (1964). The Joint Danube Survey 2 (2007) established minor counts at two stations above and under the area – at Calafati and at the delta of the river Olt, (Fish Fauna Report, Romania, Grigore Davideanu 2013). The species is included in the Standard form of area ROSCI0045 Corridor of Jiu River (724-661 river km). Its presence in the 30 km zone off NPP was also confirmed by Romanian fishermen responding to a questionnaire (Fish

[26] Tatole, V., A. Iftime, M. Stan, E.-I. Iorgu, I. Iorgu, V. Oţel, 2009 - Speciile de animale Natura 2000 din România. Muzeul Naţional de Istorie Naturală „Grigore Antipa" & ASA S.C. ASA Environmental Service LTD., Bucureşti. (in Romanian)

[27] Banarescu P. 1964. Pisces, Osteichthyes. Fauna Republici Populare Romine XIII. Bucuresti, 961 p

Fauna Report, Romania, Grigore Davideanu 2013). The main threats to the species are water pollution and the declining population of native musse species Unionidae (Tatole et al. 2009).

Spined loach (Cobitis taenia)

Conservation status: Annex II of the Habitats Directive 92/43/EEC 92/43/EEC; IUCN: LC.

In recent years, the population of that type has been divided into different types. The species C. Elongatoides occurs in the Danube, Bacesku & Maier, 1969. However, in the Bulgarian and Romanian Standard forms it is stated as Cobitis taenia. Reported in the Romanian part of Danube River (Drobeta Turnu Severin – Galati) as a common one by Banarescu (1964). The species is included in the Standard form of area ROSCI0045 Corridor of Jiu River (724-661 river km). Its presence in the 30 km zone off NPP was also confirmed by Romanian fishermen responding to a questionnaire (Fish Fauna Report, Romania, Grigore Davideanu 2013). The main threat is the pollution of waters.

European weatherfish (Misgurnus fossilis)

Conservation status: Annex II of the Habitats Directive 92/43/EEC; IUCN: LC.

The species is included in the Standard form of area ROSCI0045 Corridor of Jiu River (724-661 river km). Its presence in the 30 km zone off NPP was also confirmed by Romanian fishermen responding to a questionnaire (Fish Fauna Report, Romania, Grigore Davideanu 2013). The main threats to the species are regulation of riverbeds, shrinkage and pollution of adjacent wetlands (Tatole et al. 2009).

Balkan loach (Sabanejewia aurata)

Conservation status: Annex II of the Habitats Directive 92/43/EEC; IUCN: OF

The species is included in the Standard form of area ROSCI0045 Corridor of Jiu River (724-661 river km). The main threats to the species are pollution and waterworks (Tatole et al. 2009).

Balon's ruff (Gymnocephalus baloni)

Conservation status: Annex II of the Habitats Directive 92/43/EEC; IUCN: LC.

The species is included in the Standard form of area ROSCI0045 Corridor of Jiu River (724-661 river km). The main threats to the species are pollution and waterworks (Tatole et al. 2009).

Striped ruff (Gymnocephalus schraetzer)

Conservation status: Annex II of the Habitats Directive 92/43/EEC.

Reported in the Romanian part of Danube River (Drobeta Turnu Severin – Galati) as a common one by Banarescu (1964). The Joint Danube Survey 2 (2007) established individual specimens at Calafati (Fish Fauna Report, Romania, Grigore Davideanu 2013). The species is included in the Standard form of area ROSCI0045 Corridor of Jiu River (724-661 river km). Its presence in the 30 km zone off NPP was also confirmed by Romanian

fishermen responding to a questionnaire (Fish Fauna Report, Romania, Grigore Davideanu 2013). The main threats to the species are pollution and waterworks (Tatole et al. 2009).

Pigmy streber (Zingel streber)

Conservation status: Annex II of the Habitats Directive 92/43/EEC; IUCN: LC.

Reported in the Romanian part of Danube River (Drobeta Turnu Severin – Galati) as a common one by Banarescu (1964). The species is included in the Standard form of area ROSCI0045 Corridor of Jiu River (724-661 river km). Its presence in the 30 km zone off NPP was also confirmed by Romanian fishermen responding to a questionnaire (Fish Fauna Report, Romania, Grigore Davideanu 2013). The species prefers clean and fast-flowing waters. The main threats to the species are pollution and waterworks (Tatole et al. 2009).

Great streber (Zingel zingel)

Conservation status: Annex II of the Habitats Directive 92/43/EEC; IUCN: LC.

The species is included in the Standard form of area ROSCI0045 Corridor of Jiu River (724-661 river km). Its presence in the 30 km zone off NPP was also confirmed by Romanian fishermen responding to a questionnaire (Fish Fauna Report, Romania, Grigore Davideanu 2013). The species prefers clean and fast-flowing waters. The main threats to the species are pollution and waterworks (Tatole et al. 2009).

- ✓ Invertebrates

Hungarian runner (Carabus hungaricus). The species occurs in open, dry areas with rooted grass-shrub vegetation and derivatives, mainly of steppe nature. The adult insect occurs from April to late October, and the larva hibernates. The nature of habitats does not imply its occurrence near the Danube in the area adjacent to the IP, so the project is not expected to have direct or indirect impact on its populations. The prevalent winds in the area are west and northwest, which is another factor limiting the impact on habitats (far north of the IP) by dust or other ambient emissions.

Beetle stag beetle (*Lucanus cervus*). Sites of this PA in the vicinity of the IP cover mainly riverine terrain and moisture-heavy arable areas. Since the larvae of this species live under or close to soil levels around dead tree trunks, continuous flooding prevents the occurrence of the species in this area. It is assumed that habitats are at least 10 km NNE away from the IP, which in combination with the main west-northwest winds does not imply impact on populations.

Dragonflies (*Coenagrion mercuriale*) (not proven in Bulgaria) and Ornate Bluet (*Coenagrion ornatum*) inhabit the coastal areas of slow-flowing waterways, eg. the north bank of the Danube and the coasts of Jiu. Possible expected impacts are the higher temperatures of the water for the larvae of these species. First, significant increase in the temperature of the warm canal during the implementation of the IP is not expected, and second, the location of the area on the northern coast of the Danube does not imply thermal impact (at the confluence of the warm canal the water temperature is higher in the Bulgarian coastal

stretch of the river between the Kozloduy NPP and the island of Kozloduy, then the warm and cold streams merge and when they eventually reach the Romanian coast, the temperature would be leveled). Impact is not expected.

Yellow-Spotted Whiteface (*Leucorrhinia pectoralis*). The species is typical of peat habitats, which are absent in the vicinity of the IP within the PA. The species is reported as "available" (present) in the area, but probably occurs in its northern parts. Impact is not expected.

Locusts isophane (*Isophya costata*) and Folidoptera (*Pholidoptera transsylvanica*) (both not found in Bulgaria) are Carpathian elements, the first inhabits plains and hilly areas of Hungary, Eastern Austria and Western Romania, the second is endemic to mountainous regions of the Western Carpathians. Both species have been reported as indirect evidence for the area and probably do not occur here, they are replaced by other similar species. Even if found in the area, their habitats are expected to be in the northern parts of the area in the Carpathian region, outside the 30-kilometer surveillance strip. The remoteness of their potential habitat does not imply direct or indirect impact resulting from the implementation of the IP.

11.2.8.2.5 Details regarding protected species in the Danube that are likely to occur in the 30 km stretch (downstream or upstream the NPP)

- ✓ Aquatic invertebrates

The following aquatic invertebrates are likely to occur within the 30 km zone off the NPP in Romania:

Striped nerite (Theodoxus transversalis)

In the past (1970-90) the species was common in the area between the delta of the Jiu River to the delta of the Olt River (690-660 river km) (Negrea 1994[28], Popa 2005[29]). Surveys in 2004 did not found the specie (Popa 2005). The specie is not included in the standard form of area ROSCI0045 Corridor of Jiu River (724-661 river km), but is included in other other areas upstream or downstream, eg. at Iron Gates ROSCI0206 Porţile de Fier, and the area between Corabia and Turnu Magurele ROSCI0044 Corabia – Turnu Măgurele (642-600 river km) (Tatole et al. 2009).

Thick shelled mussel (Unio crassus)

The species is considered rare in the Romanian section of the Danube, a survey in 2004 found shells at river 514 km (Popa 2005). The species is not included in the standard form of the area ROSCI0045 Corridor of Jiu River (724-661 river km). The main threats to the species in Romania fragmentation and destruction of habitats are due to waterworks, pollution and the like (Tatole et al. 2009).

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[28] Negrea, A., 1994 - Contribution à l'etude faunistique et biogeographique des Gasteropodes dues du secteur roumain du Danube. Annls Limnol, 30 (3): 179-195

[29] Popa O. 2005. Contributions to the knowledge of the mollusks from the Romanian sector of the Danube. Trav. du Mus. Natl. d'Hist. Nat. 'Grigore Antipa', 48: 7-19.

Ramshorn snail (Anisus vorticulus)

The species is not included in the Standard form of area ROSCI0045 Corridor of Jiu river (724-661 river km), but is included in other Natura 2000 areas downstream and upstream the Danube such as ROSCI0039 Ciuperceni-Desa (794-743 river km) and downstream Calarasi – ROSCI0022 Canaralele Dunarii (Tatole et al. 2009).

- ✓ Invasive species of aquatic invertebrates and fish

The following alien species, aquatic invertebrates and fish are confirmed or expected to enter the Romanian part of the 30 km zone off NPP:

Aquatic invertebrates

Chinese pond mussel (Anodonta woodiana)

The species is common in the Romanian part of the Danube, and its range is constantly expanding (Popa 2005, Popa 2006[30]).

Mussels of the genus Dreissena – zebra mussel (*Dreissena polymorpha*) and quagga mussel (*Dreissena bugensis*).

The zebra mussel is native to the Danube; quagga mussel was found for the first time in Romania in 2004 in the Danube River at Cernavodã, near NPPs Cernavodã (Popa, 2006). In 2005 the species was found in Drobeta Turnu Severin (929 river km) (Popa 2006) and high counts were confirmed later (2008, own data). Presently occurs throughout the entire stretch of the Danube.

Asian corbicula (Corbicula fluminea)

The species was found for the first time in the Romanian part of the Danube in 1997 and then proliferated widely throughout the area (Popa, 2006). It was found at the delta of the Jiu in 2004, as well as downstream the river at km 510-480 (Popa 2005).

Counts and trends of the population in the Romanian stretch of the Danube within the 30 km zone off the NPP are not available. High counts since the onset of the invasion in 2004 were found in the lower stream of the river in Romania (Opreanu 2010)[31].

Chinese mitten crab (Eriocheir sinensis)

This species was also found in the Romanian part of the Danube (Skolka 1998)[32].

American crab (Orconectes limosus)

[30] Popa O., Popa L. 2006. Sinanodonta woodiana (Lea, 1834), Corbicula fluminea (O. F. Müller, 1774), Dreissena bugensis(Andrusov, 1897) (Mollusca: Bivalvia): alien invasive species in Romanian fauna. Travaux du Muséum National d'Histoire Naturelle "Grigore Antipa", 49:

[31] Opreanu, P. A. 2010. Changes in the structure of benthic biocoenoses on the lower course of the Danube from 1996 to 2004. Geo-Eco-Marina 16: 93-99.

[32] Skolka M and Gomoiu M-T (2001) Alien invertebrates species in Romanian waters. Ovidius University Annals of Natural Sciences, Biology -Ecology Series 5: 51-5

The species was found in the Romanian part of the Danube (at the border with Serbia) and its range is expanding gradually downstream (Pârvulescu et al. 2009)[33].

- ✓ Fish

Paddlefish (Polyodon spathula)

Established in the Danube at Drobeta Turnu Severin (2008, own data).

Asian carps – Bighead (*Aristichthys nobilis*), Carp (*Hypophthalmichthys molitrix*) and Grass carp (*Ctenopharyngodon idella*).

There is evidence that Asian carp species now breed successfully in the Romanian part of the Danube (Schiemer et al. 2004) [34].

Gibel carp (Carassius gibelio)

The species was reported for the Romanian part of the Danube River (Drobeta Turnu Severin – Galati) as a common one by Banarescu (1964). The Joint Danube Survey 2 (2007) explored two stations downstream and upstream the area at Calafati and above the delta of the river Olt, and found that the species was the second largest population after bleak (Fish Fauna Report, Romania, Grigore Davideanu 2013). It was caught during the field survey in Lake Bistrets (07.03.2013).

Pseudorasbora (Pseudorasbora parva)

The species was found for the first time in Romania in 1961 (Gavriloaie, Falka 2006[35]). At present it is common species in the Danube. The Joint Danube Survey 2 (2007) established minor counts at two stations downstream and upstream the area at Calafati and above the delta of the river Olt (Fish Fauna Report, Romania, Grigore Davideanu 2013).

American catfish (Ameiurus melas / Ameiurus nebulosus / Ictalurus punctatus)

The species American catfish (*Ameiurus melas*) was found for the first time in the Romanian part of the river at Drobeta Turnu Severin in 2005 (Popa et al. 2006).

Pumpkinseed sunfish (Lepomis gibbosus)

The species was reported for the Romanian part of the Danube River (Drobeta Turnu Severin – Galati) as a common one by Banarescu (1964). The Joint Danube Survey 2 (2007) e yestablished minor counts at two stations downstream and upstream the area at Calafati and above the delta of the river Olt (Fish Fauna Report, Romania, Grigore Davideanu 2013).

Chineese sleeper (Perccottus glenii)

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[33] Pârvulescu L, Paloș C, Molnar P (2009) First record of the spiny-cheek crayfish Orconectes limosus (Rafinesque, 1817) (Crustacea: Decapoda: Cambaridae) in Romania. North-Western Journal of Zoology 5: 424–428

[34] Schiemer F., G. Guti, H. Keckeis and M. Staras 2004. Ecological status and problems of the Danube River and its fish fauna: a review. In: Welcomme R.L., T. Petr (Eds.), Proceedings of the Second International Symposium on the Management of Large Rivers for Fisheries "Sustaining Livelihoods and Biodiversity in the New Millennium", 11-14 February 2003, Phnom Penh, Kingdom of Cambodia. Vol. 1: 273-299.

[35] Gavriloaie I.-C., Falka I. 2006. Consideratii asupra raspândirii actuale a murgoiului baltat – Pseudorasbora parva (Temminck & Schlegel, 1846) (Pisces) in Europa. Dita Musei _I. 3: 145-151.

The species was found for the first time in the Romanian part of the river at Drobeta Turnu Severin in 2005 and since then has been extending its range downstream (Popa et al. 2006).

- ✓ Birds

The following bird species have been found according to data from monitoring by Romanian experts:

Common and Latin name	Common and Latin name
Stone Curlew Burhinus oedicnemus	Great Cormorant, *Phalacrocorax pygmeus*
Whiskered Tern Chlidonias hybridus	Lesser Spotted Eagle *Aquila pomarina*
Black Tern Chlidonias niger	Long-legged Buzzard, *Buteo rufinus*
Stilt Himantopus himantopus	Short-toed Eagle, *Circaetus gallicus*
Lesser Gull Larus minutus	Marsh harrier, *Circus aeruginosus*
Ruff Philomachus pugnax	Northern Harrier, *Circus cyaneus*
Avocet Recurvirostra avosetta	Red-footed Falcon, *Falco vespertinus*
Common Tern Sterna hirundo	White-tailed Eagle *Haliaeetus albicilla*
Lesser (white-fronted) Tern Sterna albifrons	Black Kite, *Milvus migrans*
Wood Sandpiper Tringa glareola	Pern, *Pernis apivorus*
Kingfisher Alcedo atthis	Lesser White-fronted Goose *Anser erythropus*
European Roller Coracias garrulus	Ferruginous Duck, *Aythya nyroca*
Middle Spotted Woodpecker Dendrocopos medius	Red-breasted Goose, *Branta ruficollis*
Syrian Woodpecker Dendrocopos syriacus	Whooper swan *Cygnus cygnus*
Tawny Pipit Anthus campestris	Smew, *Mergus albellus*
Ortolan Bunting Emberiza hortulana	Purple Heron, *Ardea purpurea*
White-collared Flycatcher Ficedula albicollis	Sandwich heron *Ardeola ralloides*
Red-backed Shrike Lanius collurio	Great Bittern, *Botaurus stellaris*
Little Shrike Lanius minor	White Stork *Ciconia ciconia*
Woodlark Lullula arborea	Black stork *Ciconia nigra*
Barred Warbler Sylvia nisoria	Great Egret, *Egretta alba*
Corn Crake Crex crex	Lesser Egret, *Egretta garzetta*
Middle Crake Porzana parva	Lesser Bittern, *Ixobrychus minutus*
Nightjar Caprimulgus europaeus	Night Heron, *Nycticorax nycticorax*
Spoonbill Platalea leucorodia	Glossy Ibis, *Plegadis falcinellus*
	Dalmatian Pelican *Pelecanus crispus*

11.2.9 SUMMARY OF THE RADIOECOLOGICAL CONTROL IN ROMANIA WITHIN THE 30 KM SURVEILLANCE ZONE

TABLE 11.2-15: RADIOECOLOGICAL CONTROL IN ROMANIA WITHIN THE 30 KM SURVEILLANCE ZONE FROM KOZLODUY NPP

Sample	Date	Region	Location	Unit	Total beta	Radiochemistry		
						Cs-137	Sr-90	Ra-226
Open well	2008	Dj	Gighera	Bq/l	0.57±0.23	-	-	-

Sample	Date	Region	Location	Unit	Total beta	Radiochemistry		
						Cs-137	Sr-90	Ra-226
Covered well	2008	Dj	Gighera	Bq/l	0.42±0.17			
Open well	2009	Dj	Gighera	Bq/l	0.51±0.2	-	-	-
Covered well	2009	Dj	Gighera	Bq/l	0.5±0.2	-	-	-
Open well	2010	Dj	Gighera	Bq/l	0.67±0,25	-	-	-
Covered well	2010	Dj	Gighera	Bq/l	0.4±0.17	-	-	-
Deposition	2008	Dj	Gighera	Bq/m2	20.1±5	-	-	-
Deposition	2009	Dj	Gighera	Bq/m2	19.8±4.8	-	-	-
Deposition	2010	Dj	Gighera	Bq/m2	21.8±7.8	-	-	-
Aerosols	2008	Dj	Gighera	Bq/m3	0.44±0.14	-	-	-
Aerosols	2009	Dj	Gighera	Bq/m3	0.42±0.13	-	-	-
Aerosols	2010	Dj	Gighera	Bq/m3	0.45±0.14	-	-	-
Milk	15.12.2008	Dj	Gighera	Bq/l	38.1±4.7	0.13 ±0.04	0.022 ±0.009	0.0056 ±0.002
Milk	14.12.2009	Dj	Gighera	Bq/l	41.1±6.5	0.041 ±0.01	0.039 ±0.01	0.0054 ±0.003
Milk	13.12.2010	Dj	Gighera	Bq/l	41.1± 1,5	0.044 ±0.01	0.035 ±0.015	0.0049 ± 0.003
Wheat	15.12.2008	Dj	Gighera	Bq/kg	89.9±7.2	0.41 ±0.16	0.18 ±0.069	0.029 ±0.008
Wheat	14.12.2009	Dj	Gighera	Bq/kg	81.2±6.7	0.34 ±0.008	0.13 ±0.04	0.028 ±0.007
Wheat	12.11.2010	Dj	Gighera	Bq/kg	79.5±7.2	0.33 ±0.014	0.11 ±0.043	0.023 ±0.001
Apples	15.12.2008	Dj	Gighera	Bq/kg	37.1±4.9	0.039 ±0.013	0.019 ±0.005	0.0064 ±0.0028
Apples	14.12.2009	Dj	Gighera	Bq/kg	34.7±5.1	0.035 ±0.014	0.014 ±0.001	0.003 ±0.001
Apples	13.12.2010	Dj	Gighera	Bq/kg	39.3±3.8	0.037 ±0.01	0.016 ±0.007	0.0028 ±0.001
Potatoes	15.12.2008	Dj	Gighera	Bq/kg	132.7±6.7	0.047 ±0.016	0.014 ±0.006	0.022 ±0.009
Potatoes	14.12.2009	Dj	Gighera	Bq/kg	129.9±9.7	0.035 ±0.015	0.003 ±0.001	0.006 ±0.01

11.2.10 SUMMARY OF THE DEMOGRAPHIC AND HEALTH STATUS OF THE POPULATION WITHIN THE 30 AND 100 KM ZONES

In order to assess the potential transboundary impact of the new nuclear unit at the Kozloduy NPP site, the number of inhabitants in the settlements within the 30 km zone on the territory of Romania has to be taken into account – 78 323 inhabitants in the Dolj and Olt departments, in 32 settlements.[36]

Approximately 65 644 inhabitants in 45 settlements live within the 30 km zone on the territory of Bulgaria.

[36] Current data for the territory of the Republic of Romania – a letter by "Kozloduy NPP-NC" EAD, 297/01.04.2013.

The demographic potential within the 100 km zone, respectively the 30 km zone, around the Kozloduy NPP site is low. The average population density is 61.5 persons/km^2, which is considerably lower than the limiting condition of 100 persons/km^2 envisaged in the Bulgarian legislation and the IAEA guidelines for the deployment of NPPs. Within a 100 km radius there are 1289 settlements (546 in Bulgaria and 743 in Romania), and within a 30 km radius – 74 settlements (42 in Bulgaria and 32 in Romania). Most of the settlements are small villages (54.8% of all villages) and very small towns (57.4% of all towns). Within the 30 km zone, the largest settlements are the following: the town of Kozloduy (13 000 inhabitants), the town of Oryahovo (5 000 inhabitants), and on the territory of Romania – the town of Dabuleni (12 000 inhabitants) and the town of Bechet (3 400 inhabitants).

The population on the territory of Bulgaria, living within the studied area around the Kozloduy NPP site, is characterized by low reproductive capacity, due to a low birthrate and a high death rate, which formulate the negative natural growth. This is largely due to the ageing structure of the town and village population, where reproductive contingents are low.

The dynamics of such a key demographic indicator as the total mortality is similar for both countries. For Romania in 2009 it was 1141.9‰, and in 2010 – 1142‰.

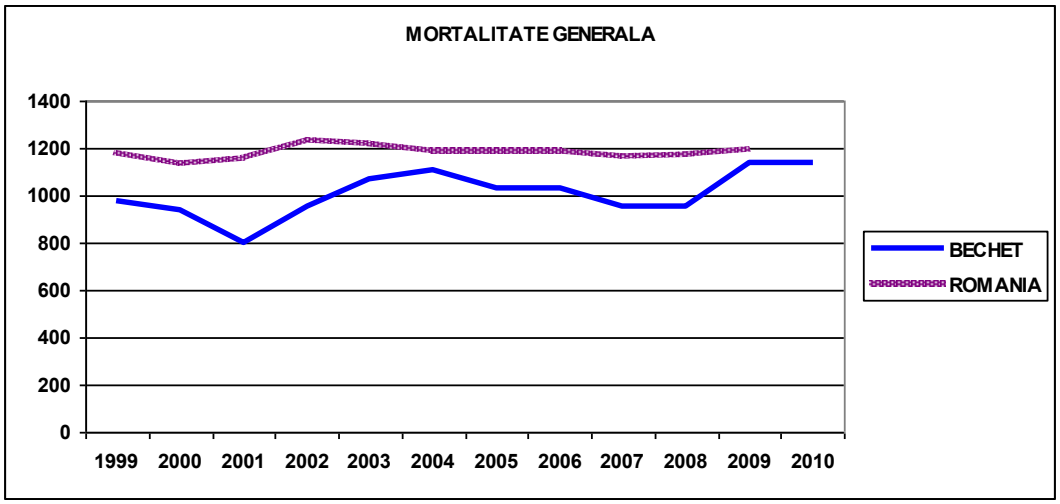


FIGURE 11.2-23: TOTAL MORTALITY RATE IN THE AREA OF THE TOWN OF BECKET FOR THE PERIOD 1999-2010

Studies conducted by Romanian specialists present a similarity in the level of total mortality in the country and that of the town of Becket (**Figure 11.2-23**), situated within the 30 km zone from the Kozloduy NPP site. The trend of total mortality for the two countries is similar.

Incidence of malignant neoplasms, and in particular leukemia, for the same period is within the same range for both countries, and very similar.

In Romania in 2009 the incidence of malignant neoplasms was 224‰, and for 2010 – 177.1 ‰; and the incidence of leukemia for 2009 and 2010 was 17.1‰ – **Figure 11.2-24**.

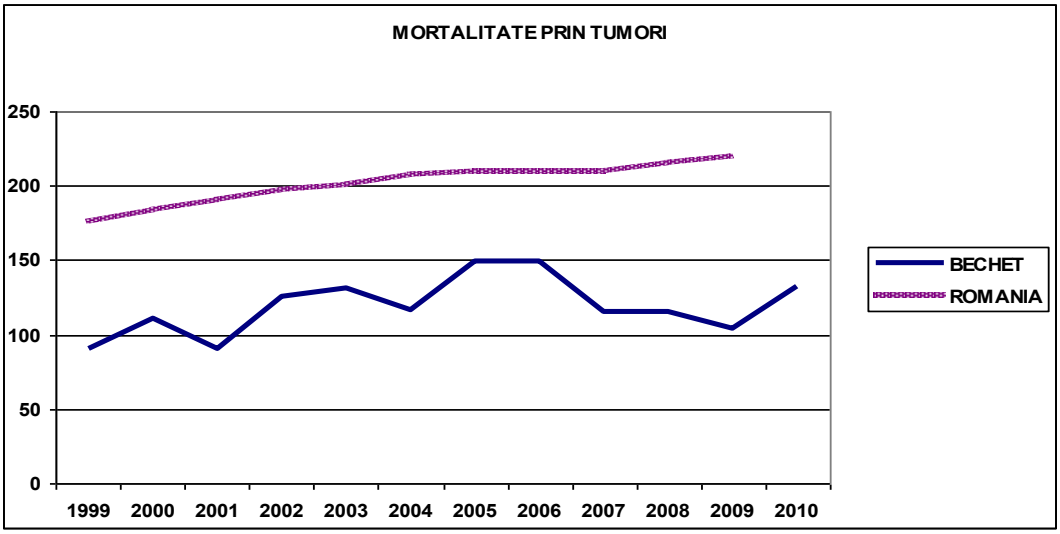


FIGURE 11.2-24: MORTALITY RATE FROM MALIGNANT NEOPLASMS IN THE AREA OF THE TOWN OF BECKET FOR THE PERIOD 1999-2010

Similar studies in the area of the town of Becket in Romania present a relatively higher incidence of these nosological units, including for recent years. Studies in both countries in similar settlements within the 30 and 100 km zones indicate the same trend for Bulgaria as well. Specialized analyses show that these trends are due to socio-economic factors.

The potential impact zone is limited to the secure area of Kozloduy NPP. This area is inaccessible to the general public. The potential impact zone does not extend beyond the national borders of Bulgaria.

It is recommended to plan and implement joint health and environmental studies by specialists from Bulgaria and Romania on common problems along the Danube River.

11.3 ASSESSMENT OF THE POTENTIAL TRANSBOUNDARY IMPACT ON THE ROMANIAN PART OF THE 30 KM SURVEILLANCE ZONE FROM THE IMPLEMENTATION OF A NNU

The activities on the present investment proposal fall entirely within the territory of the Republic of Bulgaria, but in close proximity to the Danube River and respectively to the territory of the Republic of Romania. In this regard and considering Chapter 8 of the Regulation on the Conditions and Procedures for the Performance of Environmental Impact Assessments, according to which Bulgaria is a Party of Origin, the Bulgarian Competent Authority (the MEW) has notified the Romanian party about the present investment proposal and has sent information on the project in compliance with the provisions of the Espoo Convention.

In response to the presented information, the Romanian Ministry of Environment and Forests decided to participate in the EIA procedure in a transboundary context and sent its opinion and questions (forwarded by the MEW to the Assigning Authority by a letter with

Outgoing № ОВОС-220 from 09.01.2013). These opinions have been taken into account during the preparation of the EIA Report, including in the present section.

During the realization of the activities envisaged in the project, both during the construction stage and during the operation and decommissioning stages, no direct impact is expected on any environmental components and factors in the Republic of Romania.

The proximity of the alternative sites for the deployment of a NNU to the Danube River, which also serves as the state border between the Republic of Bulgaria and the Republic of Romania, determines the possibility for indirect environmental impact on the territory of the neighboring Romania via the potential transfer of pollution as a result of the implementation of the investment proposal.

The possible pathways for a transboundary transfer of potential pollutants are via air currents – **gaseous and aerosol releases** – and **liquid releases** of debalanced water in the Danube River, as a result of the main water flow and precipitation processes.

11.3.1 SUMMARY OF THE POSSIBLE NONRADIOACTIVE POLLUTION IN THE ROMANIAN PART OF THE 30 KM SURVEILLANCE ZONE

11.3.1.1 DUST EMISSIONS DURING CONSTRUCTION

11.3.1.1.1 Impact of area sources

To assess the dispersion of emissions from sources during the construction of each of the 4 sites, a model used by the U.S. Environmental Protection Agency (EPA) ***ISC-AERMOD*** (Industrial Source Complex) will be applied. Windows interface of the model is developed by Canadian software company *Lakes Environmental.*

AERMOD consists of three modules:

- Atmospheric dispersion module (**AERMOD**),
- Terrain pre-processor (AERMAP), which is used in the presence of a complex terrain to describe the height of each receptor,
- Meteorological pre-processor (**AERMET**), which is used to prepare meteorological data input for simulation by the dispersion module.

AERMOD requires two types of hourly meteorological data: one, referring to the surface values of meteorological parameters, and another one, describing their vertical profiles, serving to render the vertical non-homogeneity in the structure of the surface boundary layer. The vertical mixing of pollutants with ambient air is limited in the event of stable stratification (a positive change of temperature with the height). The dispersion in unstable thermal conditions (strong convection) is not Gauss-like and physically it is described via turbulent convective flux due to which higher concentrations of pollutants are registered close the source.

Based on the ground characteristics of the underlying surface: roughness height, albedo and Bowen ratio (moisture amount which depends on the surface type – urban, rural,

forest, water and so on, and varies depending on the season and wind direction), ***AERMET*** calculates the parameters of the surface boundary layer, which account for its development and which affect the pollutants dispersion. These parameters include surface friction velocity (measure of velocity that relates shear between layers of flow); surface heat flow (thermal energy vertical transport); mixing layer height at day; mixing layer height at night, and more.

In the ***AERMET*** model, the stable atmospheric condition is determined based on Monin-Obukhov's length which is a measure of heat transfer near the earth's surface. The relationship between Monin-Obukhov's length and the 6 atmospheric stability classes of Pascal-Gifford is the following.

	L Values	Stability Conditions	Pascal-Gifford Class
Small negative	$-100\ m < \mathbf{L} < 0$	Very unstable	A
Large negative	$-10^5\ m \leq \mathbf{L} \leq -100\ m$	Unstable conditions	C
Very large(- or +)	$\lvert \mathbf{L} \rvert > 10^5\ m$	Neutral	D
Large positive	$10\ m \leq \mathbf{L} \leq 10^5\ m$	Stable	E
Small positive	$0 < \mathbf{L} < 10\ m$	Very stable	F

Input data on dust emissions

The quantitative values of emissions for all potential sites have been taken from **section 4.1.1.1.2 – Table 4.1-1**.

The effect of each source has been recorded according to a time schedule (i.e. they are a function of time), and the data has been entered into the so-called "HOURLY EMISSION RATE FILE" (HOREMIS), which represents an hourly schedule of the effect of each source.

Input parameters for the modelling process

A model has been created where the exact coordinates and boundaries of the 4 sites have been marked, and an exact map of the terrain has been entered in the appropriate shapefile format. Using the program module ***AERMAP*** to calculate the topography, exact data on the latitude of all sites, including the sources of pollution and the receptors for the specific project, has also been put in.

For the process of modeling, a receptor grid has been created, where the expected ground concentrations are calculated at the nodes.

Input meteorological parameters – data for 2012

For the needs of the model, a ground and a profile meteorological parameter file (.SFC and .PFL, accordingly) are also prepared, using the software product ***AERMET***, representative of the 4 sites. During the preparation of this file, the terrain specifics (arable area, coniferous forest, deciduous forest, water area and so on) is accounted for, whereas the primary meteorological data for them, prepared using the synoptic model **MM5,** are

purchased from the ***Lakes Environmental Software*** for a point with coordinates representative of the region.

The following figures present the analysis on the meteorological file, which contains records on wind speed and direction, stability classes, temperature, etc.

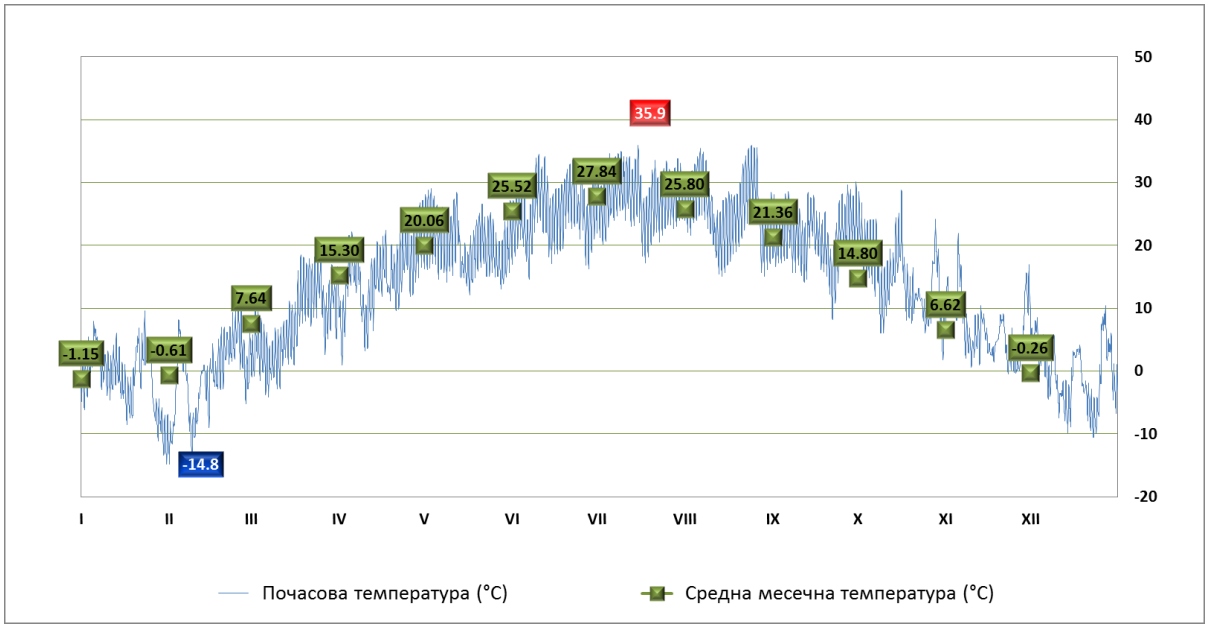


FIGURE 11.3-1: TEMPERATURE FOR 2012

Figure 11.3-1 shows the records on the hourly temperature for 2012.

The mean annual temperature was 13.61°C. The absolute maximum temperature of 35.9°C was measured in July (15.07.2012 at 17:00) and August (24.08.2012 at 16:00), with the average monthly temperature being 27.84°C and 25.8°C respectively. For the last climatic period 1961-1990 the mean monthly temperature norm for the Lom station for the month of July was 19.8°C, and for August – 19.4°C.

The absolute minimum temperature of minus 14.8°C was measured on 31.01.2012 at 08:00, with the average monthly temperature being minus 1.15°C. For the last climatic period 1961-1990 the average monthly temperature norm at the Lom station for the winter months was: for the month of January – minus 0.5°C, and for December – plus 0.6°C.

Figure 11.3-2 presents the wind rose from the hourly meteorological file for 2012, with the average annual speed being 3.02m/s. The rose is typical for the Bulgarian regions along the Danube: its orientation is based on the zonal transfer from the west to the east, and at the same time it reflects the orientation of the large river basin – the Danube River – around the Kozloduy NPP site (northwest-east), whose aeration impact is noticeable – the calm condition are only about 10%. Wind speeds within the 1÷2 m/s range represent 14.8%, and those within the 2÷4 m/s range represent 38.1%, the 4÷6 m/s range – 20.6%, the 6÷8 m/s range – 5.5%. The highest wind speeds (above 10 m/s) have the winds

blowing from west-northwest, followed by those from east-northeast. With the lowest frequency are those winds blowing from north (2.5%) and south (3%).

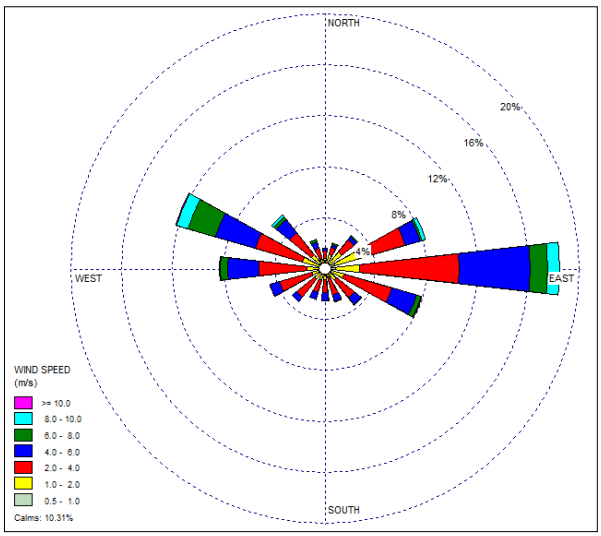


FIGURE 11.3-2: WIND ROSE FOR 2012. CALM CONDITIONS ARE 10.31%

Figure 11.3-3 shows the rose of stability classes for 2012.[37] The largest share is held by the stable atmospheric stability class (E-class) – 23.96%, and the winds with the highest frequency are those from the west, with 3.4%. The share of neutral conditions (D-class) is 13.67%, where west-southwest winds are most common, at 4.5%. Unstable atmospheric conditions (class A, B and C) represent a 42.49% share of the cases.

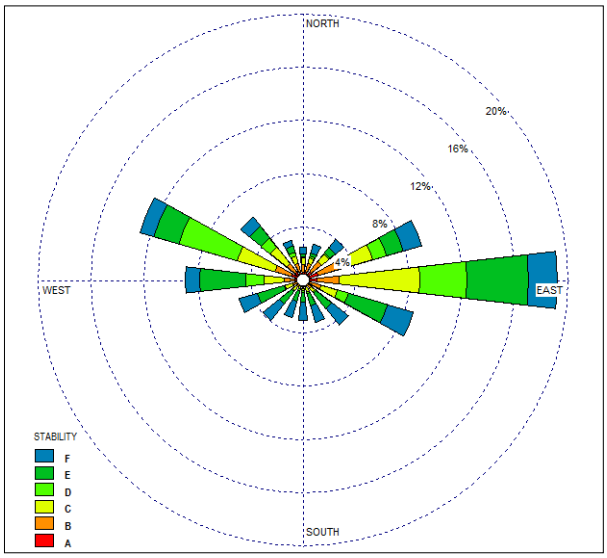


FIGURE 11.3-3: ROSE OF STABILITY CLASSES FOR 2012

[37] Gromkova, N. - Pre-processed Hourly Data Set - The Meteorological Input of Applied Diffusion Models, 1998, Bulg. Geoph. J., v. XXIV, No 3-4

11.3.1.1.1.1 Site 1

Figure 11.3-4 shows the ground field of pollution with particulate matter (PM_{10}), and **Figure 11.3-5** and **Figure 11.3-6** show the ground level pollution field with nitrogen and sulphur oxides from the construction activities for Site 1. The predominant wind comes from the east, at 18.4%. Speeds between 1 and 4 m/s form 52.9% of the annual speeds (**Figure 11.3-2**).

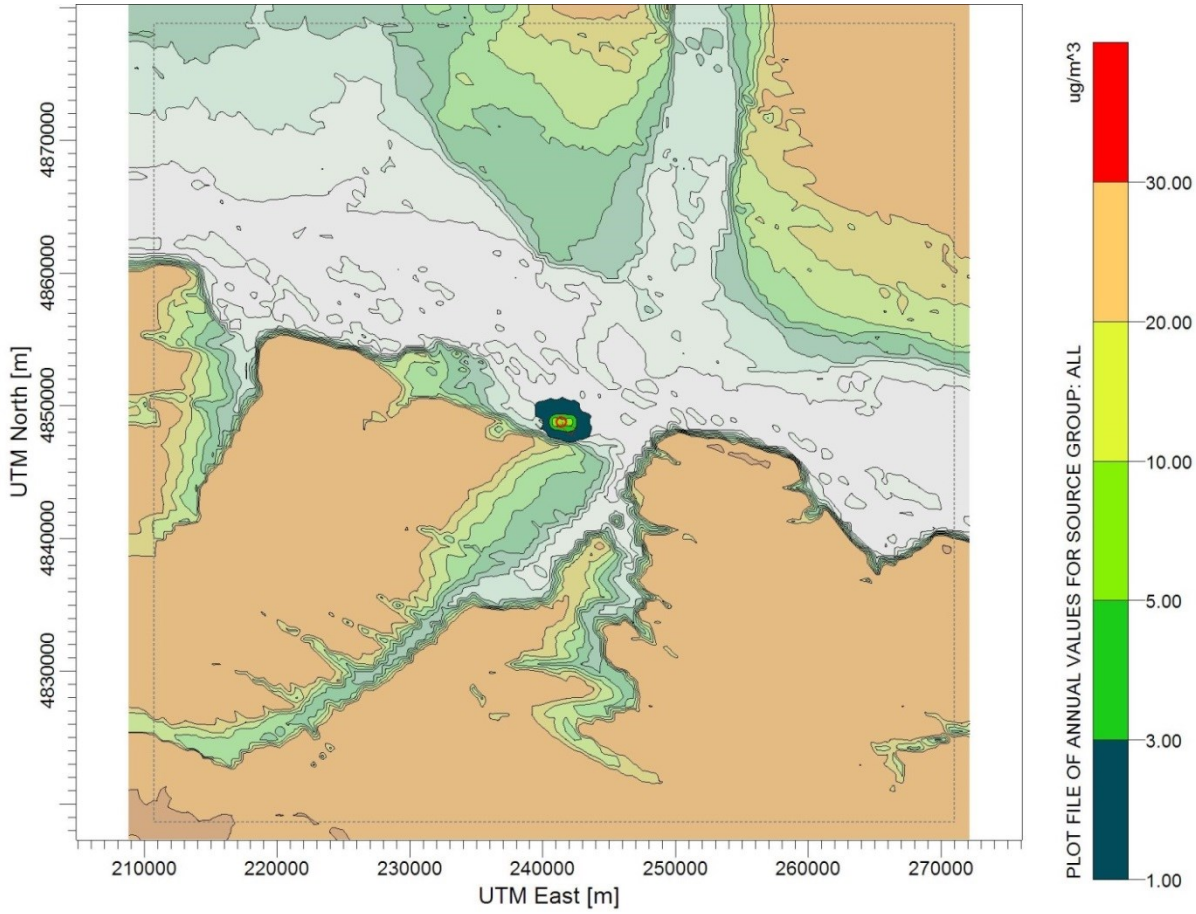
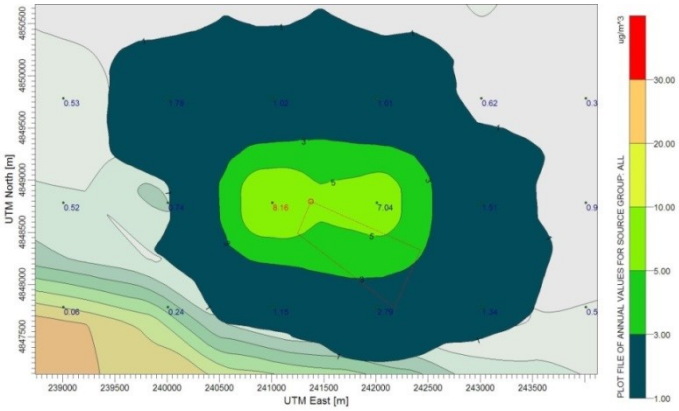


FIGURE 11.3-4: AVERAGE ANNUAL POLLUTION WITH PM_{10} FROM SITE 1

The maximum value of ground pollution with PM_{10} (the red number) is observed to the west of Site 1 and has a value of 8.16µg/m³, which is 20.4% of the annual limit values (LV) of 40 µg/m³ – **Table 11.3-1**.

PM_{10} limit values have not been exceeded.



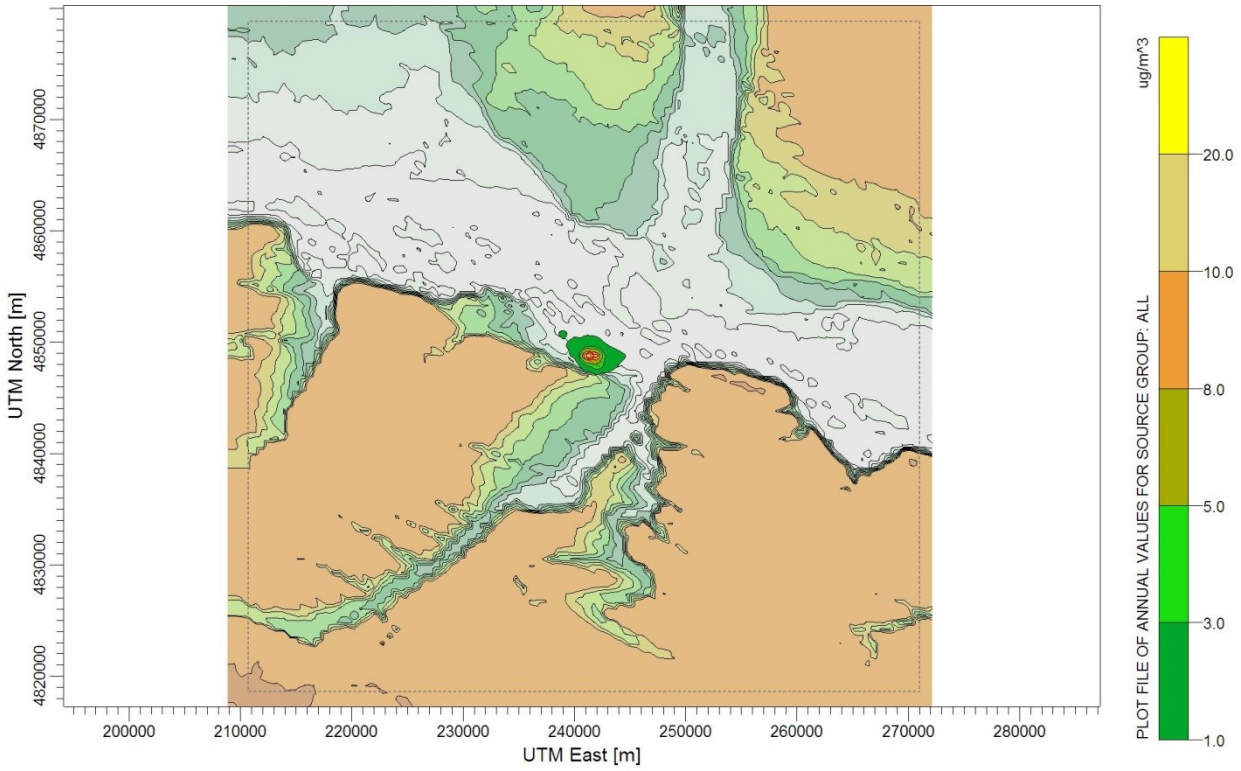
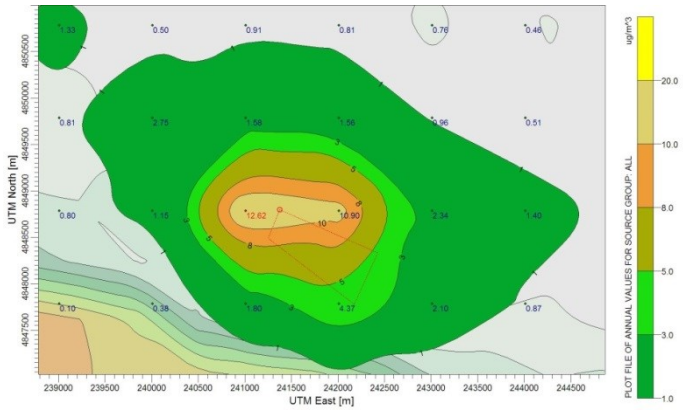


FIGURE 11.3-5: AVERAGE ANNUAL POLLUTION WITH NITROGEN OXIDES FROM SITE 1

The maximum value of ground level pollution with NO_X is observed at the point marked in blue and has a numeric value of 12.62 µg/m³ (the red number), which is 32% of the annual LV of 40 µg/m³ and 49% of the average annual Lower Assessment Threshold (LAT) of 26 µg/m³.

Nitrogen oxide limit values have not been exceeded.



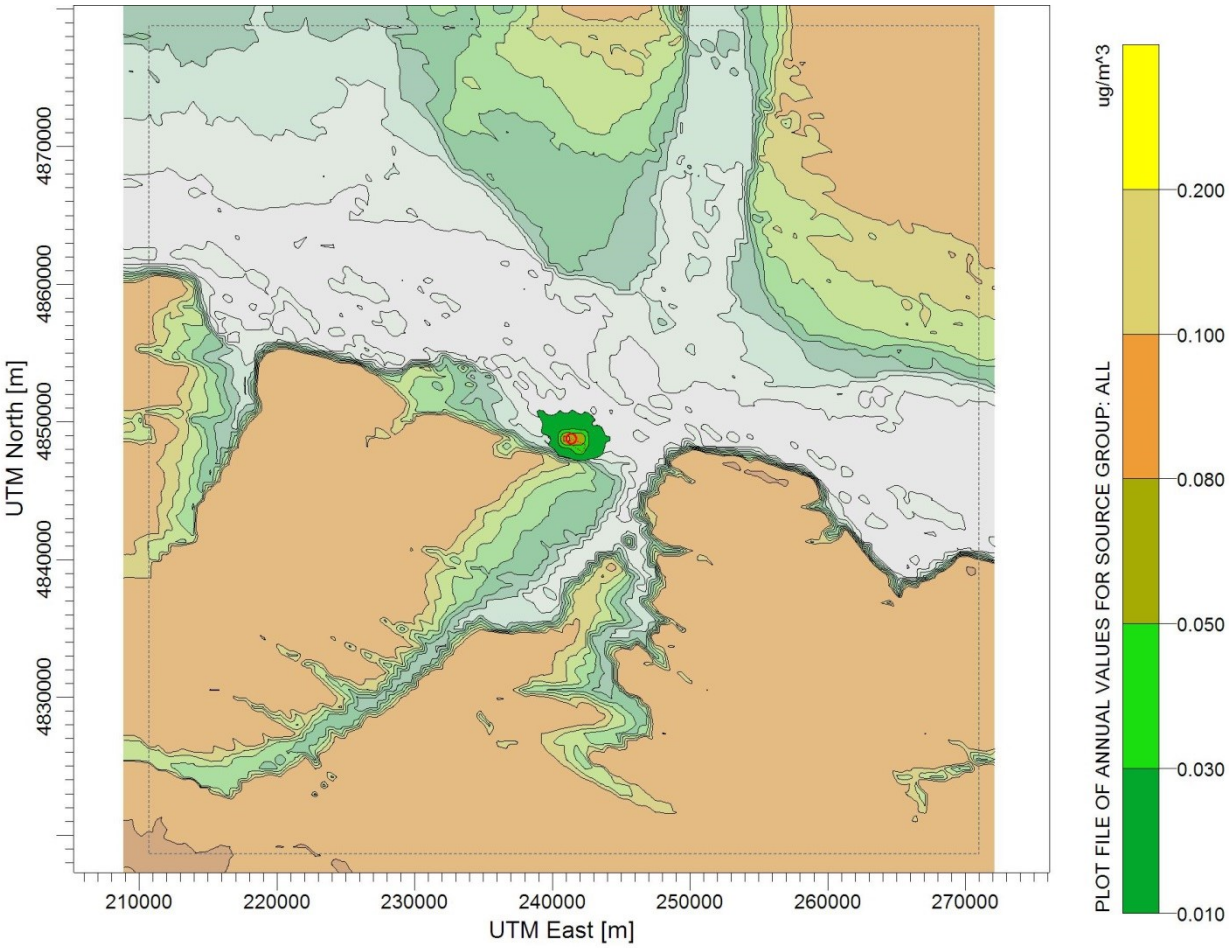
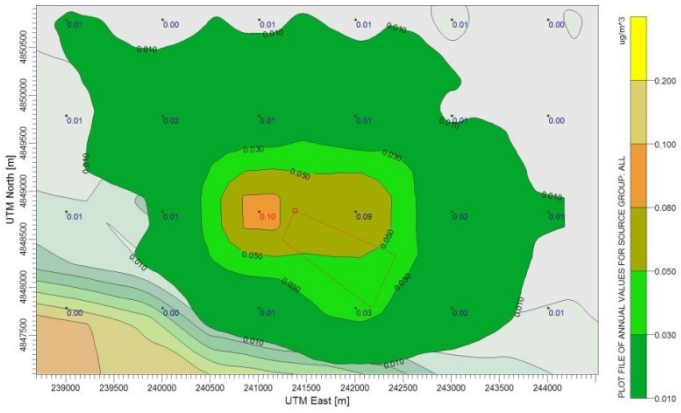


FIGURE 11.3-6: AVERAGE ANNUAL POLLUTION WITH SULPHUR OXIDES FROM SITE 1

The maximum value of ground level pollution with SO_X is observed to the west of Site 1 (the red number) and has a numeric value of 0.1 μg/m³, which is just 0.2% of the annual LV of 50 μg/m³ recommended by the World Health Organization (WHO).

Sulphur oxide limit values have not been exceeded.



11.3.1.1.1.2 Site 2

Figure 11.3-7 shows the ground level pollution field with particulate matter (PM_{10}), and **Figure 11.3-8** and **Figure 11.3-9** show the ground level field of pollution with nitrogen and sulphur oxides from the construction activities for Site 2.

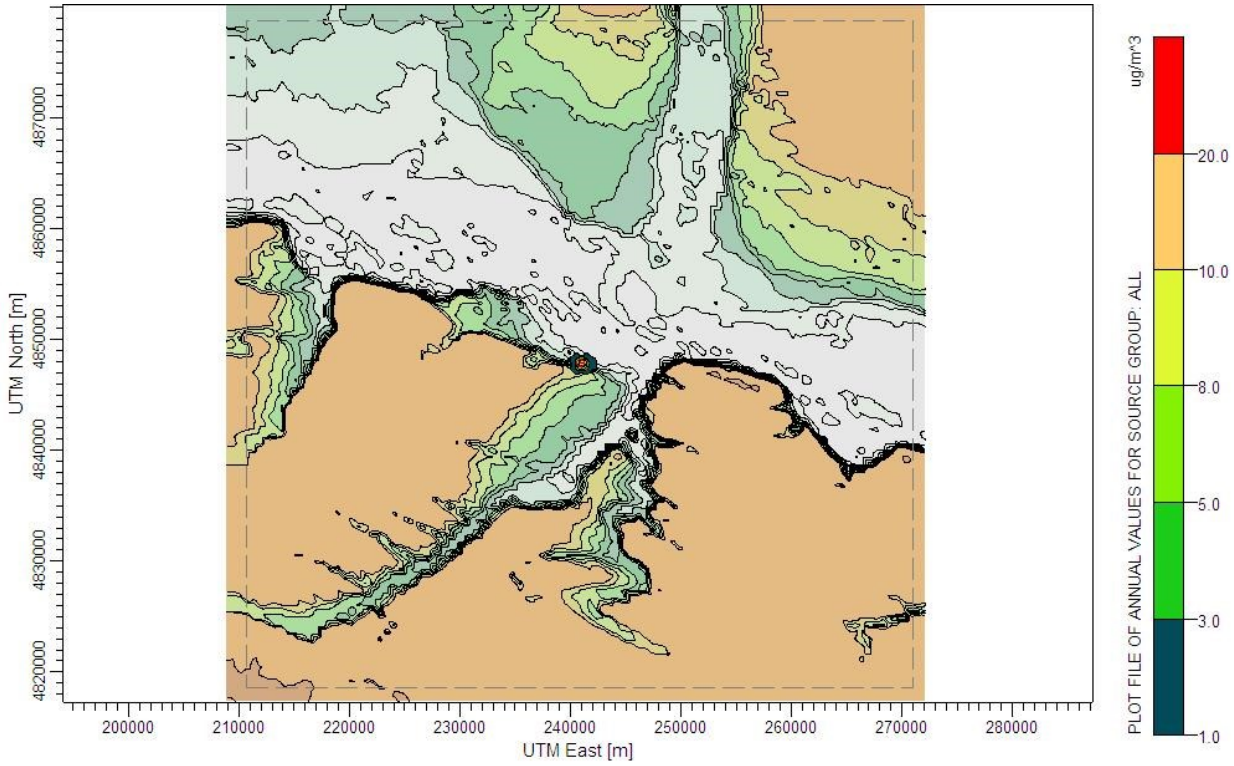
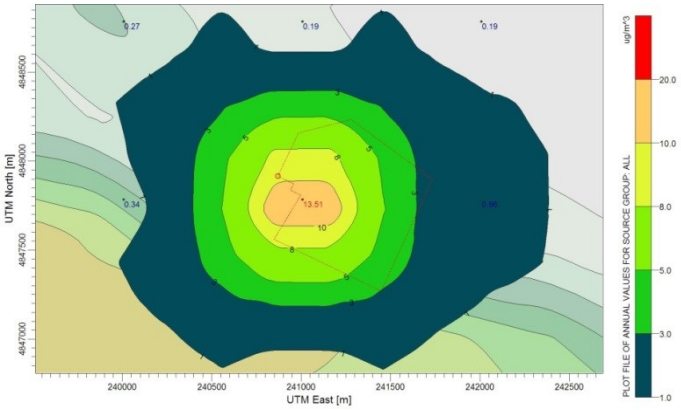


FIGURE 11.3-7: AVERAGE ANNUAL POLLUTION WITH PM_{10} FROM SITE 2

The maximum value of ground level pollution with PM_{10} (the red number) is observed to at the west border of Site 2 and has a numeric value of 13.51 μg/m³, which is 33.8% of the LV of 40 μg/m³ – **Table 11.3-1**.

PM_{10} limit values have not been exceeded.



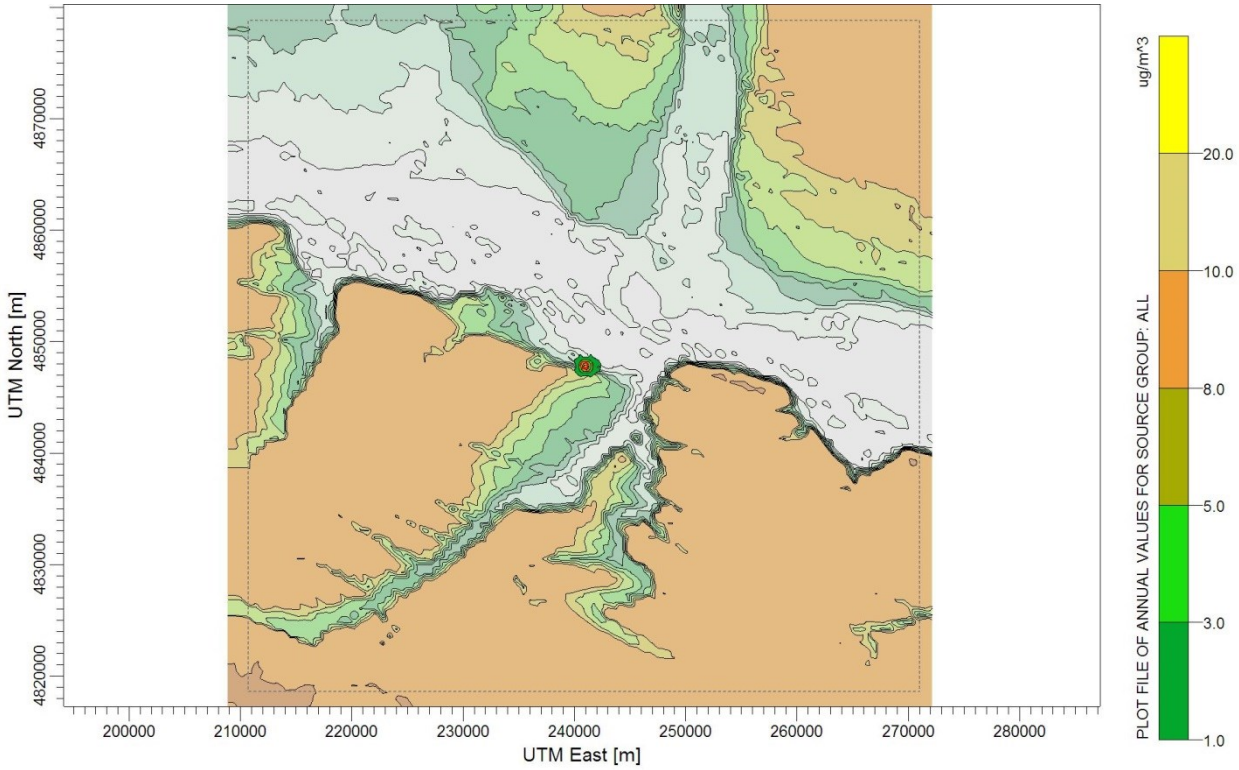
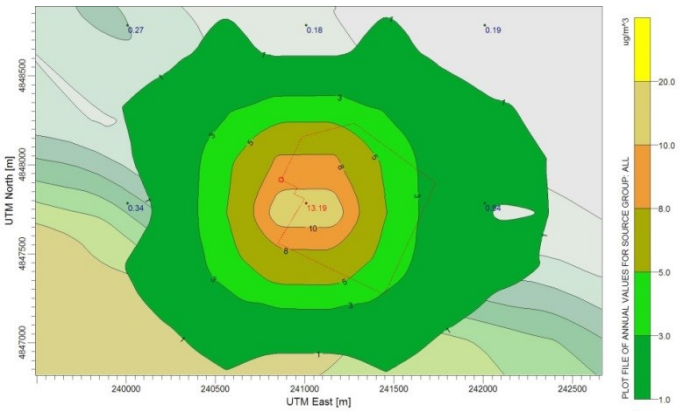


FIGURE 11.3-8: AVERAGE ANNUAL POLLUTION WITH NITROGEN OXIDES FROM SITE 2

The maximum value of ground level pollution with NO_X is observed at the point marked in blue and has a numeric value of 13.88 µg/m³ (the red number), which is 53% of the annual LV of 40 µg/m³ and 35% of the average annual Lower Assessment Threshold (LAT) of 26 µg/m³.

Nitrogen oxide limit values have not been exceeded.



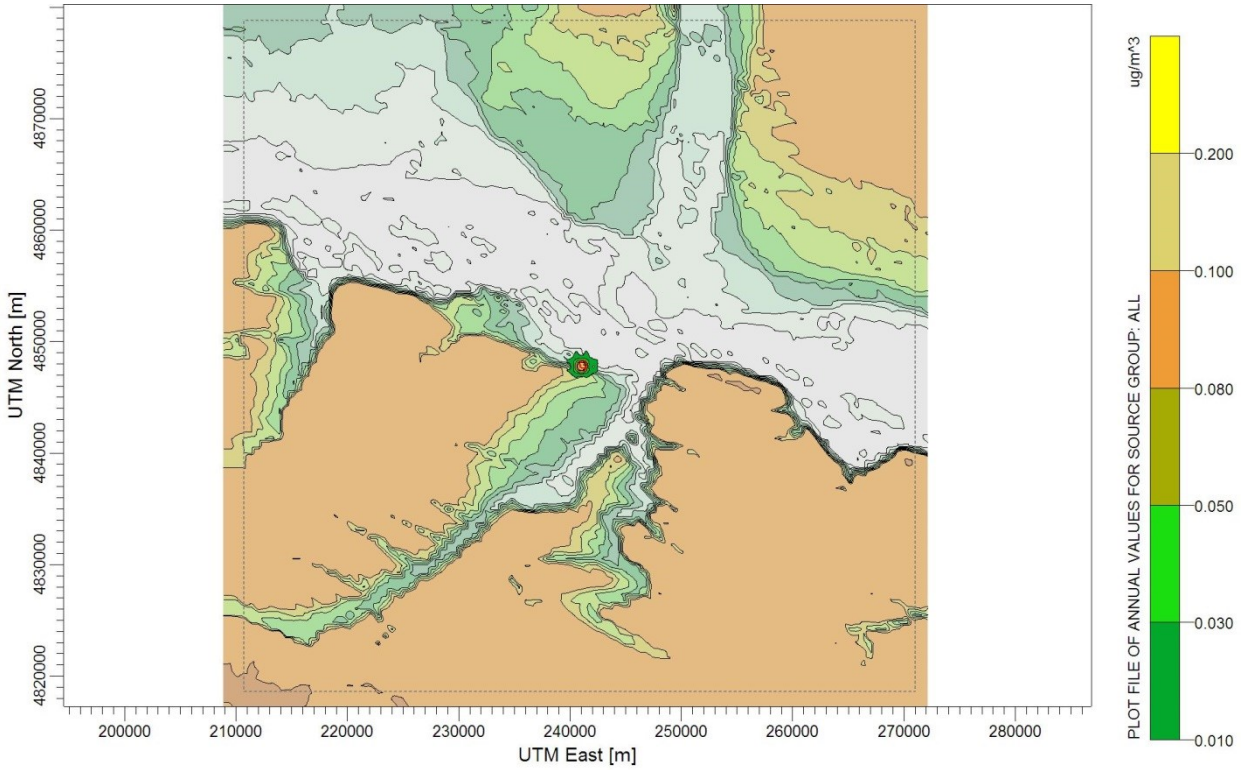
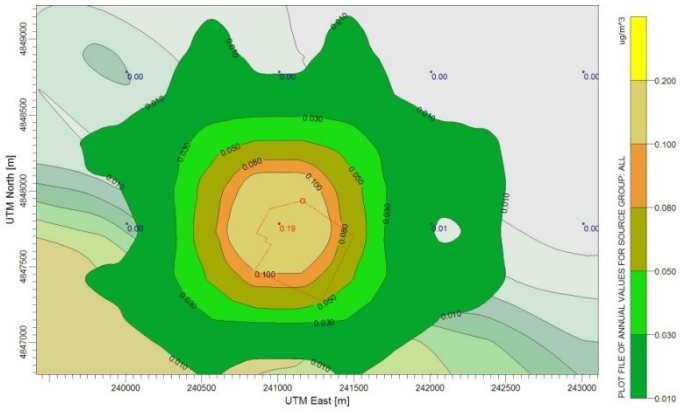


FIGURE 11.3-9: AVERAGE ANNUAL POLLUTION WITH SULPHUR OXIDES FROM SITE 2

The maximum value of ground level pollution with SO_X is observed to the west of Site 2 (the red number) and has a numeric value of 0.19 μg/m³, which is just 0.4% of the annual LV of 50 μg/m³ recommended by the World Health Organization (WHO).

Sulphur oxide limit values have not been exceeded.



11.3.1.1.1.3 Site 3

Figure 11.3-10 shows the ground level field of pollution with particulate matter (PM_{10}), and **Figure 11.3-11** and **Figure 11.3-12** show the ground level field of pollution with nitrogen and sulphur oxides from the construction activities for Site 3.

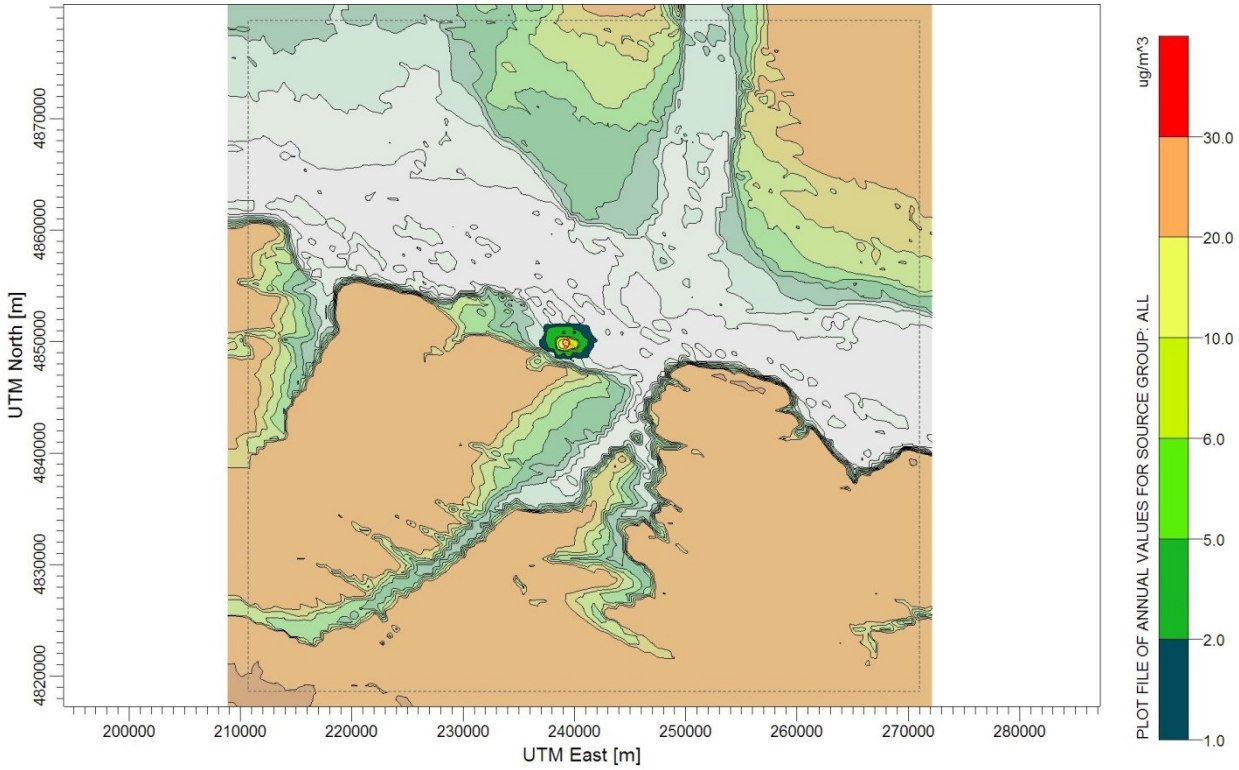
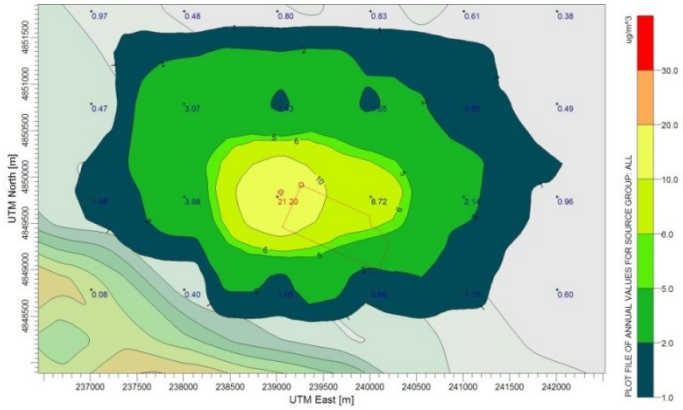


FIGURE 11.3-10: AVERAGE ANNUAL POLLUTION WITH PM_{10} FROM SITE 3

The maximum value of ground level pollution with PM_{10} (the red number) is observed to the west of Site 3 and has a numeric value of 21.20 μg/m³, which is 53% of the annual LV of 40 μg/m³ – **Table 11.3-1**.

PM_{10} limit values have not been exceeded.



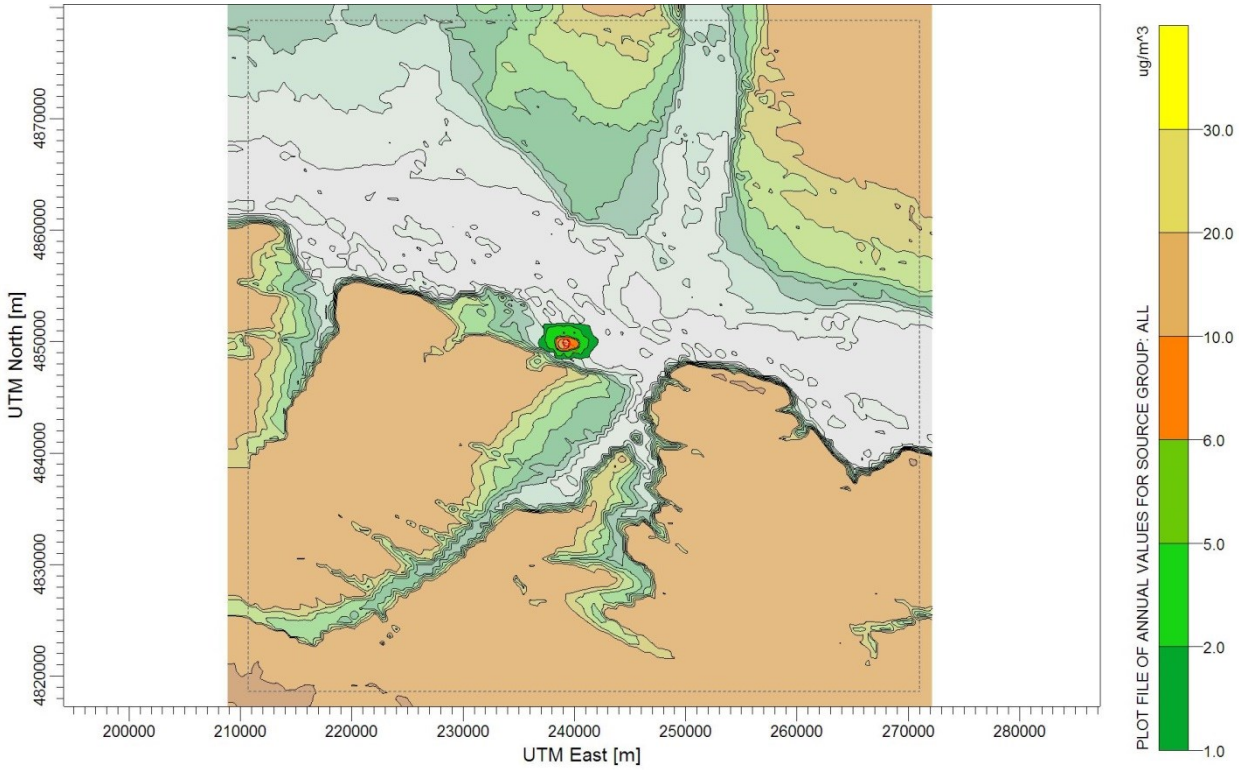
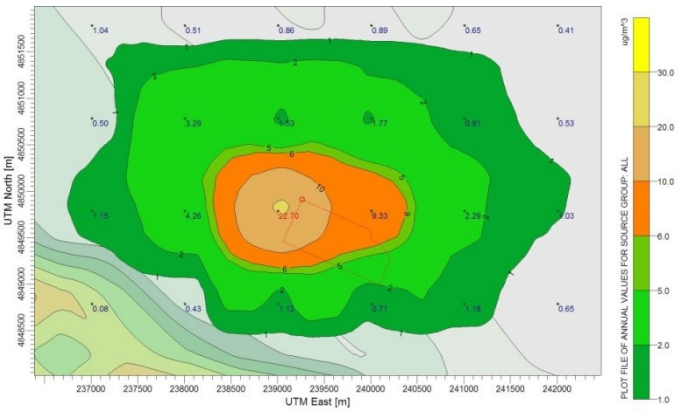


FIGURE 11.3-11: AVERAGE ANNUAL POLLUTION WITH NITROGEN OXIDES FROM SITE 3

The maximum value of ground level pollution with NO_X is observed at the point marked in blue and has a numeric value of 22.70 μg/m³ (the red number), which is 87% of the annual LV of 40 μg/m³ and 57% of the average annual Lower Assessment Threshold (LAT) of 26 μg/m³.



Nitrogen oxide limit values have not been exceeded.

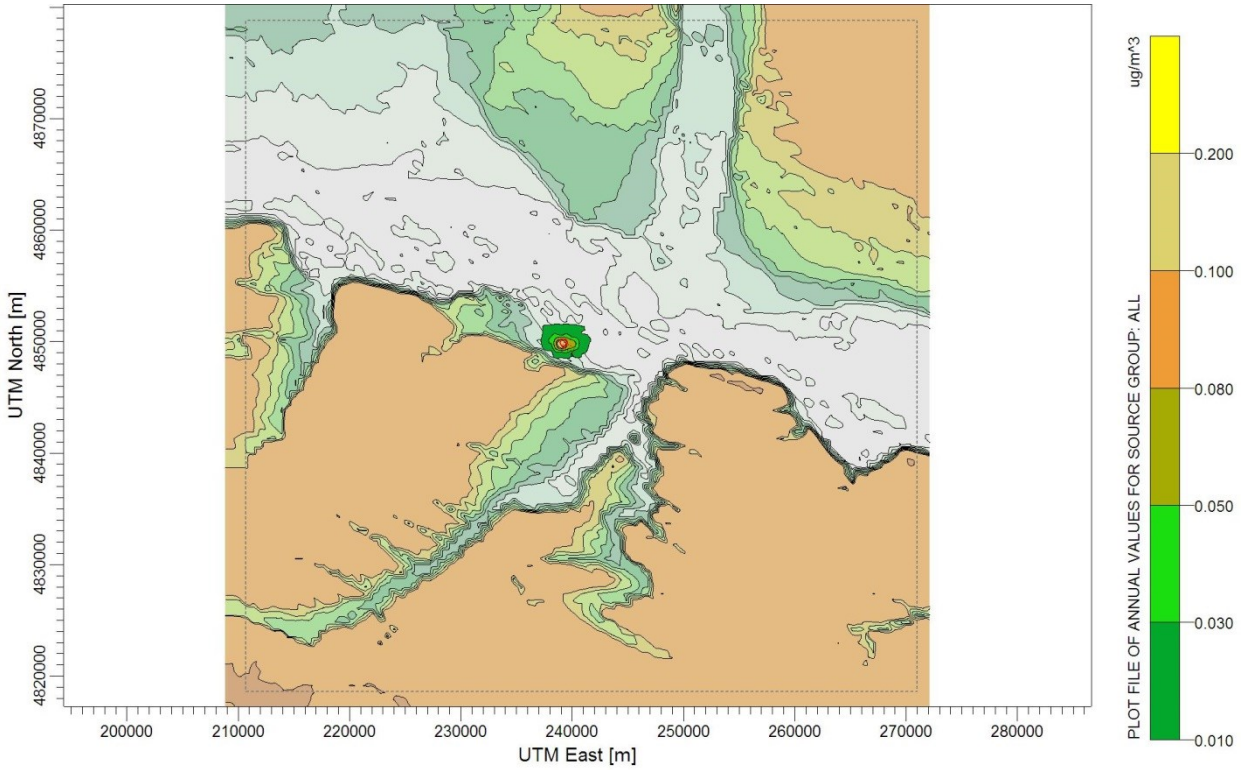
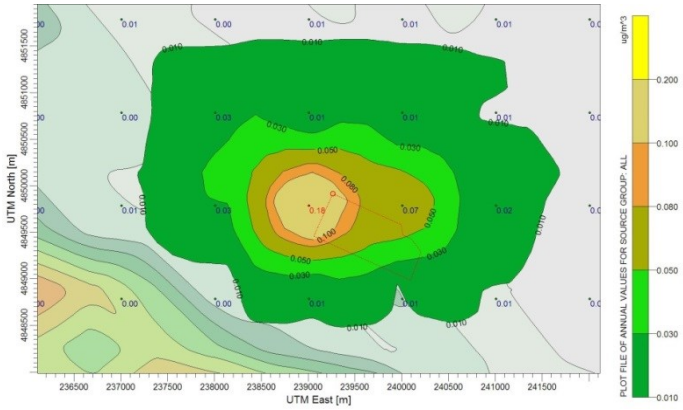


FIGURE 11.3-12: AVERAGE ANNUAL POLLUTION WITH SULPHUR OXIDES FROM SITE 3

The maximum value of ground level pollution with SO_X is observed to the west of Site 3 (the red number) and has a numeric value of 0.18 μg/m³, which is just 0.4% of the annual LV of 50 μg/m³ recommended by the World Health Organization (WHO).

Sulphur oxide limit values have not been exceeded.



11.3.1.1.1.4 Site 4

Figure 11.3-13 shows the ground leve field of pollution with particulate matter (PM_{10}), and **Figure 11.3-14** and **Figure 11.3-15** show the ground level field of pollution with nitrogen and sulphur oxides from the construction activities for Site 4.

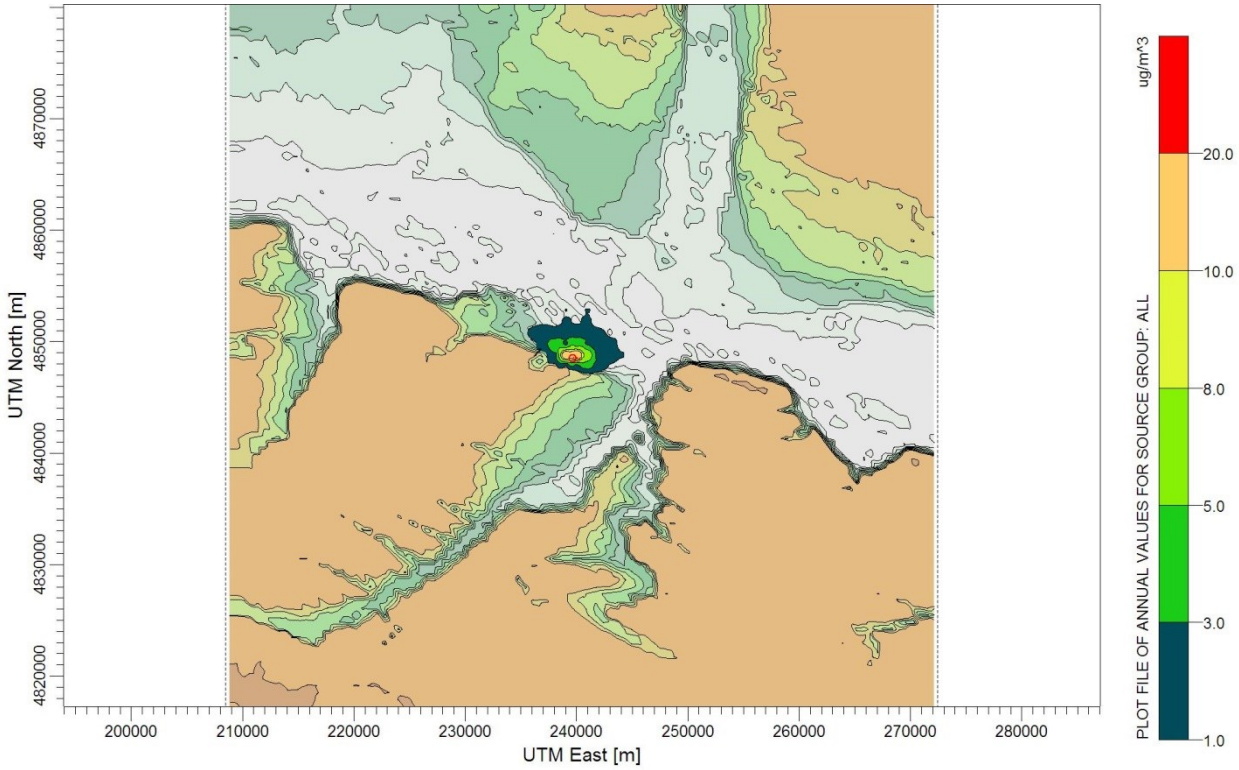
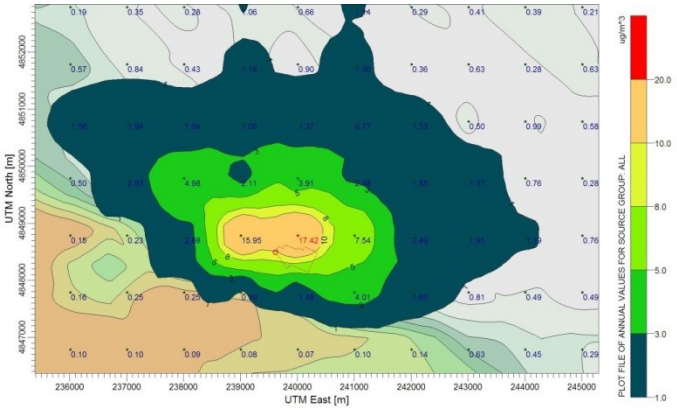


FIGURE 11.3-13: AVERAGE ANNUAL POLLUTION WITH PM_{10} FROM SITE 4

The maximum value of ground level pollution with PM_{10} (the red number) is observed to the north of Site 4 and has a numeric value of 17.42 μg/m³, which is 43.6% of the annual LV of 40 μg/m³ – **Table 11.3-1**.

PM_{10} limit values have not been exceeded.



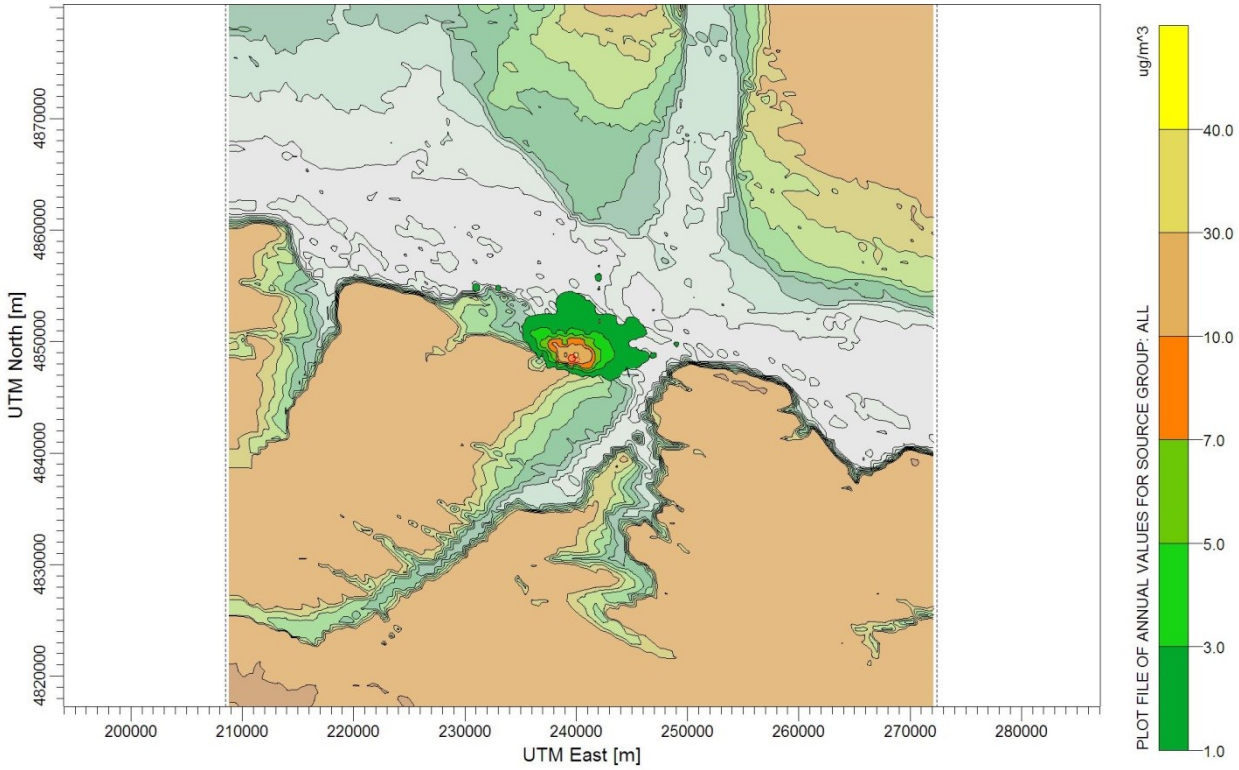
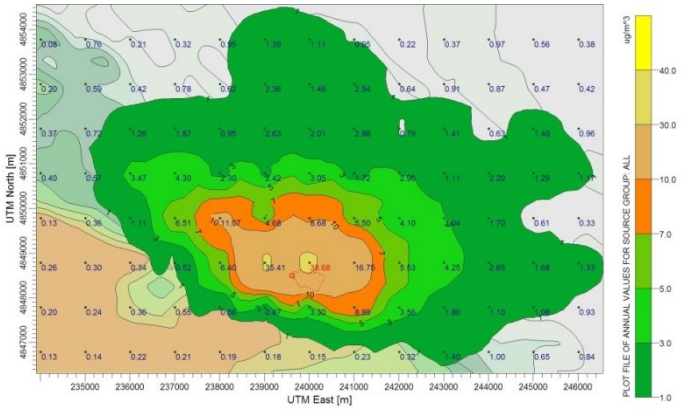


FIGURE 11.3-14: AVERAGE ANNUAL POLLUTION WITH NITROGEN OXIDES FROM SITE 4

The maximum value of ground level pollution with NO_X is observed at the point marked in blue and has a numeric value of 36.67 μg/m³ (the red number), which is 92% of the LV of 40 μg/m³ and 41% of the average annual Lower Assessment Threshold (LAT) of 26 μg/m³, which is not applied to industrial zones.

The annual nitrogen oxide limit values have not been exceeded.



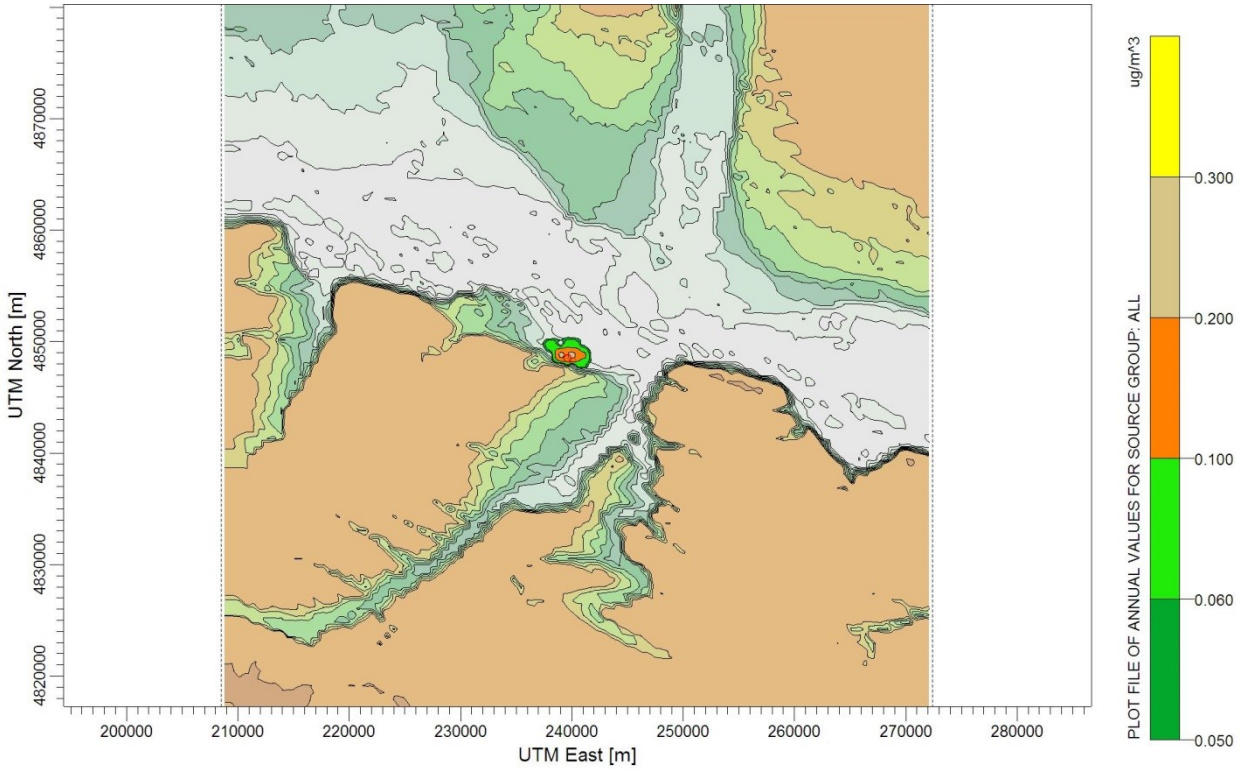
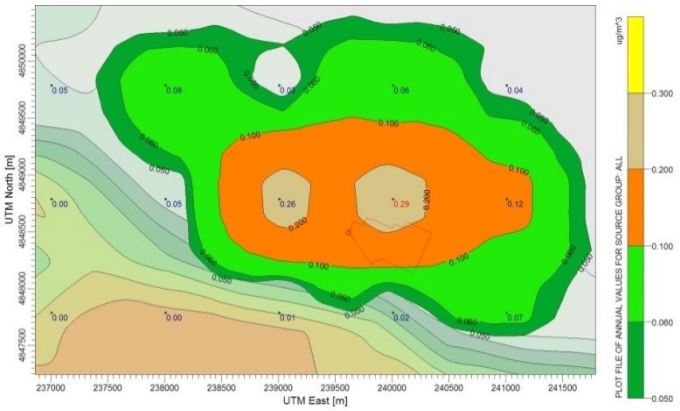


FIGURE 11.3-15: AVERAGE ANNUAL POLLUTION WITH SULPHUR OXIDES FROM SITE 4

The maximum value of ground level pollution with SO_X is observed to the west of Site 4 (the red number) and has a numeric value of 0.29 µg/m³, which is just 0.6% of the annual LV of 50 µg/m³ recommended by the World Health Organization (WHO).

Sulphur oxide limit values have not been exceeded.



The maximum concentrations are shown in **Table 11.3-1.**

TABLE 11.3-1: MAXIMUM ANNUAL CONCENTRATIONS DURING THE CONSTRUCTION STAGE

Sites	PM_{10}	SO_X	NO_X
	µg/m³		
Site 1	8.16	0.10	12.62
Site 2	13.51	0.19	13.88
Site 3	21.20	0.18	22.70
Site 4	17.42	0.29	36.67

Based on the above, we can conclude that during the construction of the NNU no transboundary impact is expected as a result of gaseous and dust emissions on the Romanian part of the 30 km surveillance zone.

11.3.1.2 THERMAL POLLUTION

The change of the temperature regime of the river as a result of the discharge of water heated up by Kozloduy NPP leads to a specific form on non-radioactive pollution. The permissible limit for the temperature rise of the open flow is 3°C for the warmest and 5°C for the coldest month of the year. The norm does not reflect how likely are combinations of water quantity with 95% provision and the average temperature of the water for the last 10 years, and whether this temperature is a representative feature of the natural temperature regime of the open flow.

*11.3.1.2.1 Studies on the thermal pollution of the Danube River in **1991***

Studies on the temperature regime of the water in the section of Kozloduy NPP have been conducted in connection with the construction of units 5 and 6 in 1991, by a team from the UACEG[38], led by prof. B. Kazakov. They also include environmental studies where a temperature profile was made for the water in the Danube River in the section between the discharge of the hot (outlet) channel and the town of Oryahovo. Due to the fact that environmental studies cannot encompass all possible combinations of changes to the factors determining the heat impact of Kozloduy NPP on the Danube River, the results from the studies have been used to derive semi-empirical dependencies to calculate the size of the heat-influenced area for the Danube River, based on similar studies conducted by the Cornell University for the conditions in the USA. These include the water quantity of the Danube River before the OPS, the water quantity taken in by the cooling system of the power plant, the temperature difference between the water borrowed and returned to the river, and the geothermal characteristics of the section of the Danube River – average width and depth. 4 dependencies have been established – two for the maximum distance from the right bank at a pre-set isotherm and length of the zone to the right bank, enclosed by that isotherm. The margin of error for these dependencies is from 3.8% to 6.5%.

The conducted studies show that:

- the temperature of the water in the hot (outlet) channel before the discharge into the river follows a natural rise of the water temperature in the Danube River before the OPS by the hour during the day, with a temperature difference of 7.5-8.5°C, during normal operational conditions;
- the heat stratification along the river at the zone of the thermal plume only occurs up to about 700 m after the discharge of the Hot Outlet Channel (HOC). The maximum stratification in the vertical direction (by about 4°C) is observed at about

[38] "Kozloduy" NPP. A study of thermal pollution to the Danube River by the NPP, along with reduction measures – 1991. A scientific report by a team lead by Prof. B. Kazakov.

200 m after the discharge and at about 80-100 m into the cross-section to the waterway (midstream) of the river;

→ the "thermal pollution" strain in the Danube River (with ΔT = 3°C) is then manifested at about 1700 m after the discharge of the HOC, with a maximum width of about 300 m: for example, 80% of relative dispersion of water temperature in the Danube River after the merger of the HOC (with a flow rate of 75 m^3/s) occurs at about 2 km downstream.

*11.3.1.2.2 Studies on the thermal pollution of the Danube River in **1999**.*

In order to establish some current characteristics of the thermal impact of Kozloduy NPP on the Danube River, expeditionary studies were carried out on August 4 and 5, 1999, along the Danube from the port of the town of Kozloduy to the village of Ostrov, for the purposes of the EIA[39] conducted in 1999 by experts from the team and the National Institute of Meteorology and Hydrology under the BAS, with the cooperation of NPP management and via the provided motorboat.

The analysis on the results from these studies demonstrated that:

→ The thermal impact of Kozloduy NPP at an average 24-hour capacity of 1380 MW on the Danube River on 04.08.1999 was relatively more pronounced than the one on 09.09.1991, when only units 3 and 6 were working, at a reduced capacity.

The results from the measurements made on 05.08.1999 showed a consistently elevated temperature by about 2°C compared to the ones that were expected based on the calculations and the ongoing monitoring conducted by the Executive Agency for Exploration and Maintenance of the Danube River (EAEMDR), based in city of Ruse. That is why these results should only be used as a guideline on the nature of the temperature change in the Danube River, in contrast to the more stringent results from 4.08.1999, which correspond well to previous studies and the ongoing monitoring. The possible reasons for these deviations could be sought in the inaccurate coordination of the motorboat along the stream, using only the navigational equipment and/or a possible systematic error in the measuring device.

The conclusion of the experts is that the results from the examination of the isotherm +3°C (a temperature field with a temperature higher by 3°C than the natural one for the Danube River) in previously conducted studies and during the conducted experiment are grounds to assume that there is concordance in the results from the different studies.

Using the established dependencies, the team made calculations in order to determine the amount of the heat-influenced area from the Danube River after the discharge of the hot channel, under average monthly water quantities and with a 95% probability. The operation of the power plant has been studied when working at 1760 MW and 3760 MW – respectively at a discharge rate from the hot channel amounting to 104 and 180 m^3/s. The

[39] EIA Report on Kozloduy NPP – 1999.

calculations were made for two isotherms: +3°C and +5°C. The results obtained show that during the operation of 4 units, with a total quantity of heated waters of 104 m^3/s, to a temperature 10°C above the temperature of the Danube River, the heat-influenced area, at a 5% probability to not exceed the value, and a temperature of + 3°C above the natural one during the individual months of the year, has a length of 2.3 to 10.6 km, i.e. it extends from ^{km}684.3 to ^{km}676.1, forming near the Bulgarian bank and having a maximum width in the zone from 100 to 185 m – **Figure 11.3-16**.

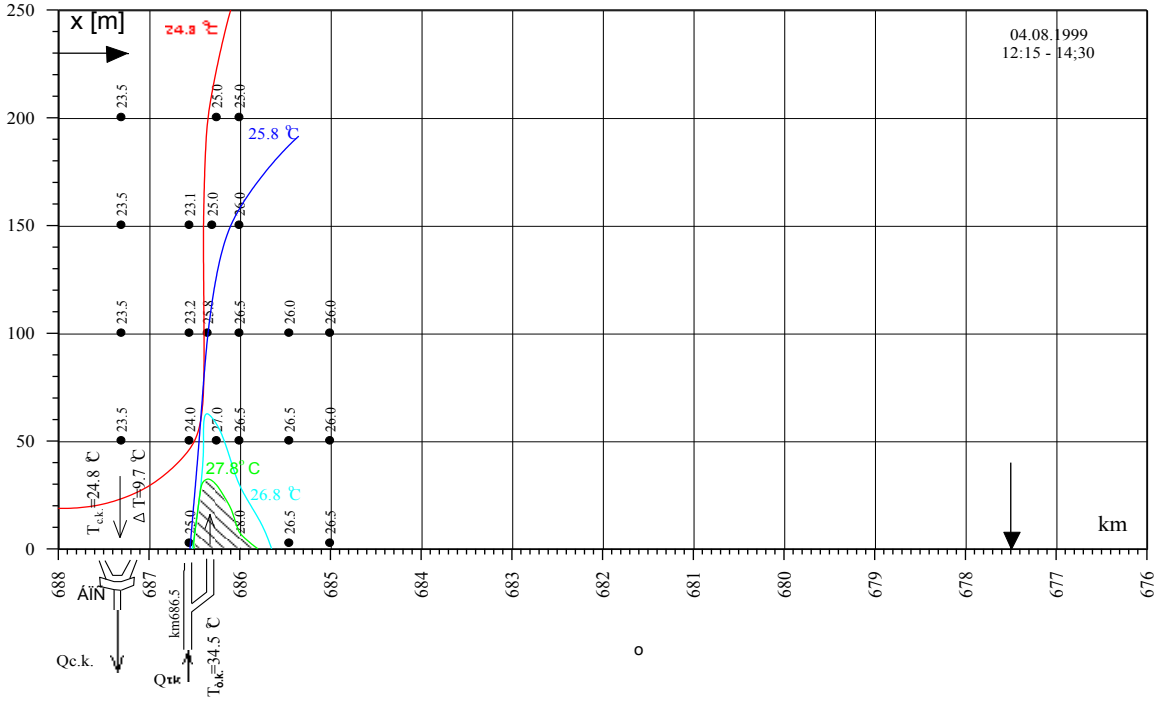


FIGURE 11.3-16: ISOTHERMAL OUTLINE AND RESULTS FROM MEASUREMENTS ON THE HEAT-INFLUENCED AREA OF THE DANUBE RIVER ON 04.08.1999

When the full capacity of the 6 units of the power plant is utilized (3760 MW), and respectively the quantity of the heated waters rises to 180 m^3/s, the length of the heat-influenced area by 3°C will vary during the individual months from 7.0 to 31 km, and have a width from 175 to 320 m. The size of the heat-influenced area is usually greatest in the month of October. The thermal plume is drawn relatively quickly to the river bank, and at a distance of about 7-7.5 km after the discharge the difference between the water temperature of the river and the plume reaches 1.8°C (about 80% dispersion). At a temperature difference of 0.2°C the maximum width of the plume from the bank to the waterway reaches 195 m, and the length – about 21-22 km.

Based on the results presented above, we can draw the conclusion that for inflowing water quantities up to Q_T=160 m^3/s the influence of the heat exchange between the heated water coming from Kozloduy NPP into the Danube River and the environment for the section between kilometer 687 (the point of discharge of the hot channel) to kilometer 678 (the port of Oryahovo) is negligible and can be ignored.

These trends are also confirmed by the data shown on **Figure 11.3-17**: to **Figure 11.3-20:** which shows that after the commissioning of Kozloduy NPP a certain thermal load was observed at Oryahovo ($^{km}678$) as compared to Lom ($^{km}743.3$), not exceeding 3°C, which is the regulatory limit.

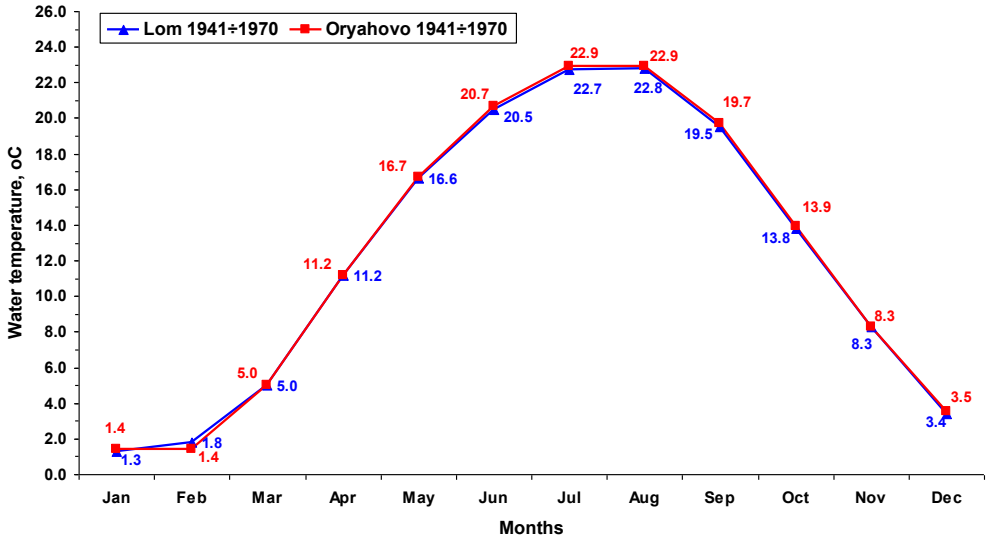


FIGURE 11.3-17: AVERAGE MONTHLY WATER TEMPERATURES (IN °C) AT THE LOM AND ORYAHOVO STATIONS FOR THE PERIOD 1941-1970 – BEFORE THE COMMISSIONING OF THE NPP[40].

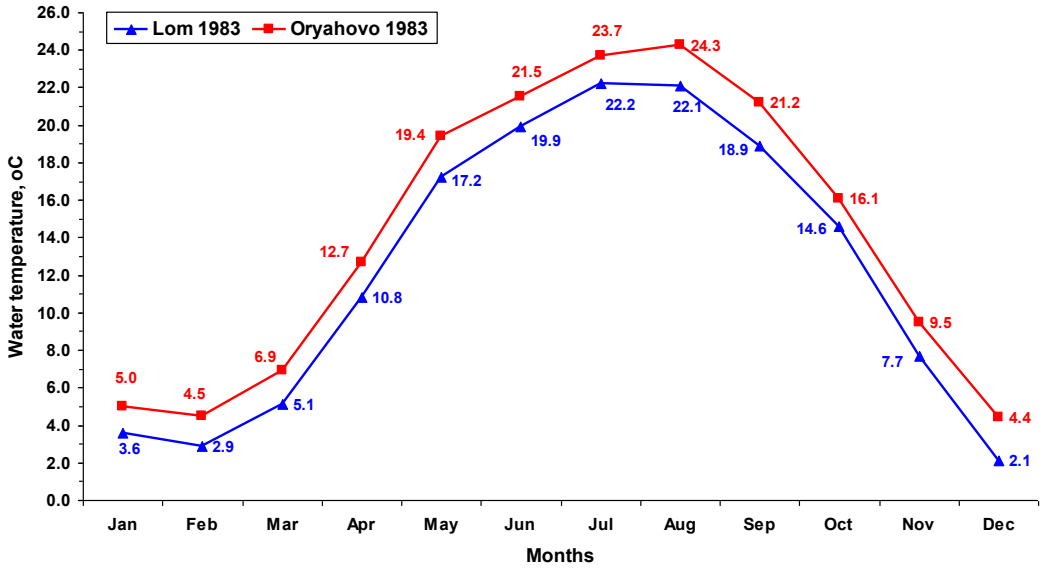


FIGURE 11.3-18: AVERAGE MONTHLY WATER TEMPERATURES (IN °C) AT THE LOM AND ORYAHOVO STATIONS FOR 1983 (A DRY YEAR) – WITH 4 UNITS IN OPERATION[41]

[40] Rusev, B. K., V. T. Naydenov (red.) 1978. Limonology of the Bulgarian section of the Danube River. BAS Publishing House, Sofia, 308 p.

[41] EIA on Kozloduy NPP –1999.

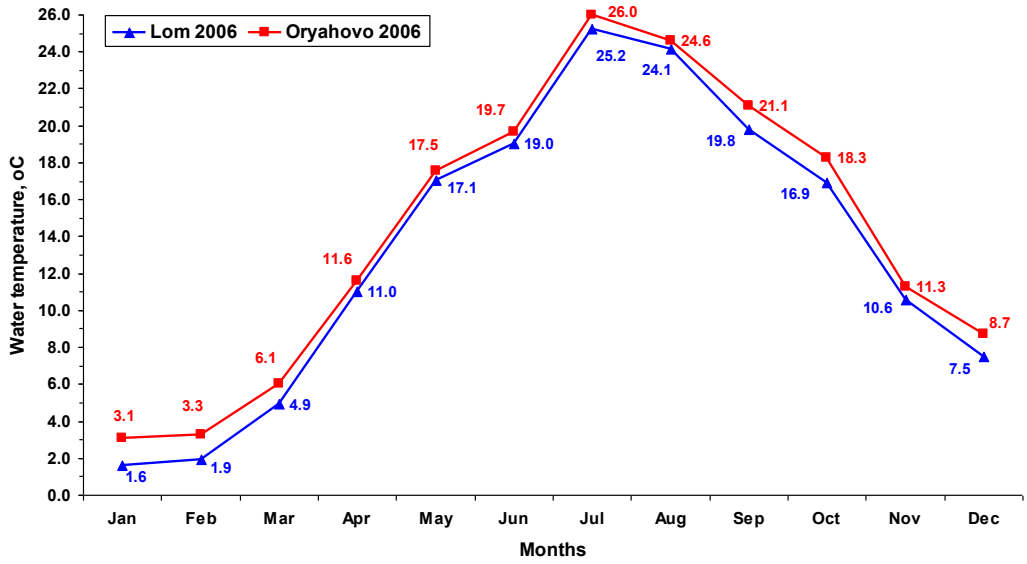


FIGURE 11.3-19: AVERAGE MONTHLY WATER TEMPERATURES (IN °C) AT THE LOM AND ORYAHOVO STATIONS FOR 2006 (A YEAR WITH VERY HIGH WATER LEVELS) – WITH 4 UNITS IN OPERATION (3, 4, 5 AND 6)[42].

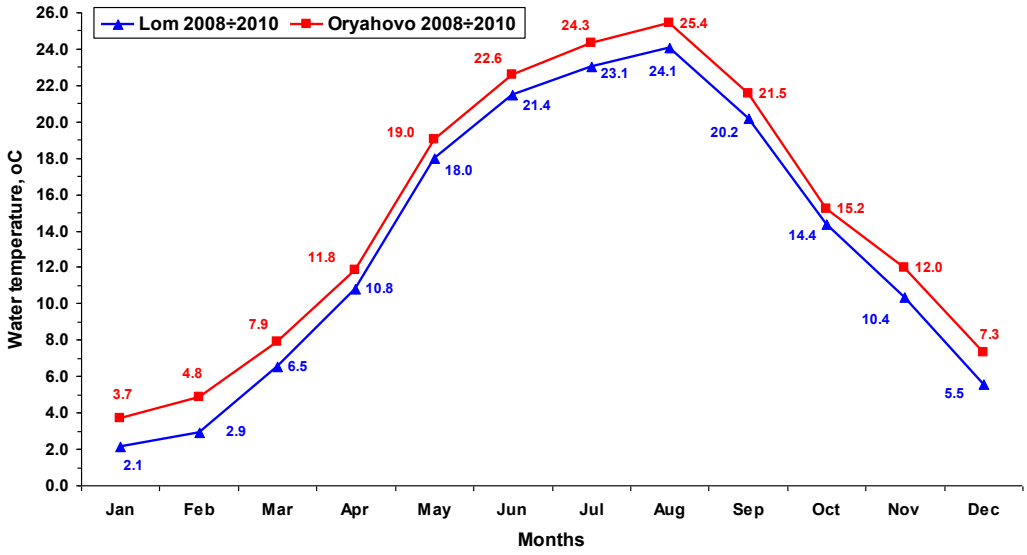


FIGURE 11.3-20: AVERAGE MONTHLY WATER TEMPERATURES (IN °C) AT THE LOM AND ORYAHOVO STATIONS FOR THE PERIOD 2008-2010 – WITH 2 UNITS IN OPERATION (5 AND 6).

Figure 11.3-21 shows the difference in the average daily temperatures, measured at Oryahovo and Lom for the period 2002-2012. As we can see, no lasting trend can be established regarding the increase of these differences during the period. The average rise

[42] Letter № 438 from 17.03.2013 with PPP 34 from 17.03.2013 – data provided by the Executive Agency for Exploration and Maintenance of the Danube River (EAEMDR, www.appd-bg.org) to the Assigning Authority.

of the temperature is within 1.5–2.0°C, and only in isolated cases it exceeds 3.0°C[43]. In individual cases the temperature difference is reversed, which can be explained with a more intense turbulent exchange, leading to a rupture of the flow of heated waters close to the Bulgarian bank.

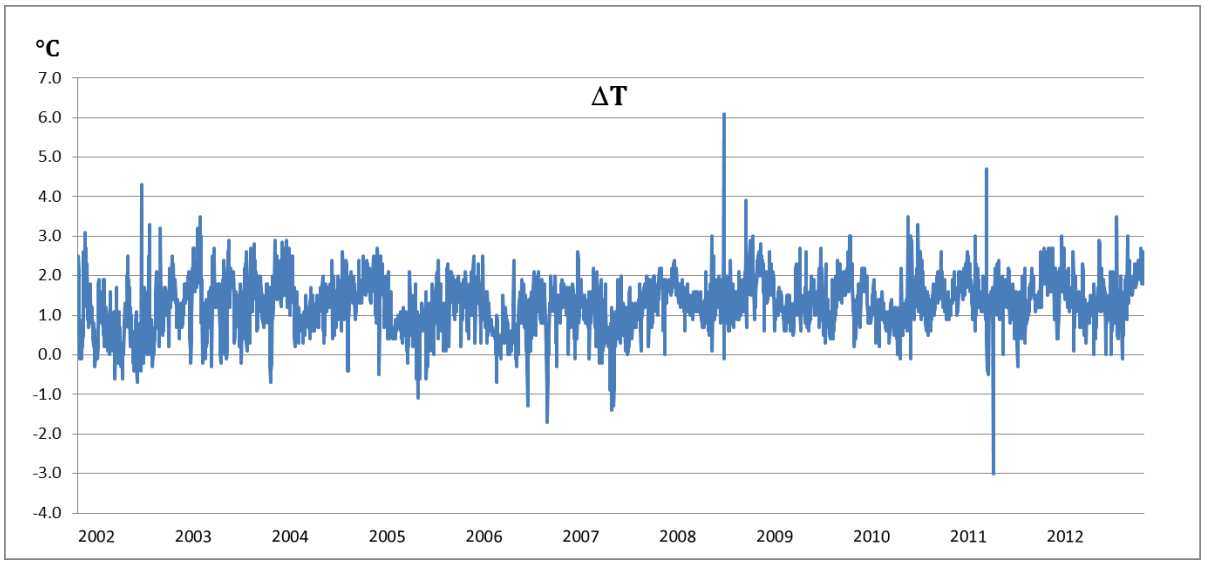


FIGURE 11.3-21: DIFFERENCE IN THE AVERAGE DAILY WATER TEMPERATURES (IN °C) AT THE ORYAHOVO AND LOM STATIONS FOR THE PERIOD 2002-2012

Figure 11.3-22 shows the difference in the average daily water temperatures, measured at Oryahovo and Lom for the period 01.01.2012 – 31.12.2012. We can see that when the NPP operates at a 2000 MW output, the difference in the temperatures rarely exceeds 2°C.

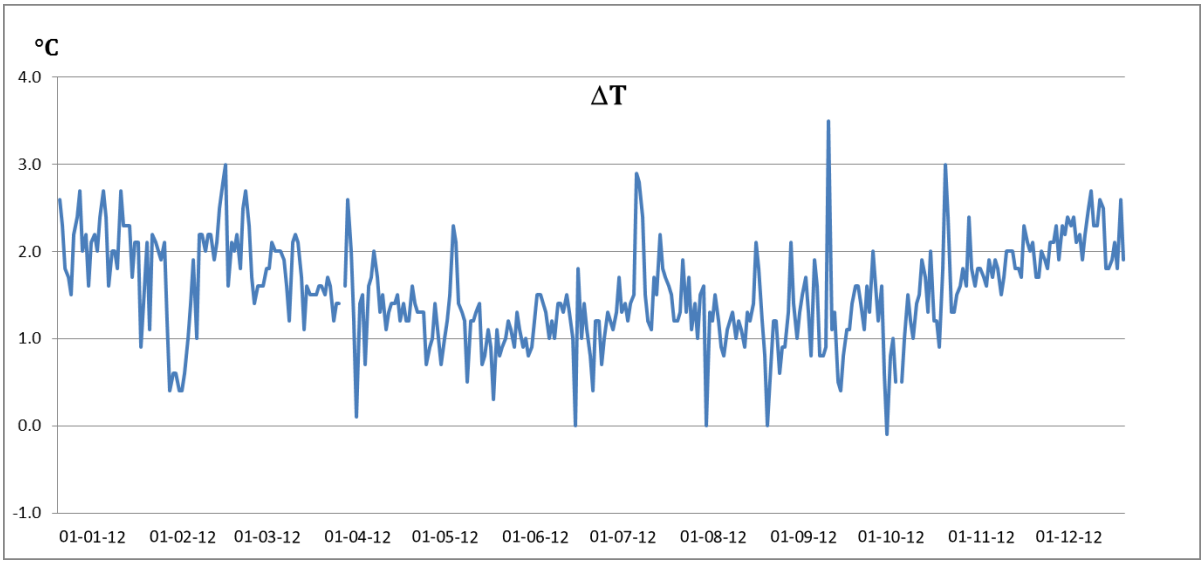


FIGURE 11.3-22: DIFFERENCE IN THE AVERAGE DAILY WATER TEMPERATURES (IN °C) AT THE ORYAHOVO AND LOM STATIONS FOR 2012

[43] Letter № 438 from 17.03.2013 with PPP 34 from 17.03.2013 – data provided by the Executive Agency for Exploration and Maintenance of the Danube River (EAEMDR, www.appd-bg.org) to the Assigning Authority.

Based on the results presented above, we can draw the conclusion that for inflowing water quantities up to Q_T=160 m³/s the influence of the heat exchange between the heated waters coming from Kozloduy NPP into the Danube River for the section from kilometer 687 (the point of discharge of the hot channel) to kilometer 678 (the port of Oryahovo) and the environment is negligible and can be ignored. Even after the commissioning of the new unit, the maximum parameters of the plume quoted above cannot be reached, based on the accumulated measurements during the operation of the NPP with Q_T=180 m³/s. After the commissioning of Kozloduy NPP, a certain thermal load was observed at Oryahovo (^{km}678) as compared to Lom (^{km}743.3), which does not exceed 3°C, which is the regulatory limit.

11.3.1.3 ICE REGIME OF THE DANUBE RIVER

In the section of the Danube River within our territory, for more than 70 years there were only 5 ice lockdowns at flow rates from 4870 m³/s to 11 910 m³/s. The fact that the last one was in 1963 shows that after the construction of the "Zhelezni Vrata" water supply system, the probability of freezing in the Bulgarian section of the Danube River has decreased substantially. The occurrence of events similar to those during the catastrophic wave during the accidents at "Zhelezni Vrata" I and II, and of icing lockdowns (at the same time) is of low probability and should not happen together, even more so because during the occurrence of the catastrophically high waters, amounting to more than 20 000 m³/s, ice blocking is not possible. It is only possible at low to average water levels (around elevation level +25.00 m), which happens during the winter. If we assume that even at this low probability such an event is still possible, it would create water retention up to 2.5 m and the average level of 25.00 m will go up to 27.00 m. Due to these reasons, the elevation of the water level and the flooding of Kozloduy NPP due to water retention caused by an ice drift is very unlikely.

Data from previous studies show that water retention in the area of the Onshore Pumping Station at low waters can reach up to 3.60 m, and at high waters – up to 1.50 m. The probability of the manifestation of water retention as a result of lockdowns at Oryahovo is 1 time per 10 years, and the water levels reached after water retention have a 0.5% repeat rate, i.e. 1 time per 200 years.

The commissioning of the new nuclear unit will not lead to any significant change to the thermal and ice regime of the river in the section between the OPS and Oryahovo, as well as any cumulative and transboundary impact.

11.3.2 SUMMARY ASSESSMENT OF THE PROBABILITY FOR RADIOACTIVE POLLUTION RESULTING FROM THE IMPLEMENTATION OF THE NNU ON ATMOSPHERIC AIR – GASEOUS, AEROSOL AND LIQUID RELEASES IN THE ROMANIAN PART OF THE 30 KM SURVEILLANCE ZONE DURING NORMAL OPERATION

The radioactive pollution of atmospheric air is caused by radioactive releases (emissions) from the nuclear power plant. Airborne radionuclides can lead to radiation in two principal

ways: externally – from photons and electrons emitted by radionuclides emitted as a result of radioactive decay, and internally – via their inhalation.

In terms of human health, these releases are evaluated by the radiation exposure of the human body in comparison to the threshold concentration levels for conventional pollutants in the atmospheric air.

The assessment of the radiation exposure level of the population within the 30 km zone to gaseous and aerosol releases was made using the modeling program LEDA-CM, "SHIELD Normal Operation", adapted to the geographical and meteorological characteristics of Kozloduy NPP region. The methodology reflects both the external and internal impact of radioactive releases and assesses the annual individual effective dose, the annual individual equivalent dose and the dose for the critical group, as well as the collective dose to the population by age groups. The program is based on the method adopted by the European Union (EU) – CREAM (Consequences of Releases to the Environment Assessment Methodology) Radiation Protection 72 – Methodology for assessing the radiological consequences of routine releases of radionuclides to the environment. This modeling program is based on the following types of mathematical models: 1) releases to the atmospheric air, 2) transfer to the environment, 3) impact pathways (ground model) and 4) dosimetric models.

The assessment of the external and internal exposure of the population in the NNU region to **gaseous and aerosol releases** takes into account the following impact pathways:

- ✓ External exposure to a radioactive cloud;
- ✓ External exposure resulting from depositions on ground surface;
- ✓ Internal exposure by inhalation;
- ✓ Internal exposure via the consumption of radioactively contaminated foodstuffs.

The assessment of the external and internal exposure of the population in the NNU region to **liquid releases** takes into account the following impact pathways:

- ✓ staying in the water of the Danube River – external exposure during swimming and boating;
- ✓ contact with the riverside sediment of the Danube River – external exposure resulting from riverbed sediments and stay on the beach;
- ✓ ingestion of products (fish) from the water of the Danube River – internal exposure as a result of fish consumption;
- ✓ stay on territories irrigated with water from the Danube River – external exposure;
- ✓ ingestion of plant products, irrigated with water from the Danube River (fruits, vegetables, etc.) – internal exposure;
- ✓ ingestion of meat and milk from animals using drinking water from the Danube River – internal exposure;

- ✓ Ingestion of meat and milk from animals, fed with fodder irrigated with water from the Danube River – internal exposure;
- ✓ usage of drinking water – internal exposure.

Assessments of the radiation risk encompass the following range:

(1) Risk of radiation-induced cancer for the general population and individuals of working age;

(2) Risk of hereditary diseases for the general population and individuals of working age;

(3) Risks of and damage to certain tissues in the general population;

(4) Risks of hereditary diseases for the first generation and for two generations;

(5) Risks of hereditary diseases for the reproductive part of the population, estimated for two generations, resulting from exposure of the first generation before the second one;

(6) Risks of hereditary diseases for the reproductive part of the population, estimated for the first generation after the exposure.

11.3.2.1 EXPOSURE TO GASEOUS AND AEROSOL RELEASES

The detailed assessment is presented in item 4.11.

The primary pathways of receiving the individual or collective dose of gaseous and aerosol releases in the atmosphere are presented in **Figure 11.3-23**.

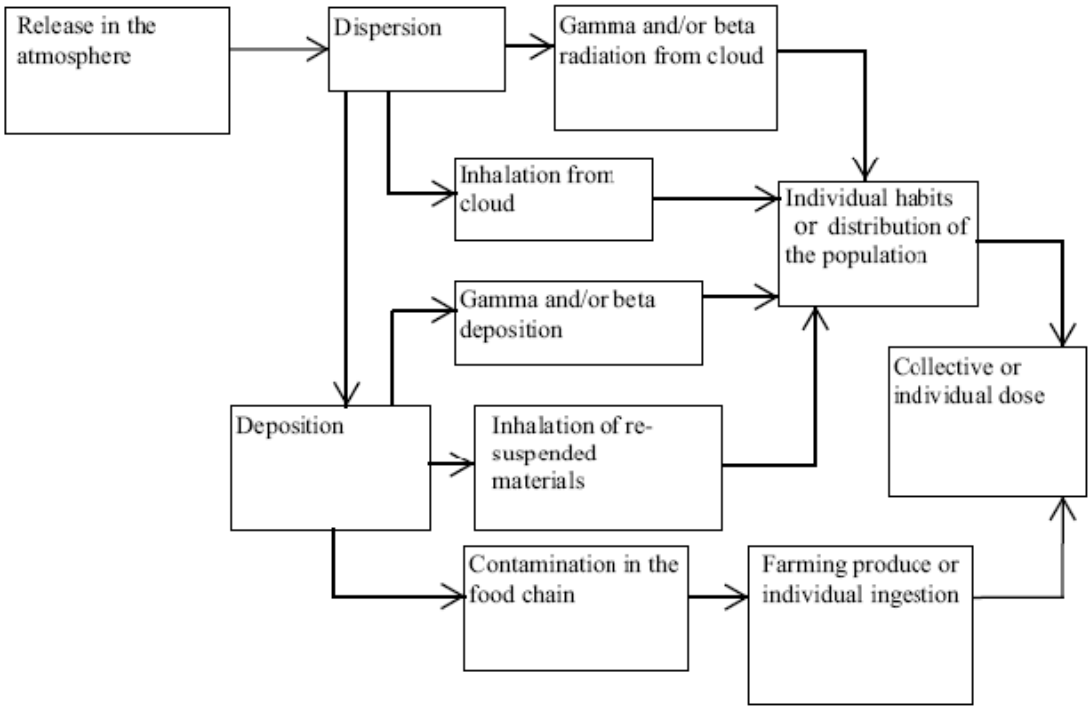


FIGURE 11.3-23: PRIMARY PATHWAYS OF RECEIVING THE INDIVIDUAL OR COLLECTIVE DOSE OF GASEOUS AND AEROSOL RELEASES IN THE ATMOSPHERE

The data on the radioactive releases to the atmosphere was taken from:

- Annual Report, Results from the radiation environmental monitoring for Kozloduy NPP in 2012, № 13.РМ.ДОК.175
- Data on airborne emissions from the NNU (A letter from the " Kozloduy NPP – New Build" EAD, with outgoing № 396/08.05.2013)

TABLE 11.3-2: RADIONUCLIDES IN THE GASEOUS AND AEROSOL RELEASES DURING NORMAL OPERATION AND EXPECTED OPERATIONAL OCCURRENCES, BQ/A

Nuclide	Westinghouse AP 1000	AES BBEP-1000/B466
H – 3	1.3E+13	3.9E+3
C – 14	2.7E+11	3.0E+2
Ar-41	1.3E+12	
Kr-83m		1.0E+3
Kr-85m	1.3E+12	3.6E+3
Kr-85	1.5E+14	3.6E+2
Kr-87	5.6E+11	1.9E+3
Kr-88	1.7E+12	7.0E+3
Xe-131m	6.7E+13	3.1E+2
Xe-133m	3.2E+12	1.4E+3
Xe-133	1.7E+14	4.7E+4
Xe-135m	2.6E+11	
Xe-135	1.2E+13	2.5E+4
Xe-138	2.2E+11	3.5E+2
I – 131	4.4E+09	3.4E+8

Nuclide	Westinghouse AP 1000	AES BBEP-1000/B466
I – 132		7.5E+8
I – 133	1.5E+10	9.0E+8
I – 134		1.9E+8
I – 135		6.1E+8
Cr – 51	2.3E+07	6.3E+3
Mn – 54	1.6E+07	8.7E+3
Co – 57	3.0E+06	
Fe – 59	2.9E+06	
Co – 58	8.5E+08	
Co – 60	3.2E+08	1.0E+5
Sr – 89	1.1E+08	9.8E+5
Sr – 90	4.4E+07	2.1E+3
Zr – 95	3.7E+07	
Nb – 95	9.3E+07	
Ru – 103	3.0E+06	
Ru – 106	2.9E+07	
Sb – 125	2.3E+07	
Cs – 134	8.5E+07	4.7E-2
Cs – 136	3.2E+06	
Cs – 137	1.3E+8	5.9E-2
Ce – 141	1.6E+06	

- Requirements, outlined in the EUR – European Utility Requirements for LWR Nuclear Power Plants (requirements of the European operating organizations for NPPs with light water reactors).

Pursuant to the EUR, the limits on airborne radioactive emissions for normal operation modes and for the expected operational occurrences are the following:

– For radioactive noble gasses – 50 TBq;

– For long-lived aerosols and halogen elements – 1 GBq.

(*These referent values were defined on the basis of 1500 MW$_e$)*

In the interest of comprehensiveness and conservative assessment of the statutory collective annual doses, the following power output values have been assumed for the NNU: AP 1000 – 1200 MW*e*, AES BBEP-1000/B466 – 1000 MW*e*, at 1500 MW*e* and 90% availability, as envisaged in the EUR.

Figure 11.3-24 presents the distribution of individual effective doses within the 30 km zone around Kozloduy NPP.

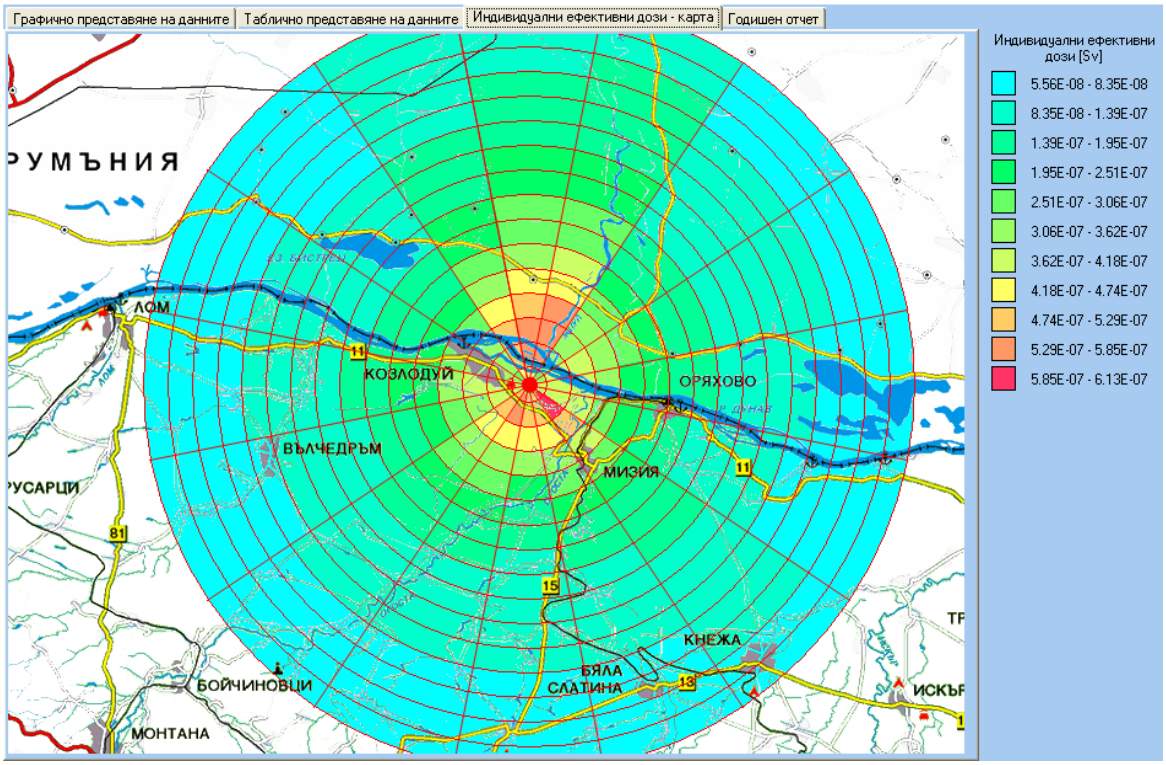


FIGURE 11.3-24: DISTRIBUTION OF THE INDIVIDUAL EFFECTIVE DOSE FOR ADULTS FOR ALL ROUTES OF EXPOSURE AND INTAKE OF RADIOACTIVE EMISSIONS IN THE ATMOSPHERE UNDER THE EUR, SV

The received assessments on the annual effective dose per person from the population have been compared to: the admissible limit for the population of the country – 1 mSv/a (BNRP-2012); the control release threshold – 10 μSv/a (BNRP-2012); the limit of exposure to radioactive releases from the NPP under all operating conditions – 0.05 mSv/a (guidelines by the BNRA, given in letter № 47-00-171/12.02.2013) and background exposure characteristic for this geographical region – 2.33 mSv/a. The statutory collective doses have been compared to the average values for PWR reactors in the world (UNSCEAR Report – 2000, 2008).

In cases of airborne radioactive emissions in accordance with the EUR, the collective annual dose has been evaluated to be 2.49×10^{-2} manSv/a. The statutory collective annual dose of gaseous and aerosol emissions, applicable to the population within the 30 km zone, amounts to 1.84×10^{-2} manSv/GW.a.

The conducted model-based and mathematically based assessments indicate that the additional radiation exposure of the population within the 30 km zone due to the operation of the NNU is negligible and that no transboundary impact is expected.

11.3.2.2 EXPOSURE TO LIQUID RELEASES

Liquid radioactive releases to the Danube River are dispersed as a result of the primary water flow and the process of precipitation. The main exposure pathways with regard to people are the following: external exposure from contact with the water environment and the accumulated precipitations at the river bottom, consumption of foods derived from the

river, utilizing the river water for drinking purposes, consumption of foods from crops and pastures irrigated with water from the river.

The input data on liquid releases have been taken from:

- ✓ Demographic data and data on consumption and habits:
  - Bulgarian part: Annual Report, Results from the radiation environmental monitoring for Kozloduy NPP in 2012, №13.RM.DOC.175
  - Romanian part: A letter by the Romanian Ministry of Environment and Forests, № 3672/RP/18.10.2012
- ✓ Hydrological data:
  - Annual Report, Results from the radiation environmental monitoring for Kozloduy NPP in 2012, №13.RM.DOC.175
- ✓ Emissions into the water:
  - Annual Report, Results from the radiation environmental monitoring for Kozloduy NPP in 2012, №13.RM.DOC.175
  - Data on emissions into the water by the NNU.

TABLE 11.3-3: RADIONUCLIDES IN THE LIQUID RELEASES DURING THE NORMAL OPERATION AND EXPECTED OPERATIONAL OCCURRENCES, BQ/A

Nuclide	Westinghouse AP-1000
Te-131m	3.33E+06
Te-131	1.11E+06
I-131	5.23E+08
Te-132	8.88E+06
I-132	6.07E+07
I-133	2.48E+08
I-134	3.00E+07
Cs-134	3.67E+08
I-135	1.84E+08
Cs-136	2.33E+07
Cs-137	4.93E+08
Ba-137m	4.61E+08
Ba-140	2.04E+08
La-140	2.75E+08
Ce-141	3.33E+06
Ce-143	7.03E+06
Pr-143	4.81E+06
Ce-144	1.17E+08
Pr-144	1.17E+08
All remaining ones	7.40E+05
H-3	3.74E+13

For AES BBEP-1000/B466: In the volume of debalanced water discharged in the environment the emissions of tritium are around $8.5x10^{12}$ Bq/year[44].

- Requirements outlined in the EUR – European Utility Requirements for LWR Nuclear Power Plants.

Pursuant to the EUR, the limits for radioactive emissions for normal operation modes and expected operational occurrences are the following:

– Liquid ones, with the exception of tritium – 10 GBq. (*This reference value was defined on the basis of 1500 MW_e*)

In the interest of comprehensiveness and conservative assessment of the statutory collective effective annual doses, the following power output values have been assumed for the NNU: AP 1000 – 1200 MW*e*, AES BBEP-1000/B466 – 1000 MW*e*, at 1500 MW*e* and 90% availability, as envisaged in the EUR.

To assess the radiation exposure of the population to liquid releases, we have used the modelling program DARR-CM, adapted to the hydrology of the area of Kozloduy NPP, using a conservative estimate of the exposure dose for the critical population group.

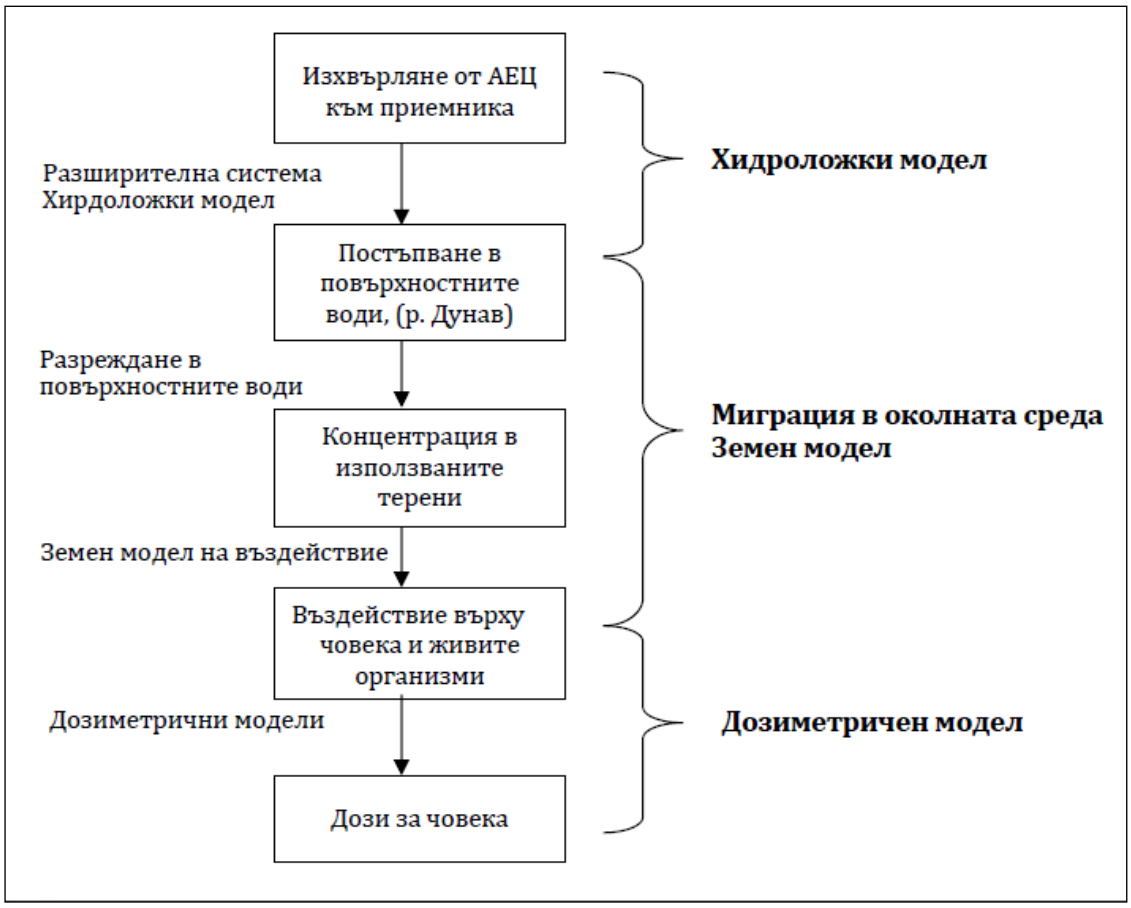
The methodology consists of a series of interrelated models depicting the transfer of radionuclides through different environmental sectors, and the impact pathways by which they may exhibit effects on people.

The methodology reflects both the external and the internal impact of radioactively contaminated waters and evaluates the annual individual dose for a "reference individual" and a critical group, as well as the collective dose for the population in three age groups: babies (0 – 1-year-old), children (1 – 10-year-old) and adults (over 10-year-old), in settlements along the Danube River.

This methodology is based on three types of mathematical models: 1) hydrologic models, 2) impact pathway models (ground model) and 3) dosimetric models.

Figure 11.3-25 shows the links between these models, which are used in the analyses on the results from Kozloduy NPP units. The annual release of radionuclides within the expanded system serves as the starting point for these analyses.

[44] According to data provided by the Contracting authority, letter No 828/13.08.2013



1. Left column, top-down: Expanded system – hydrologic model; Dilution into surface water; Ground impact model; Dosimetric models.
2. Middle column, top-down: Release from the NPP to the receiver; Entry into surface water (the Danube River); Concentration in the used lands; Impact on humans and living organisms; Doses for the human.
3. Right column, top-down: **Hydrologic model; Migration into the environment – ground model; Dosimetric model**.

FIGURE 11.3-25: APPLIED MODELS

The model programs used for evaluating the individual and collective effective doses of the population resulting from radioactive releases into the environment have been verified and validated.

The results from the received assessments on the maximum individual effective dose within the 30 km zone and the critical group from the population living along the Danube River (**Table 11.3-4**) are graphically presented at **Figure 11.3-26** and **Figure 11.3-27**.

TABLE 11.3-4: INDIVIDUAL DOSES WITHIN THE 30 KM ZONE FROM LUQUID RELEASE OF NNU

NNU	Individual effective dose, [Sv]		Collective dose [man.Sv]	Statutory collective dose [man.Sv/GW.a]	Comparison to UNSCEAR ^{3}H $1.4.10^{-2}$ [man.Sv/GW.a]
	For thhe population within 30 km zone	For critical group			
EUR release limits	$1.71.10^{-7}$- $3.07.10^{-7}$	$2.26.10^{-6}$	$2.45.10^{-3}$	$1.81.10^{-3}$	12%
AP-1000	$5.32.10^{-7}$- $9.89.10^{-7}$	$6.97.10^{-6}$	$7.32.10^{-3}$	$5.42.10^{-3}$	38.5%
AES BBEP-1000/B466	$1.2.10^{-7}$- $2.25.10^{-7}$	$1.58.10^{-6}$	1.65.10-3	1.22.10-3	8.7%

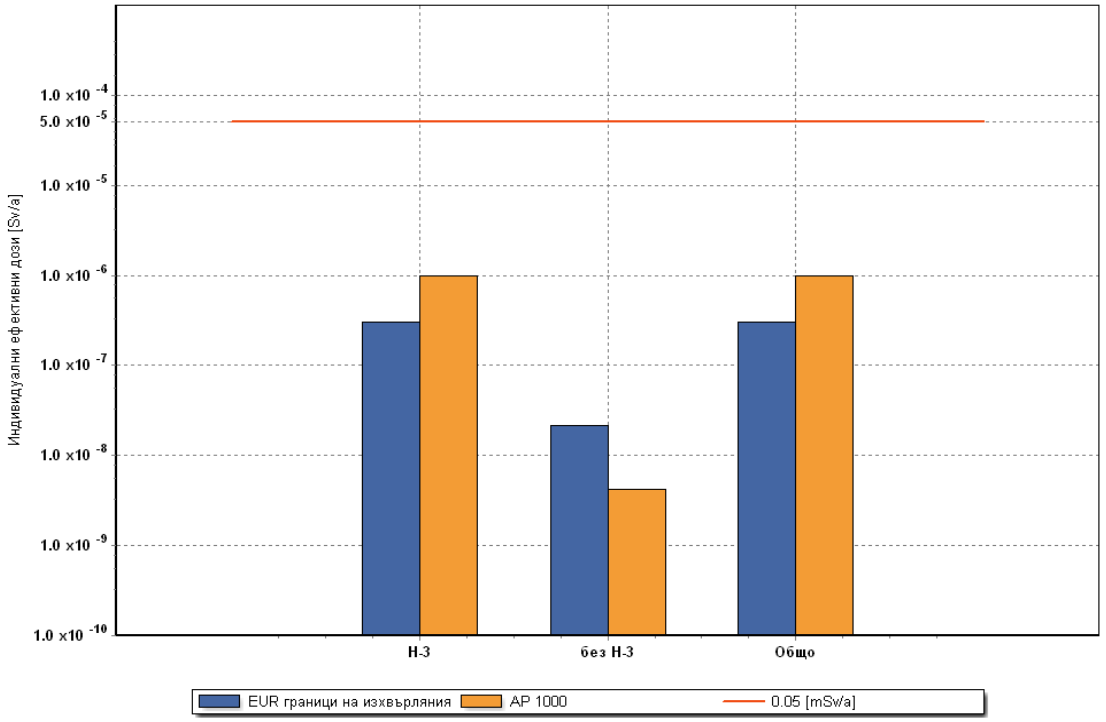


FIGURE 11.3-26: MAXIMUM RADIATION EXPOSURE TO LIQUID RELEASES WITHIN THE 30 KM ZONE

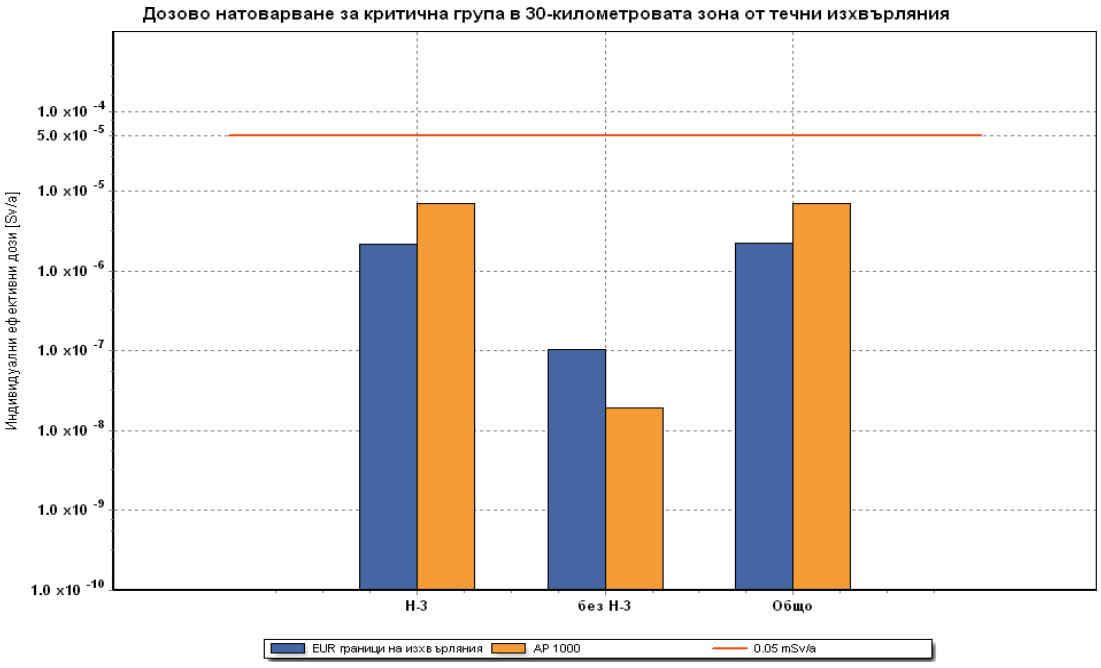


FIGURE 11.3-27: RADIATION EXPOSURE TO LIQUID RELEASES FOR THE CRITICAL GROUP WITHIN THE 30 KM ZONE

The assessements are below the permissible rate for the population of the country 1 mSv/a (OHP3-2012); the control release threshold 10 μSv/a (OHP3-2012); limit of exposure (0.05 mSv/a) for radioactive release from NNU under all operational modes (guidelines of NRA given in letter No. 47-00-171/12.02.2013) and the background exposure, characteristic for this geographic region 2.33 mSv/a.

The collective dose for the population within the 30 km zone from liquid radioactive releases under the EUR has been estimated to be 2.45×10^{-3} man.Sv/a. The statutory collective dose per unit of generated electric power amounts to 1.81×10^{-3} man.Sv/GW.a.

The collective dose for the population within the 30 km zone from the design-level liquid releases of AP-1000 has been estimated to be 7.32×10^{-3}man.Sv/a. The statutory collective dose per unit of generated electric power amounts to 5.42×10^{-3}man.Sv/GW.a.

In summary, the assessments on the NNU are completely comparable with the data for a large number of PWR reactors in the world (UNSCEAR–2000, 2008) and no transboundary effect is expected.

11.3.2.3 RADIOBIOLOGICAL EFFECTS AND RADIATION RISK FOR THE REFERENCE INDIVIDUAL

The assessment of the radiobiological effects and the radiation risk for a reference individual in the event of radioactive releases from the NNU is done using the program HeConEmpPop (Health Consequences for Employees and the Population). The modeling program formalizes the methodology for assessment of the radiobiological effects and the radiation risk, pursuant to ICRP Publication 103, The 2007 Recommendations of the International Commission on Radiological Protection.

The use of radioactive substances and ionizing radiation represents a risk to human health. The benefits and the risk to human health are the two sides of the application of radioactive substances and ionizing radiation. They are equally important and that is why they have to be considered together. This concept is logical, but its practical application is difficult because the risk and the benefits should be assessed quantitatively. To that end, the International Commission on Radiological Protection has developed a methodology for the assessment of the risk of ionizing radiation. The modelling program evaluates deterministic and stochastic effects.

The model programs that are used to assess the individual and collective exposure of the population to radioactive releases to the environment have been verified and validated.

The resulting assessments of the exposure impact of the releases from the NNU are completely comparable with the global practice, according to official UN data (UNSCEAR – 2000, 2008).

According to statistical data from the National Statistical Institute from the census conducted on 01.02.2011, the population within the 30 km zone around Kozloduy NPP on the territory of Bulgaria amounted to 65 994 people, and on the territory of Romania it was 75 150 people. The following conclusions can be drawn about the aforesaid population regarding the radiobiological effects and the radiation risk as a result of the operation of the NNU:

Deterministic effects

There is no risk of the development of deterministic effects for the population within the 30 km zone of Kozloduy NPP.

Individual doses of gaseous and aerosol releases, as a combined number for all nuclear facilities and the NNU, are within the range $1.35 \times 10^{-6} \div 1.94 \times 10^{-6}$ Sv, and only from the NNU the gaseous and aerosol releases – within the range $1.79 \times 10^{-8} \div 6.13 \times 0^{-7}$Sv.

These doses are much lower than the threshold level established by Art. 10 of the BNRP as a maximum annual effective dose, which is 1 mSv for the population.

Based on the above, we can state that there is no risk of the development of deterministic effects for the population within the 30 km zone of the NPP on the territory of the Republic of Romania.

Stochastic effects

The probability for the occurrence of radiation-induced cancer for the whole population is respectively: 3.29×10^{-8} for AP-1000; 9.85×10^{-10} for AES BBEP-1000/B466 and 3.37×10^{-8} for the EUR-based maximum release levels, and the probability for the occurrence of hereditary diseases is respectively: 1.2×10^{-9} for AP-1000; 3.58×10^{-11} for AES BBEP-1000/B466 and 1.23×10^{-9} for EUR-based maximum release levels, therefore the risk of stochastic effects is negligibly small.

No impact is expected within the 30 km zone of the NPP on the territory of the Republic of Romania.

11.3.3 SUMMARY OF THE POTENTIAL RADIATION RISK IN THE ROMANIAN PART OF THE 30 KM SURVEILLANCE ZONE IN THE EVENT OF AN ACCIDENT

Pursuant to the basic standards for radiation protection (BNRP-2012) and the internationally accepted definitions for the events occurring at nuclear power plants, each unplanned event (including an error in the course of operation, damage to a device or facility, or any other incident) resulting in consequences (or the potential consequences) that cannot be ignored in terms of protection or safety and could lead to potential exposure, is defined as an accident.

The assessment of the impact of environmental risks resulting from the implementation of the investment proposal was carried out regarding:

- ✓ ***Design-based Accidents*** – pursuant to the Regulation on Ensuring the Safety of Nuclear Power Plants (2004), this is the type of accident that has been envisaged in the design of the nuclear power plant, in accordance with specific design limits, including ones for the level of damage to the fuel and the release of radioactive substances into the environment. Safety systems are envisaged in the design in order to counteract any event from this class and re-establish control.
- ✓ ***Severe Accidents*** – pursuant to the Regulation on Ensuring the Safety of Nuclear Power Plants (2004), this is the type of accident that causes significant damage to the active zone.

Chapter 6 reviews the radiation risks related to the operation of the nuclear power plant. To that end each of the two categories of accident conditions – i.e. design-based accidents and severe accidents – has been modelled. The chapter ends with comments on the results from the assessment and their influence for determining the emergency planning zone in the vicinity of the power plant.

The assessment of the accident conditions is divided into the assessment of the so-called design-based accidents and of the so-called severe accidents. These two types of accident conditions differ not only in the probability for their occurrence but also in their development and severity.

The maximum severity that can be reached during design-based accidents is the release of radioactive substances from the coolant of the first circuit and, in limited cases, gas gaps along the casing of the fuel rods. Therefore it becomes clear that the leakage into the hermetic containment represents a negligible amount in comparison with the total inventory of radioactive substances contained in the active zone. That is also why the possible consequences of design-based accidents are much smaller than the ones of severe accidents. According to the INES scale (see below), they are classified at levels 3 and 4.

Severe accidents result in serious damage to the active zone of the reactor. For reactors with pressurized water, this denotes an accident resulting in the melting of nuclear fuel and therefore to the release of radioactive substances from the active zone into the hermetic

containment, and subsequently into the environment. The international scale of the INES classifies these accidents at levels 5 to 7.

The requirement applied during the design of new power plants considerably differ from the old projects in terms of the extended use of protection in depth, both as a preventive measure against severe accidents, and as a means to handle the consequences of such accidents.

A severe accident can only occur after repeated breakdown of the power plant systems or the personnel in the different independent levels of protection in depth, for instance in the event of a failure of the primary cooling system and a subsequent prolonged failure of the external and then of the internal power supply sources.

Nuclear power plants from the new generations are equipped with special systems to counter and control such situations, even though the likelihood of their occurrence is negligibly small. New nuclear power plants are designed in such a manner that the probability for the occurrence of severe accidents is lower than 10^{-5}/reactor.year.

Even at the negligibly small probability for the occurrence of a severe accident where the actual reactor was damaged, a large quantity of radioactive substances could only leak out into the environment if they pass the subsequent hermetic casing (containment). At the same time, the containment is designed in such a way and is equipped with such systems that its integrity would not be compromised even in case of severe accidents, such as interaction of the melted fuel with the concrete, combustion or explosion of hydrogen, interaction of flying objects, overpressure, etc. The cooling of the destroyed active zone and the removal of the heat from the containment is ensured in such a way that it remains intact not only during the accident but a long time after that. A widely recognized international standard on limiting any significant release of radioactive substances into the environment is that the likelihood of the occurrence of such circumstances would be lower than once per 1 000 000 years, i.e. 10^{-6}/reactor.years, which has been ensured at least tenfold for the types of reactors that are being considered.

The possible radiological consequences of a severe accident are limited, as envisaged in the requirements for the safety of the new nuclear sources, in a way ensuring that the release of radioactive substances would cause no severe exposure or damage to the health of the population in close proximity to the nuclear power plant, and would not result in the manifestation of long-term and widespread restrictions involving regulation of food chains, the use of the land or of water areas. Containing radiological consequences should lead to a situation where even in the event of a severe accident there is no need to evacuate the populated zone in close proximity to the power plant, and no other emergency protective measures (shelters, iodine prophylactics) are necessary outside the emergency planning zones of the nuclear power plant.

Even though the release of radionuclides from the fuel into the atmosphere of the containment could continue for up to tens of hours, for the purposes of the calculation we assume the release of the whole quantity at one go, immediately after the occurrence of the

accident. Furthermore, we pessimistically envisage that the whole amount of radionuclides is released from the containment into the environment at a constant rate over 6 hours after the accident, even though in reality that release could last for at least a few days.

As a design-based accident we chose a nuclide vector representing the long-term impact on the environment, containing I-131 and Cs-137. This nuclide vector is based on the European requirements to III-rd generation nuclear power plants (European Utilities Requirements for Light Water Reactors – EUR). Pursuant to the EUR, we have envisaged an accident with a probability close to the value 10^{-6}/year.

TABLE 11.3-5: NUCLIDE VECTOR FOR A DESIGN-BASED ACCIDENT

High altitude release		Ground level release	
Radionuclide	TBq	Radionuclide	TBq
I-131	150	I-131	10
Cs-137	20	Cs-137	1.5

For the generation of the nuclide vector of a severe accident, we took into account the share of the inventory of radionuclides that has leaked out from the damaged fuel to the containment in accordance with the regulations of the U.S. Nuclear Regulatory Commission NUREG-1465.

The share of the radionuclides that have leaked out from the containment, compared to the total amount of radionuclides in the containment (determined in the aforesaid manner) has been chosen in compliance with the requirements applicable to the potential suppliers of the nuclear facility. It is from these requirements that the limit values for Xe-133, I-131 and Cs-137 have been chosen.

The values of the radionuclides released in the environment have conservatively been suggested, using the aforesaid method, as follows:

TABLE 11.3-6: TABLE ON THE ELEMENT OF THE SOURCE OF A SEVERE ACCIDENT

Radionuclide	TBq
Xe-133	770 000
I-131	1 000
Cs-137	30

The values of the remaining nuclear fission products have been recalculated based on the limit values for Cs-137, in direct proportion to their relative concentration against Cs-137 in the atmosphere of the containment. The relevance of this method has been verified via available descriptions of the source of comparable projects.

The following input parameters have been chosen for the calculation of the radiological consequences of the accident conditions:

TABLE 11.3-7: TABLE OF THE INPUT PARAMETERS FOR THE CALCULATION OF THE RADIOLOGICAL CONSEQUENCES UNDER ACCIDENT CONDITIONS

Height of release	**for a design-based accident: 45 m, 100 m for a severe accident: 45 m**
Distribution of iodine forms	aerosol: 5 % organic: 5 % elemental: 90 %
Time of release	6 hours
Heat superelevation of particles	zero

Two meteorological conditions have been chosen for each of the calculations. They were chosen in such a manner that the modelled version would have the worst radiological outcomes. The individual versions of the meteorological conditions differ mostly in terms of wind speed and class of meteorological weather (poss. rain quantity). The class of meteorological weather is given in the so-called Pasquill weather stability scale (Pasquill-Gifford notice).

TABLE 11.3-8: TABLE OF THE INDIVIDUAL VERSIONS OF METEOROLOGICAL CONDITIONS

Scenario version	**1**	**2**
Wind speed [m/s]	5	2
Atmosphere stability class	D	F
Rain quantity [mm/h]	10	0

The short term (48 hours, 7 days, 30 days) exposure of an individual is the sum of the contributions via the following impact pathways:

- external exposure to a cloud,
- inhalation (incl. from resuspension),
- external exposure to radionuclides deposited on the ground.

The calculation of the annual individual exposure dose also includes internal exposure resulting from the consumption of contaminated foodstuffs and water. The effects of the internal irradiation resulting from the ingestion-based annual intake are quantitatively represented through the effective 70-year exposure doses for a child, which is 1-2 year old at the time of the accident (referred to as the “annual ingestion effective dose”). The same principle was used for the calculation of the “lifetime dose”, i.e. the sum total of doses from

external exposure and the exposure doses from a 70-year intake. The following factors have influenced the calculation of the results: disintegration time, age of the person, speed of dry deposition, etc.

Two versions of meteorological conditions have been chosen for the modelling of the effect of a severe accident, and for long-term measures the 1st version was chosen, with the presence of rainfall which increases the impact at short distances.

The radiological results of the analyzed accidents, as evident from the conducted analyses, attest to the acceptability of the environmental risks.

The results from the assessment of design-based accidents show that for an arbitrary hypothetical design-based accident, the exposure of the population does not necessitate the adoption of any emergency protection measures, even within the closest inhabited zone around the NNU.

The modelling of the radiological effects of severe accidents do not show any exceeding of the threshold values for the initiation of emergency protective measures outside existing emergency planning zones of Kozloduy NPP. As far as subsequent protective measures are concerned, even within the closest populated zone around the NNU no permanent migration would be required (the threshold value of the dose 1 mSv would not be exceeded). In this case we should not exclude the possibility for regulation on the distribution and consumption of agricultural product cultivated within 30 km from the source, depending on the direction of pollution.

In conclusion we can summarize that, as expected, more than half of the total exposure would happen along the pathway of ingestion. As a result, the introduction of a short-term restriction to the consumption of locally grown products would have a substantial impact on reducing the accumulated dose.

The actual scope and location of the subsequent protective measures that should be undertaken would depend on the movement and development of the accident and the actual meteorological conditions, and in the case of long-term measures – on the complex monitoring on the affected territory.

11.3.4 SUMMARIZED ASSESSMENT OF THE POSSIBLE CUMULATIVE RADIATION RISK IN THE ROMANIAN PART OF THE 30 KM SURVEILLANCE ZONE

A detailed assessment has been presented in **Chapter 5 – CUMULATIVE EFFECT, item 5.11**.

In order to assess the cumulative effect, an analysis has been conducted on the radiation exposure of the population within the 30 km zone of Kozloduy NPP in terms of gaseous, aerosol and liquid radioactive releases into the environment under all operational conditions from the existing facilities at the NPP site (units 5 and 6, the SFSP, the NRSF), the facilities of the Specialized Division "RAW-Kozloduy" and the future activities on the decommissioning of units 1÷4, including the Size Reduction and Decontamination Facility (SRDF), the Plasma Melting Facility (PMF), the NRSF – "Radiana" site, and the NNU.

According to the Environmental Impact Assessment Report on the NRRAW, there is no release of radioactive material in the atmosphere and in discharged water under all operational conditions.

The assessment of the risk of radioactive releases on the population includes:

- ✓ Assessing the individual and collective doses for the population;
- ✓ Assessing the radiobiological effects and the radiation risk.

The following impact pathways have been taken into account for the assessment of the external and internal exposure of the population in the region:

- ✓ External exposure to a radioactive cloud;
- ✓ External exposure resulting from depositions on ground surface;
- ✓ Internal exposure by inhalation;
- ✓ Internal exposure via the consumption of radioactive contaminated foodstuffs.

The assessment of the external and internal exposure of the population in the NNU region to **liquid releases** takes into account the following impact pathways:

- ✓ staying in the water of the Danube River – external exposure during swimming and boating;
- ✓ contact with the riverside sediment of the Danube River – external exposure resulting from riverbed sediments and stay on the beach;
- ✓ ingestion of products (fish) from the water of the Danube River – internal exposure as a result of fish consumption;
- ✓ stay on territories irrigated with water from the Danube River – external exposure;
- ✓ ingestion of plant products, irrigated with water from the Danube River (fruits, vegetables, etc.) – internal exposure;
- ✓ ingestion of meat and milk from animals using drinking water from the Danube River – internal exposure;
- ✓ Ingestion of meat and milk from animals, fed with fodder irrigated with water from the Danube River – internal exposure;
- ✓ usage of drinking water – internal exposure.

Assessments of the radiation risk encompass the following range:

1. Risk of radiation-induced cancer for the general population and individuals of working age;
2. Risk of hereditary diseases for the general population and individuals of working age;
3. Risks of and damage to certain tissues in the general population;
4. Risks of hereditary diseases for the first generation and for two generations;

5. Risks of hereditary diseases for the reproductive part of the population, estimated for two generations, resulting from exposure of the first generation before the second one;
6. Risks of hereditary diseases for the reproductive part of the population, estimated for the first generation after the exposure.

11.3.4.1 DOSES OF GASEOUS AND AEROSOL RELEASES

The cumulative effect in the event of different sources of gaseous and aerosol releases has been presented in **Table 11.3-9** and **Figure 11.3-28** and **Figure 11.3-29**.

TABLE 11.3-9: CUMULATIVE EFFECT WITHIN THE 30 KM ZONE FROM GASEOUS AND AEROSOL EMISSIONS

Source Description	Collective effective dose [manSv]	Individual effective dose [Sv]
"Kozloduy" NPP 2012 + SE1-4 + PMF	$2.65.10^{-2}$	$1.10.10^{-8} – 1.33.10^{-6}$
"Kozloduy" NPP 2012 + SE1-4 + PMF + AP 1000	$4.58.10^{-2}$	$4.20.10^{-8} – 1.93.10^{-6}$
"Kozloduy" NPP 2012 + SE1-4 + PMF + AES BBEP-1000/ B466	$2.67.10^{-2}$	$1.12.10^{-8} – 1.35.10^{-6}$
"Kozloduy" NPP 2012 + SE1-4 + PMF + EUR release limits	$5.14.10^{-2}$	$3.56.10^{-8} – 1.94.10^{-6}$

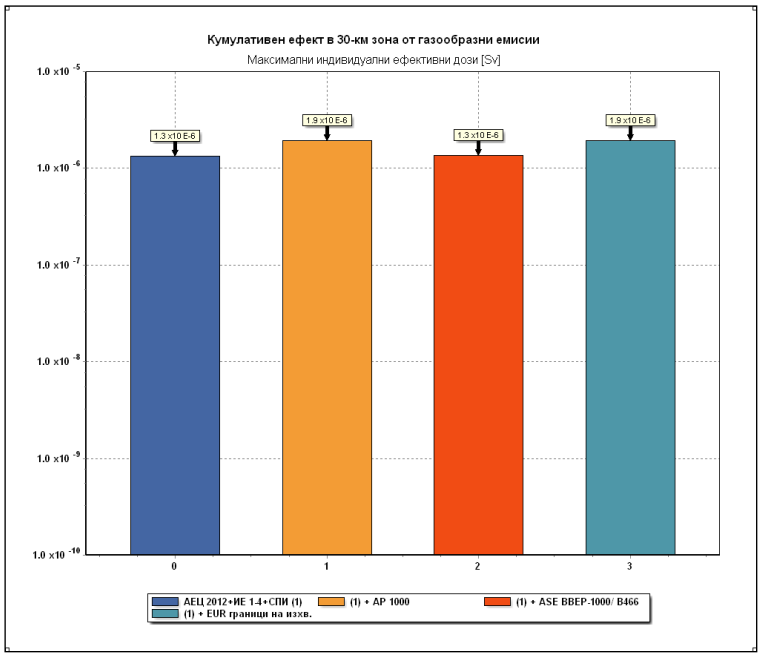


FIGURE 11.3-28: MAXIMUM INDIVIDUAL EFFECTIVE DOSES (SV) OF GASEOUS AND AEROSOL RELEASES

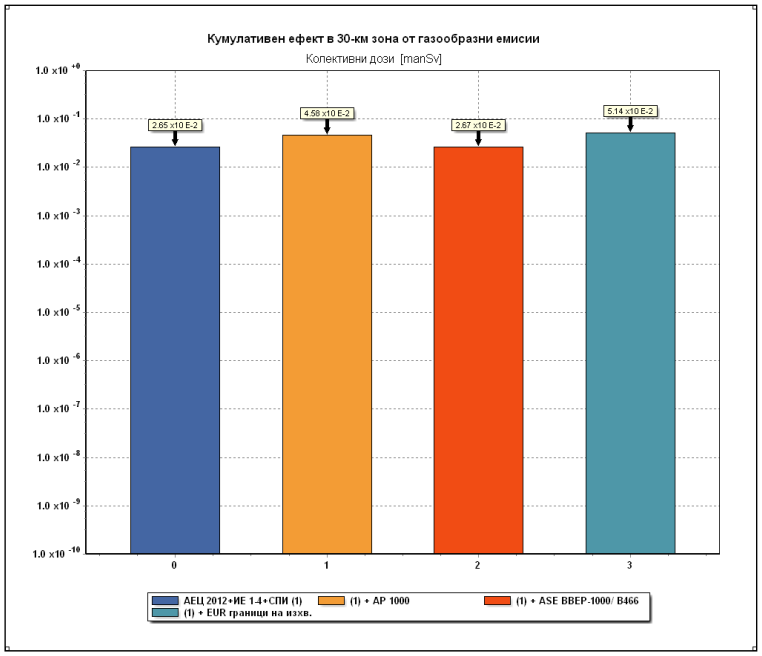


FIGURE 11.3-29: COLLECTIVE DOSES (MANSV) FROM GASEOUS AND AEROSOL RELEASES

11.3.4.2 DOSES FROM LIQUID RELEASES

The assessment of the exposure doses from liquid releases uses a model of complete mixing in the Danube River and does not distinguish between the left and the right bank. Based on this, it is claimed that the estimated doses for the respective kilometer are identical for both banks. The critical group from the population includes *settlements* downstream along the Danube River – the town of Oryahovo, the village of Leskovets, the village of Ostrov and the village of Gorni Vadin.

TABLE 11.3-10: CUMULATIVE EFFECT WITHIN THE 30 KM ZONE FROM LIQUID EMISSIONS

Source Description	Collective effective dose [manSv]	Individual effective dose [Sv]
"Kozloduy" NPP 2012 + SE1-4	$4.47.10^{-3}$	$3.42.10^{-7}$ – $6.37.10^{-7}$
"Kozloduy" NPP 2012 + SE1-4 + AP 1000	$1.18.10^{-2}$	$7.74.10^{-7}$ – $1.63.10^{-6}$
"Kozloduy" NPP 2012 + SE1-4 + EUR release limits	$6.92.10^{-3}$	$5.13.10^{-7}$ – $9.44.10^{-7}$
"Kozloduy" NPP 2012 + SE1-4 + AES BBEP-1000/B466	$6.12.10^{-3}$	$4.62.10^{-7}$ – $8.62.10^{-7}$

The cumulative effect from all sources of liquid releases is presented in **Table 11.3-10** and **Figure 11.3-30** and **Figure 11.3-31**.

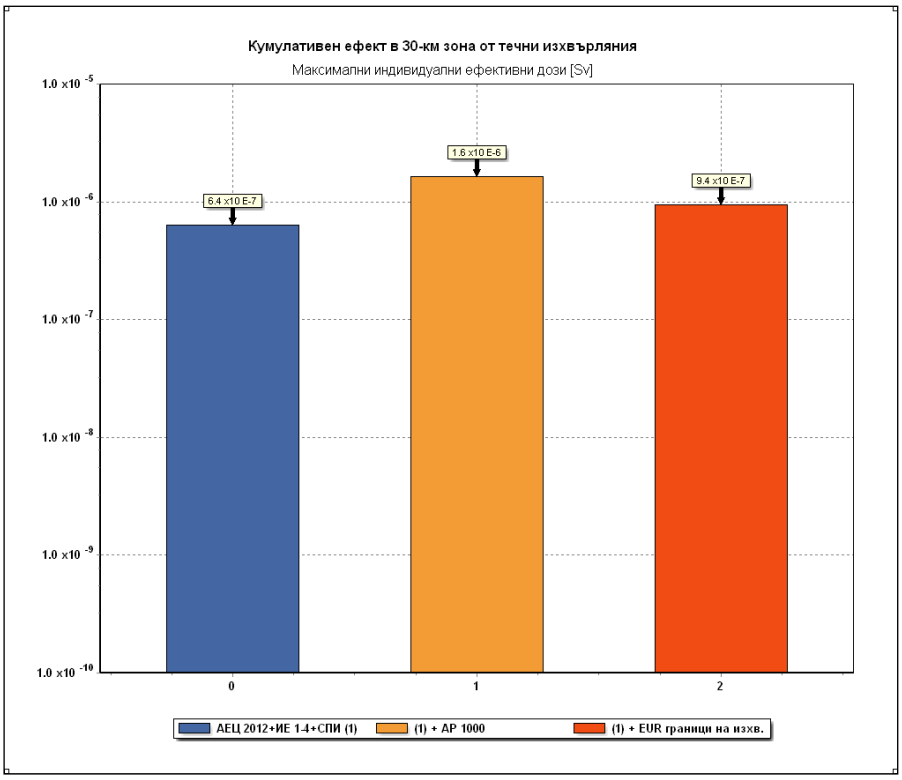


FIGURE 11.3-30: MAXIMUM INDIVIDUAL EFFECTIVE DOSES (SV) FROM LIQUID RELEASES

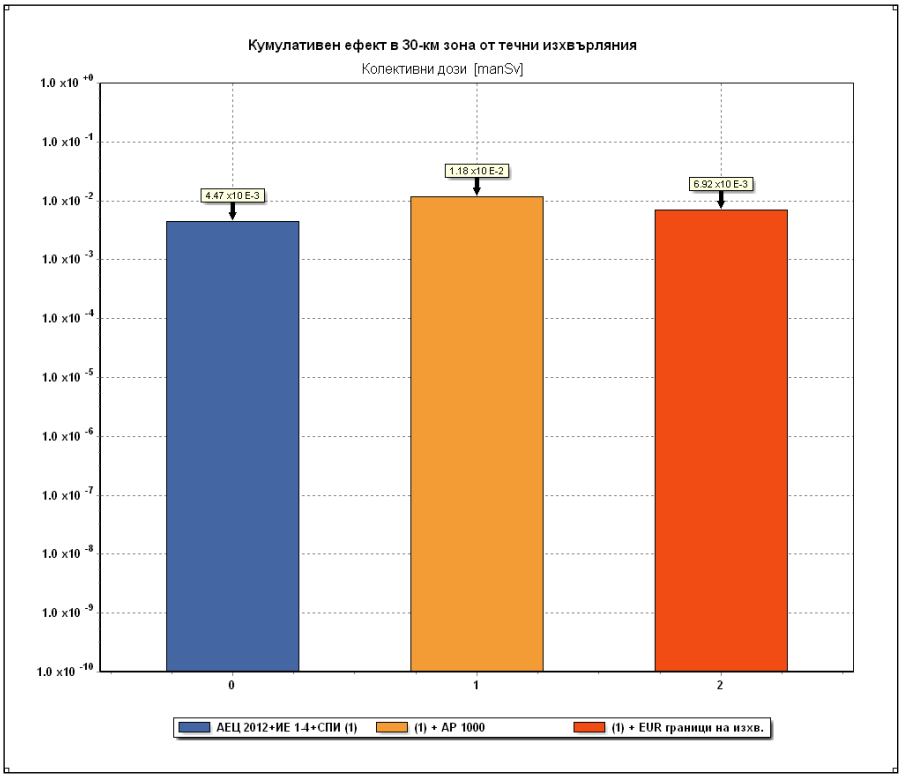


FIGURE 11.3-31: COLLECTIVE DOSES (MANSV) FROM LIQUID RELEASES

The maximum annual effective dose for the population within the 30 km zone of Kozloduy NPP, caused only by aerosol emissions under all operating conditions of the existing and the new nuclear capacities, was established to be 1.94 μSv/a. This is just 0.08% of the exposure from the natural radiation background of the country (2.33 mSv/a) and 0.2% of the norm for the population (1 mSv/a) BNRP-2012.

The maximum annual effective dose for the population within the 30 km zone of Kozloduy NPP, caused only by liquid emissions under all operating conditions of the existing and the new nuclear capacities, was established to be 1.63 μSv/a.

The exposure is negligible and is under 0.16 % of the annual effective dose limit of 1 mSv (BNRP-2012) and thousand times lower than the natural background exposure (2.33 mSv/a).

TABLE 11.3-11: CUMULATIVE EFFECT WITHIN THE 30 KM ZONE FROM GASEOUS, AEROSOL AND LIQUID EMISSIONS

Source Description	Maximum individual effective dose from gaseous and aerosol emissions	Maximum individual effective dose from liquid emissions	Maximum individual effective dose – Total
	[Sv]		
"Kozloduy" NPP 2012 + SE1-4 + PMF + AP 1000	1.93E-06	1.63E-06	3.56E-06
"Kozloduy" NPP 2012 + SE1-4 + PMF + AES BBEP-1000/ B466	1.35E-06	8.62E-07	2.21E-06
"Kozloduy" NPP 2012 + SE1-4 + PMF + EUR release limits	1.94E-06	9.44E-07	2.88E-06

Pursuant to guidelines by the BNRA, given in letter № 47-00-171/12.02.2013, under all operating conditions of Kozloduy NPP, the annual individual effective dose from internal and external exposure of the population, caused by the impact of liquid and gaseous releases in the environment for all units and facilities which already are located and will be located at the Kozloduy NPP site, must not be higher than 0.25 mSv. The maximum annual effective dose for the population within the 30 km zone of Kozloduy NPP (cumulative effect), resulting from the liquid, gaseous and aerosol emissions to the environment, has been established to be 3.56 μSv/a, which is much lower than the 250 μSv/a quota and the 1 mSv/a limit value applicable to the population (BNRP-2012) and which is below the 10 μSv/a level for release of control (BNRP-2012). The additionally received radiation exposure is about 500 times lower than the one of the natural radiation background (2.33 mSv).

11.3.4.3 RADIOBIOLOGICAL EFFECTS AND RADIATION RISK TO THE REFERENCE INDIVIDUAL

The completed assessments on the cumulative dose impact of the existing and the new nuclear capacities are completely comparable with the global practice, according to official UN data (UNSCEAR-2000, 2008).

According to data of the National Statistical Institute from the census conducted on 01.02.2011, the population within the 30 km zone around Kozloduy NPP on the territory of Bulgaria amounted to 65 994 people, and on the territory of Romania it is 75 150 people. The following conclusions can be drawn about the aforesaid population regarding the radiobiological effects and the radiation risk as a result from the cumulative impact of the existing and the new nuclear capacities:

Deterministic effects

There is no risk of the development of deterministic effects for the population within the 30 km zone of Kozloduy NPP.

Individual doses of gaseous and aerosol releases, as a cumulative number for all nuclear facilities and the NNU, are within the range $1.35x10^{-6} \div 1.94x10^{-6}$ Sv (See **Table 11.3-9**).

These doses are much lower than the threshold level established by Art. 10 of the BNRP as a maximum annual effective dose, which is 1 mSv for the population.

Based on the above, we can state that there is no risk of the development of deterministic effects for the population within the 30 km zone of the NPP.

Stochastic effects

The risk of stochastic effects is negligibly small.

The probability for the occurrence of radiation-induced cancer for the whole population is respectively: $1.06x10^{-7}$ for the existing nuclear capacities + AP-1000; $7.43x10^{-8}$ for the existing nuclear capacities + AES BBEP-1000/B466 and $1.07x10^{-7}$ for the existing nuclear capacities + EUR-based maximum release limits, and the probability for the occurrence of hereditary diseases is respectively: $3.86x10^{-9}$ for the existing nuclear capacities + AP-1000; $2.7x10^{-9}$ for the existing nuclear capacities + AES BBEP-1000/B466 and $3.88x10^{-9}$ for the existing nuclear capacities + EUR-based maximum release limits.

11.3.5 SUMMARY OF THE POTENTIAL IMPACT OF THE IMPLEMENTATION OF THE NNU ON BIODIVERSITY IN THE ROMANIAN PART OF THE 30 KM SURVEILLANCE ZONE

11.3.5.1 FLORA

Both in the Bulgarian and in the Romanian part of the 30 km surveillance zone the implementation of the NNU is not expected to cause any negative impact on the flora and the natural habitats, due to the absence of air, water and soil pollution by harmful emissions, as well as due to the absence of any radioactive and light pollution.

11.3.5.2 FAUNA

In the Romanian part of the 30-kilometer surveillance zone, the implementation of the NNU is not expected to cause any significant negative impact on the fauna, due to the absence of air, water and soil pollution by harmful emissions, as well as due to the absence of any radioactive, noise and light pollution.

11.3.5.3 IMPACT FROM THE IMPLEMENTATION OF THE NNU ON TARGET SPECIES IN THE PROTECTED AREAS FROM NATURA 2000 IN THE ROMANIAN PART OF THE 30 KM SURVEILLANCE ZONE

11.3.5.3.1 ROSPA0010 Bistreț (Bistrets)

No significant negative impact is expected from the implementation of the NNU on the target species within the protected area due to the absence of air, water and soil pollution by harmful emissions, as well as due to the absence of any radioactive, noise and light pollution.

The terrain of the IP is outside the borders of the protected area, and that is why no changes are expected to the structure, functioning, fragmentation and species composition.

Positive effects have been documented due to the thermal pollution of the Danube River from Kozloduy NPP, on fish-eating birds, among which there are globally endangered species such as the Dalmatian Pelican (*Pelecanus crispus*).

11.3.5.3.2 ROSPA0023 Confluență Jiu-Dunăre (Merger of the Jiu River and the Danube River)

No significant negative impact is expected from the implementation of the NNU on the target species within the protected area due to the absence of air, water and soil pollution by harmful emissions, as well as due to the absence of any radioactive, noise and light pollution.

The terrain of the IP is outside the borders of the protected area, and that is why no changes are expected to the structure, functioning, fragmentation and species composition.

Positive effects have been documented due to the thermal pollution of the Danube River from Kozloduy NPP, on fish-eating birds, among which there are globally endangered species such as the Dalmatian Pelican (*Pelecanus crispus*).

11.3.5.3.3 ROSPA 0135 Nisipurile de la Dăbuleni (Sands of Dabuleni)

No significant negative impact is expected from the implementation of the NNU on the target species within the protected area due to the absence of air, water and soil pollution by harmful emissions, as well as due to the absence of any radioactive, noise and light pollution.

The terrain of the IP is outside the borders of the protected area, and that is why no changes are expected to the structure, functioning, fragmentation and species composition.

11.3.5.3.4 ROSCI0045 Coridorul Jiului (Jiu River corridor)

No significant negative impact is expected from the implementation of the NNU on the target invertebrate animals, fish, amphibians, reptiles and mammals within the protected area due to the absence of air, water and soil pollution by harmful emissions, as well as due to the absence of any radioactive, noise and light pollution.

11.3.5.4 CUMULATIVE IMPACT IN COMBINATION WITH OTHER PROJECTS IMPLEMENTED AT THE PROPOSED SITE AND ITS VICINITY, WHICH MAY BE HARMFUL TO THE NATURAL CAPITAL OF THE TWO COUNTRIES

The nature of the existing industrial structure, the energy and transport infrastructure within the 30 km zone of Kozloduy NPP has a missing or predominantly low level of cumulative impact on biodiversity and the target habitats and species within the protected areas, both on the Bulgarian and the Romanian side. With regard to each of the four sites under consideration, the primary and most significant industrial installation is the existing power plant and its facilities.

The distance between the boundaries of the protected areas on the Romanian side and each of the four alternative sites for the NNU is sufficient. As a result, we expect no direct cumulative impact by direct destruction or damage to habitats and species (resp. withdrawal of areas from them and from the zones).

According to the information contained in letter №615/RP/15.03.2013 by the Ministry of Environment and Climate Change of the Republic of Romania, there are no investment plans for the Romanian side of the 30 kilometer surveillance zone. In this sense, the NPP is the main industrial site within the 30 km zone of the 4 sites under consideration. The site of the existing power plant houses various facilities that will not have any significant cumulative impact on the Romanian protected areas. The elements of the IP outlined above lead to the conclusion that they cannot exhibit neither direct nor indirect impact, due to the fact that they are not located within the protected areas and are not sources of environmentally harmful emissions.

The data from the ongoing environmental non-radiation and radiation monitoring for recent years also support the conclusion that no cumulative impact is expected.

Based on the above, we can draw the conclusion that no significant negative impact on the examined territory is expected from the implementation of the NNU, as well as cumulative effect on biodiversity and the target species within the four protected areas – ROSPA0010 Bistreț (Bistrets), ROSPA0023 Confluență Jiu-Dunăre și (Merger of the Jiu River and the Danube River), ROSPA 0135 Nisipurile de la Dăbuleni și (Sands of Dabuleni), ROSCI0045 Coridorul Jiului (Jiu River corridor).

No impact is expected from the implementation of the NNU within the 30 kilometer monitoring scope, as well as on the integrity of the four protected areas – ROSPA0010 Bistreț (Bistrets), ROSPA0023 Confluență Jiu-Dunăre și (Merger of the Jiu River and the Danube River), ROSPA 0135 Nisipurile de la Dăbuleni și (Sands of Dabuleni) and ROSCI0045 Coridorul Jiului (Jiu River corridor) – in terms of their structure, functions and conservation purposes. No transboundary impact is expected.

11.3.6 COMPARATIVE MEASUREMENT OF THE GAMMA RADIATION BACKGROUND WITHIN THE 30 KM ZONE

For the purpose, the biodiversity team conducted measurements to determine the natural radiation background and air radioactivity within the 30 km surveillance zone around Kozloduy NPP. They made instrumental measurements of the radiation gamma background of the four alternative sites for the implementation of the NNU and of selected locations within the protected areas under Natura 2000 – BG0002009 "Zlatiyata", BG0000533 "Kozloduy Islands ", BG0000614 "Ogosta River " BG0000336 "Zlatiya" in Bulgaria and ROSPA0023 "Jiu River – Danube River valley", ROSCl0045 "Jiu River corridor ", ROSPA00l0 "Bistrets River" and ROSPA 00135 "Sands of Dabuleni" in Romania using a mobile dosimeter "Radioscope" Massag Sensoric GmbH, Basel, Switzerland. The results are presented in **Figure 11.3-32**.

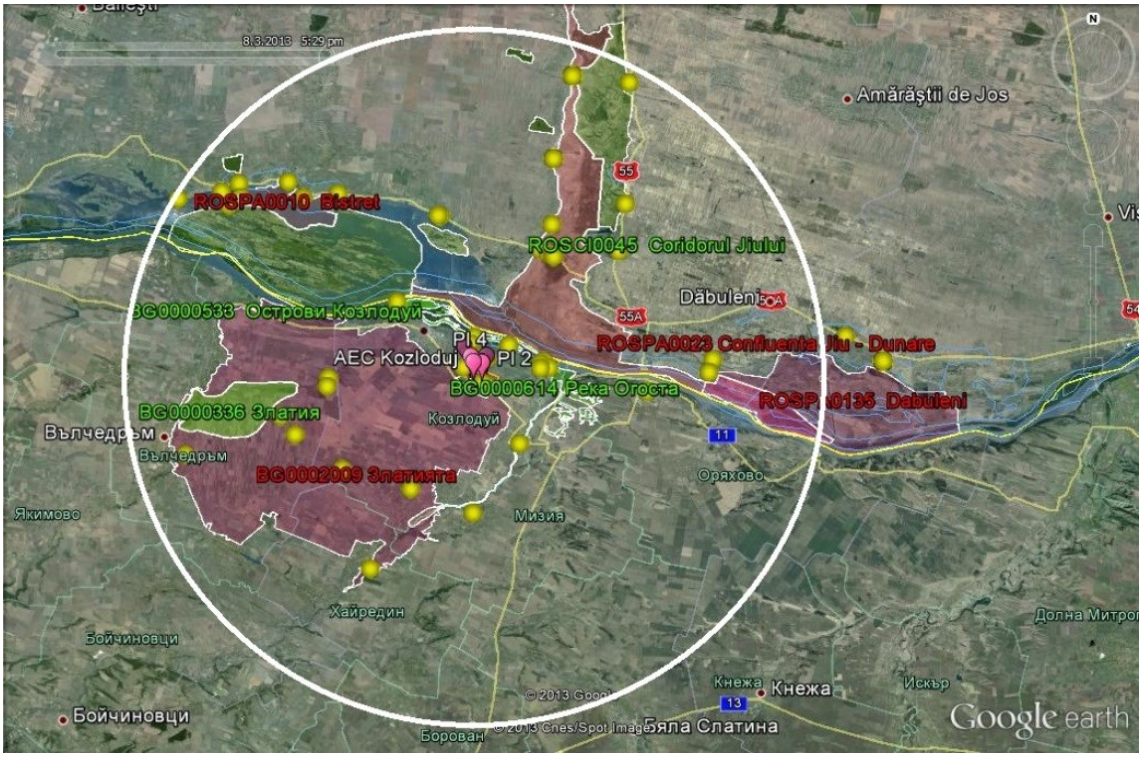


FIGURE 11.3-32: LOCATIONS OF CONDUCTED MEASUREMENTS OF THE GAMMA BACKGROUND WITHIN THE 30 KM SURVEILLANCE ZONE AROUND KOZLODUY NPP

The comparison of the measurement results shows insignificant differences which fall within the permissible error of the device used.

The average values of the gamma background are presented in **Table 11.3-12** and **Table 11.3-13**:

TABLE 11.3-12: AVERAGE VALUES OF THE NATURAL RADIATION BACKGROUND AND AIR RADIOACTIVITY WITHIN THE 30 KM SURVEILLANCE ZONE AROUND THE KOZLODUY NPP IN BULGARIA

Location	Geographic coordinates:	Average values of the gamma background μSv/h
"Kozloduy" NPP checkpoint	-	0.140
Site 1	43°45'33.2"N 23°46'39.9"E	0.084
Site 2	43°44'20.1"N 23°47'03.9"E	0.080
Site 3	43°45'02.2"N 23°45'53.2"E	0.078
Site 4	-	
Territory of Kozloduy NPP beyond the four sites	43°45'47.7"N 23°46'22.2"E	0.084
Outlet channel	43°44'59.9"N 23°50'48.7"E	0.103
ТК2 station	43°44'59.9"N 23°50'48.7"E	0.084
Onshore Pump Station	43°45'01.4"N 23°51'21.3"E	0.074
"Zlatiyata" PA	-	0.098
Ribaritsa River	-	0.069
Valchedram	43°40'55.9"N 23°28'05.7"E	0.084
"Shishmanov Val" Dam	43°44'31.8"N 23°37'14.3"E	0.100
Village of Hayredin	43°39'22.9"N 23°42'31.3"E	0.090
"Ogosta River" PA	43°41'29.5"N 23°49'28.7"E	0.086
Village of Sofronievo	43°38'16.0"N 23°46'29.7"E	
"Ostrov" PA	-	0.077
"Kozloduy Islands" PA	43°46'03.7"N 23°48'47.0"E	0.074
Drainage areas, Kozloduy swamp	43°45'11.8"N 23°50'47.5	0.073

TABLE 11.3-13: AVERAGE VALUES OF THE NATURAL RADIATION BACKGROUND AND AIR RADIOACTIVITY WITHIN THE 30 KM SURVEILLANCE ZONE AROUND KOZLODUY NPP IN ROMANIA

Location	Geographic coordinates:	Average values of the gamma background μSv/h
ROSPA00l0 "Bistrets River" near Javal	43°50'13.3"N 23°51'35.2"E	0.085
Bistrets Lake	43°52'50.2"N	0.084

Location	Geographic coordinates:	Average values of the gamma background μSv/h
	23°27'30.5"E	
Bistrets Lake	43°52'55.0"N 23°31'32.9"	0.088
Desnatsuy River	43°53'38.9"N 23°34'35.8"E	0.080
"Isolda" farm	43°52'55.0"N 23°35'33.1"E	0.078
Rice paddies	43°52'06.1"N 23°44'13.8"E	0.086
Forest near the Jiu River	43°50'31.7"N 23°50'46.2"E	0.085
ROSCl0045 "Jiu River corridor " Malu Mare	44°12'58.8"N 23°51'49.5"E	0.093
Rojitse	44°03'17.2"N 23°56'19.6"E	0.093
Murta	43°58'17.0"N 23°56'31.5"E	0.084
Jinjova	43°54'44.7"N 23°51'38.7"E	0.083
Gomosteni	43°51'41.1"N 23°51'32.4"E	0.092
Javal	43°50'29.8"N 23°50'50.0"E	0.092
ROSPA0023 "Jiu River – Danube River valley" Jiets Leshtava	43°50'26.6"N 23°55'50.7"E	0.090
Pisku Sadoven	43°52'38.3"N 23°56'16.1"E	0.084
ROSPA 00135 "Sands of Dabuleni"	43°44'47.9"N 24°01'36.7"E	0.086
Dabuleni-east	43°45'16.6"N 24°12'45.7"E	0.111

The obtained results on the potency of the equivalent dose of gamma radiation are within the range from 0.10 to 0.19 μSv/h, which are similar to the ones measured in recent years. This implies that **this background will remain within the same range, both during construction and during the operation and decommissioning.**

No impact is expected from the implementation of the NNU within the 30 kilometer monitoring scope, as well as on the integrity of the four protected areas – ROSPA0010 Bistreț (Bistrets), ROSPA0023 Confluență Jiu-Dunăre și (Merger of the Jiu River and the Danube River), ROSPA 0135 Nisipurile de la Dăbuleni și (Sands of Dabuleni) and ROSCI0045 Coridorul Jiului (Jiu River corridor) – in terms of their structure, functions and conservation purposes. No transboundary impact is expected.

11.3.6.1 MEASURES TO REDUCE THE IMPACT ON BIODIVERSITY AND THE PROTECTED AREAS WITHIN THE ROMANIAN PART OF THE 30 KM SURVEILLANCE ZONE AROUND KOZLODUY NPP AND THE IMPACT OF RESIDUAL EFFECTS AFTER THEIR IMPLEMENTATION

Based on the assessments presented above, we can draw the conclusion that there is no need to prescribe measures to reduce the negative impact on biodiversity, and there is no need to prescribe measures to reduce the negative impact on the protected areas within the Romanian part of the 30 km surveillance zone around the Kozloduy NPP.

11.3.6.1.1 Methodological basis for the monitoring on invasive alien invertebrate animals and fishes

Standard methods are already being used. Additionally, it is necessary to take plankton samples – for planktonic larvae (of *Dreissena*, *Corbicula fluminea*), as well as to examine all suitable substrates for adult fouling organisms (for example *Dreissena*): piers, harbor walls, hydraulic facilities and boats. Invasive species inhabiting soft bottoms (for example A. woodiana) are handled using bottom dredges, incl. malacological ones.

It is recommended to investigate:

- ✓ the presence of aquatic invasive alien species – larvae, adult individuals, live, shells, druses, fouling, etc.
- ✓ the quantitative parameters – density of the invasive populations, size of the colonies / druses, extent of coverage, etc.
- ✓ the population dynamics – increase / decrease the range, density, extent of coverage, etc.
- ✓ the protected species of aquatic invertebrates or fishes, in order to monitor the state of their populations as a result of the potential impact of invasive species.

11.3.6.1.2 Monitoring frequency

For the Danube River it is recommended that samples should be collected twice a year – during high waters (spring) and during low waters (summer-autumn); if necessary – that is if new invasive species are introduced – possibly even more often, several times during the construction and after its completion.

11.3.6.1.3 Monitoring locations

In the Danube River samples must always be taken from the point of discharge of the two hot (outlet) channels, as well as at least 2 additional stations – situated above and below the NPP area. It is admissible to use other locations or the addition of more measurement points, in the vent that new invasive species are introduced.

The regular mechanical cleaning of the hot channels, especially in the event of blooms, fouling, clusters of clams, etc.

Fouling should be cleaned up from the fuel ships, anti-fouling coatings should be used for their hulls, ship waters for technical purposes must be disposed in special containers and never in the Danube River or the channels.

11.3.7 RAW MANAGEMENT SYSTEM

Operational RAW from the Kozloduy NPP site is stored in the different facilities for unprocessed, processed or conditioned storage, which does not limit the possible options for their subsequent processing, release and/or disposal. The approach adopted since 2005 by Kozloduy NPP for the management of RAW is cantered around transferring all currently generated RAW from categories 2-I and 2-II to the "RAW" State Enterprise for treatment, and gradually eliminating all historically accumulated RAW. The implemented set-up for the management of RAW streams is in compliance with the regulations on the safe management of RAW, operating with sources of ionizing radiation and staff radiation protection, environmental protection requirements and the terms and conditions envisaged in the respective licenses and permits, issued to "Kozloduy NPP" EAD and the "RAW" State Enterprise.

11.3.7.1 KEY DOCUMENTS IN THE AREA OF RAW MANAGEMENT

National legislation:

- ✓ Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management, ratified by the Republic of Bulgaria by law, SG, issue 42/23.05.2000;
- ✓ Act on the Safe Use of Nuclear Energy – 01.07.2012;
- ✓ Regulation on the Basic Radiation Protection Standards – 05.10.2012;
- ✓ Strategy for the Management of Spent Nuclear Fuel and Radioactive Waste by 2030, adopted by a decision of the Council of Minister of 05.01.2011;
- ✓ Regulation on the Safe Management of RAW – 17.08.2004;
- ✓ Regulation on Radiation Protection During Activities with Sources of IR – 24.08. 2004, amended and supplemented on 08.10.2012;
- ✓ Regulation on the Conditions for the Transfer of RAW to SE "RAW" of 23.07.2004;
- ✓ Regulation for the conditions and procedure for establishing of special-statutory areas around nuclear facilities and facilities with sources of ionizing radiation – 06.08.2004, amended by SG issue 46 of 12.06.2007;
- ✓ Regulation on the Assessment, Collection, Spending and Control Over the Funds and Outstanding Contributions to the "RAW" Fund;
- ✓ Regulation on safety during decommissioning of nuclear facilities of 20.08.2004;
- ✓ Regulation on Ensuring the Safety of Nuclear Power Plants – 30.07.2004, amended by SG issue 46 of 12.06.2007.

IAEA documents:

- ✓ SS-115. International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources, 1996.
- ✓ 111-F. The Principles of Radioactive Waste Management, 1995.
- ✓ 111-G–1.1. Classification of Radioactive Waste, 1994.
- ✓ NS-G-2.7. Radiation Protection and Radioactive Waste Management in the Operation of Nuclear Power Plants, 2002.
- ✓ IAEA TECDOC-1492- Improvements of RW management at WWER NPP's – April 2006.

11.3.7.2 CATEGORIES OF RAW IN KOZLODUY NPP

The RAW categories in Kozloduy NPP are in compliance with Art. 5 of the Regulation on RAW Management Safety, SG issue 72 from 17.08.2004.

- ✓ **Category 1 –** transient RAW which can be released from control after appropriate treatment and/or temporary storage for no more than 5 years, which reduces its specific activity below the levels for release from control pursuant to the established criteria;
- ✓ **Category 2 –** low and intermediate level waste, containing radionuclides in concentrations that do not require any special measures to remove emitted heat during storage and disposal; radioactive waste from this category is further subdivided into:
  a) Category 2a – short-lived low and intermediate level waste, containing mostly short-lived radionuclides (with half-life shorter or equal to the half-life of Cs-137), and long-lived alpha-activity radionuclides with specific activity smaller than or equal to 4.10^6 Bq/kg for each individual package and smaller than or equal to 4.10^5 Bq/kg within the whole volume of RAW;
  b) Category 2b – long-lived low and intermediate level waste, containing long-lived alpha-activity radionuclides (with half-life longer than to the half-life of Cs-137) with specific activity exceeding the boundaries of category 2a.
- ✓ **Category 3** – high level waste, where the concentration of radionuclides is such that heat release must be taken into account for the storage and disposal.

Due to the specifics of the units at the site of "Kozloduy NPP" EAD, and in particular the operation of units with PWR reactors, the RAW resulting from the operation process and historically stored is mostly category **2a** RAW (short-lived low and intermediate level RAW), containing short-lived radionuclides (with half-life shorter than or equal to $\mathbf{T}_{1/2}$ of **Cs-137**), and long-lived alpha-activity radionuclides with specific activity up to 4.10^6 Bq/kg for each individual package.

In connection with the specific characteristics of the methods utilized for the processing of RAW and in compliance to Art. 7 of the Regulation on the Safe Management of RAW,

additional categories of RAW have been introduced for the site of "Kozloduy NPP" EAD. The additional categories further subdivide category 2a envisaged in the aforesaid Regulation and pertain to operationally measurable parameters within limits proposed by the "RAW" State Enterprise and in compliance with the procedure of the "RAW" SE for acceptance of RAW from Kozloduy NPP. The following two main groups have been developed:

- ✓ Additional categories of solid RAW (category 2a)
  - 2-I category – with an equivalent dose of gamma radiation at a distance of 0.1 m from the surface of the waste amounting to 1μSv/h to 0.3 mSv/h;
  - 2-II category – with an equivalent dose of gamma radiation at a distance of 0.1 m from the surface of the waste amounting to 0.3 mSv/h to 10mSv/h;
  - 2-III category – with an equivalent dose of gamma radiation at a distance of 0.1 m from the surface of the waste above 10mSv/h;

Solid RAW from each of the aforesaid additional categories is characterized as compactable (textile, wadding and waste, based on polyvinylchloride, polyethylene and other plastics) and non-compactable (metals, wood, construction materials, etc.).

- ✓ Additional categories of liquid RAW:
  - 2 – H category – with activity up to 3.7E+5 Bq/l;
  - 2 – C category – with activity from 3.7E+5 Bq/l to 7.2E+7 Bq/l;
  - 2 – B category – with activity above 7.2E+7 Bq/l.

The lower activity levels for the 2-H category depend on the radionuclide composition and the levels of unconditional release of the respective radionuclide (resp. mixture of radionuclides), regulated by the "Regulation on Radiation Protection During Activities Involving Sources of Ionizing Radiation" – 24.08.2004, amended and supplemented on 08.10.2012.

Liquid RAW from each of the additional categories, depending on their origin, can be characterized as:

- ✓ liquid radioactive concentrate
- ✓ ion-exchange resins
- ✓ sludges and sediments
- ✓ oils

11.3.8 OUTLINE OF THE RAW MANAGEMENT ACTIVITIES AT KOZLODUY NPP SITE AND THEIR TECHNOLOGICAL SEQUENCE[45]

11.3.8.1 SOLID RAW

- ✓ Pre-processing of solid RAW within the Controlled Area – includes the activities on the collection, separation (pre-sorting) and transfer to the delivery points. The main principle is the separate collection/sorting.
- ✓ In the controlled areas there are waste collection points, operating in adherence to established operational documents, as well as waste pre-sorting points – where waste is sorted based on their radiometric and physical characteristics.
- ✓ Processing of solid RAW – conducted at the RAWPP of the "RAW-Kozloduy" Specialized Division (SD). The main purpose of the solid RAW processing line is to reduce the volume of the incoming low and intermediate RAW from categories 2-I and 2-II, and to prepare it for conditioning. The technological process is based on the operational principles of stream positioning, direct RAW streaming, rhythmicity and relative synchronization in the performance of the main technological operations, and an optimal degree of mechanization and automation. The primary stages in the processing of solid RAW are:
  - Acceptance of solid RAW at the RAWPP,
  - Separation of solid RAW at the RAWPP – done on the basis of physical and radiometric characteristics, in three stages:
    - preliminary separation of large and heavy RAW;
    - separation of the RAW, based on physical and radiometric characteristics and loaded into 200 l barrels;
    - transfer of the barrels for further loading.
- ✓ Compressing solid RAW into 200 l barrels, using a --50 t press,
- ✓ Crushing of solid RAW,
- ✓ Packing of solid RAW into 200 l barrels,
- ✓ Compressing the barrels with solid RAW, using a 950t press.

11.3.8.2 LIQUID RAW

The extraction and transportation of liquid RAW from units 1÷4 to the RAWPP of the "RAW-Kozloduy" Specialized Division is carried out via a specialized vehicle – a bottom-carrier tank-truck, with ongoing radiation control before and after the loading of the tank-truck at the RAWPP, including a gamma cartogram of the room and the tank-truck.

[45] Comprehensive program for the management of RAW by " Kozloduy NPP" EAD

The acceptance of liquid RAW from units 5 and 6 is carried out via a direct pipeline link, with ongoing radiation control before and after the acceptance of the bottom, including a gamma cartogram of the technological tunnel.

When liquid RAW is accepted, it is analyzed in terms of chemical and radionuclide contents.

The preliminary processing and conditioning of liquid RAW is done at the RAWPP, using a separate line – "Liquid RAW". The technology for the reduction of the volume of liquid RAW involves a duplex evaporator and concentrator, followed by cementing into RRCs.

11.3.8.3 PACKING OF RAW

The process is based on a reinforced concrete container, specifically licensed by the BNRA. The packing of category 2-I and 2-II solid RAW is done depending on its radionuclide characteristics, in a differentiated manner:

- ✓ joint conditioning of category 2-C liquid RAW, by incorporating the super-compressed barrels of solid RAW into a cement radioactive matrix;
- ✓ incorporating the super-compressed barrels of solid RAW into a cement non-radioactive matrix;
- ✓ packing the super-compressed barrels of solid RAW without immobilizing them into a matrix.

Once the packing has been compacted (placing and closing the lid, then sealing up the lid opening), the weight of the filled-up RRC is measured, and a technological and operational RC and PCC has been conducted, a passport is issued for each packing of conditioned RAW.

11.3.8.4 TRANSPORTATION OF SOLID RAW

- ✓ The transportation of RAW within the territory of the site is done using a specialized transportation vehicle (STV) with RAW containers – 2 (6) m^3.
- ✓ The transportation of solid RAW, packaged into 200 l barrels within the territory of the site is done using a specialized transportation vehicle (STV) with baskets (pallets).
- ✓ The unloading and organizing of the packages at the designated areas of the open platforms is done using a mobile crane with lifting capacity exceeding 30 t.
- ✓ The transportation of RAW in bio-protected containers within the territory of the site is done using a specialized transportation vehicle (STV) – a container carrier. Containers are used in the cases when the dose potency Pγ of the collected solid RAW is from 2 to 10 mSv/h.
- ✓ The transportation of RAW with dose potency Pγ above 10 mSv/h is done under separate programs for each case.

11.3.8.5 TRANSPORTATION CONTAINERS UTILIZED AT THE SITE OF "KOZLODUY NPP" EAD

- ✓ 2m³ transporting containers for RAW (with a loading capacity of 0.9 t). This type of containers is transported via a STV with a closed cargo compartment, 1 or 2 containers at a time.
- ✓ 6m³ metal containers for RAW (with a loading capacity of 2.7 t). This type of containers is transported via a STV with a closed cargo compartment, 1 or 2 containers at a time. Each container from this type is equipped with a draining system that controls and drains away any potential leaks. The draining valves are closed, with the exception of the cases when control is exercised on the presence of liquids within the RAW container.
- ✓ 0.2m³ bioprotective containers for RAW (with a loading capacity of 0.25 t and own weight of 2.25 t). This type of containers is transported separately (one by one) in the transportation socket of a STV with a loading capacity greater than the weight of the bioprotective container, in a closed cargo compartment.
- ✓ 2x0,2m³ bioprotective containers for RAW (with a loading capacity of 2x0.25 t and own weight of 2 t). This type of containers is transported separately (one by one) in the transportation socket of a STV with a loading capacity greater than the weight of the bioprotective container, in a closed cargo compartment.
- ✓ 5m³ RRCs (with gross weight ≤ 20 t) with a fixed/attached reinforced concrete lid. The lid is left without any technological openings. This type of containers is transported separately (one by one) in the transportation socket of a STV with a loading capacity greater than the weight of the bioprotective container.
- ✓ 0.2m³ metal barrels (with a loading capacity of 0.25 t) with replaceable metal lids fixed to the barrels or with metal lids attached to the edges of the barrels. This type of containers is transported via a STV with a closed cargo compartment, in a metal transportation basket, 8 units per basket, two baskets at a time. Each basket is reliably affixed to the STV via a removable attachment system (attaching belts and metal hooks), ensuring the safe transportation. The total complex, consisting of the basket and the system for its attachment, must retain its integrity during the transportation.

11.3.8.6 PACKING OF CONDITIONED RAW

The packing of the processed super-compressed solid and conditioned liquid Raw is done using a reinforced concrete container (RCC) with a capacity of 5 m³. The RCC is licensed by the regulatory authority governing the transportation and storage of conditioned RAW. It was designed by Kozloduy NPP. The "RAW – Kozloduy" SD is the legal successor of the RCC and manufactures RCC with its own formwork, materials, supplies, etc.

RCC production is compliant to BNS requirements on the materials used, pursuant to industrial standard OH 0185755-92 "Reinforced concrete container for transportation and storage of processed radioactive waste", and to the guidelines of the IAEA in the series on

the safe transportation of radioactive materials. OH 0185755-92 envisages, apart from functional and operational requirements to the container, stringent criteria for the inspection and testing of manufactured containers, both under normal control and storage conditions and under accident conditions (falling from 6 m, fire-resistance, immersion under water).

RCC with conditioned RAW are stored in the constructed RAW Storage Facility within the Kozloduy NPP site, and are subject to disposal without any additional processing.

11.3.9 INTEGRATED MANAGEMENT SYSTEM

A description of the nuclear and radiological characteristics regarding the safety of the power plant with regard to the functioning of the integrated management system (safety management, quality assurance, security measures, environmental protection, health and safety at the workplace, financial agreements):

In adherence to the terms and conditions of the issued licenses and permits for the safe use of nuclear energy, "Kozloduy NPP" EAD has developed and implemented an integrated management system (IMS), based on a procedural approach with four levels of differentiation, interdependence and management of processes and activities for the purpose of achieving high management efficiency, and ensuring complete continuity of the existing quality management system (QMS).

A Management System (MS) was implemented on the basis of the guidelines and recommendations in "The Management System for Facilities and Activities" № GS-R-3:2006 of the International Atomic Energy Agency (IAEA:), Safety Guide PP-8:2011 "Management System for Facilities and Activities" of the BNRA and SSR-2/2: 2011 "Safety of Nuclear Power Plants: Commissioning and Operation". The following standards of the International Organization for Standardization (ISO) have been taken into account: BS EN ISO 9001:2008 "Quality Management Systems. Requirements", BS EN ISO 14001:2004, "Environmental Management Systems", BS OHSAS 18001:2007, "Occupational Health and Safety Management Systems" and №13 – "Nuclear Security Recommendations on Physical Protection of Nuclear Material and Nuclear Facilities" (INFCIRC/225/Rev. 5), etc. With the adoption of the MS, a new version of the "Management System Guidelines" was introduced at the end of 2012, fulfilling all requirements envisaged in the GS-R-3 safety standard and the other applicable regulatory requirements and recommendations in the area of nuclear energy and industrial practices.

The activities in "Kozloduy NPP" EAD are structured into 29 processes (3 management ones, 4 primary ones and 22 auxiliary ones), established on the basis of the graded approach and backed by the necessary resources, criteria and methods for their functioning, management, monitoring and measurement.

For each process within the MS of "Kozloduy NPP" EAD there are responsible officials, each serving as the person in charge, coordinator and manager of the process.

The management system integrates all aspects of management and ensures coordination on the fulfilment all requirements on general safety, health and safety at work, environmental protection, security, quality and economy, in order to ensure the highest priority for safety.

The requirements of the MS are applied, in a coordinated fashion, to all activities and the results from them (a product, a service) for each of the processes.

The graded approach is based on assessments on the activities and their result, using predefined factors that are taken into account:

- the importance and complexity of each individual product or activity;
- the influence of each product or activity on safety, health, the environment, quality, security, the economy;
- the possible consequences from the improper performance of the activity or the disparity of the product.

Based on the assessment on the activities and the products in terms of their significance most of all on safety, as well as taking into account their influence for environmental protection, ensuring the health and safety at work, security, quality and economic efficiency, the requirements of the MS are applied to different degrees.

By implementing a graded approach, the resources and attention are directed to the activities/processes and equipment that is of greater importance to security, which leads to a reduction of the total costs for safety improvement.

The MS envisages mechanisms for continuous inspection, assessment and optimization of MS requirements, enabling:

- multi-dimensional analysis of the MS in terms of organizational structure, activities, resources, documents, information systems, etc.;
- a centralized place for the storage of computer data, ensuring uniformity and consistency of information;
- the creation of a unified knowledge basis for different aspects of the activities of the organization;
- the analysis, simulation and optimization of the processes on a number of parameters, and the generation of different reports.

The outlining and management of the processes at Kozloduy NPP is done using the ARIS software product for the modelling, analysis and management of business processes.

The experience gained on the establishment of an integrated management system at Kozloduy NPP will be transferred to the new capacities when they are constructed.

11.3.10 TRANSPORTATION OF SNF

The transboundary impact of the transportation of SNF depends on the adoption of the following decisions:

- → Ground transportation of SNF using the available road vehicles within the expanded site of Kozloduy NPP with the NNU.
- → Transportation of SNF using the available road vehicles, adapted for the transportation containers with Westinghouse-type fuel, or with new vehicles within the expanded site of Kozloduy NPP with the NNU.
- → Signing a new contract or an annex to the existing contract for the transportation and processing of SNF in Russia.
- → Signing a new contract for the transportation and processing of SNF in a country and processing plant suggested by the Westinghouse company.

The first two solutions do not require an amendment to the existing agreements with Romania, Ukraine and Russia.

11.3.11 INTERNATIONAL CONVENTIONS IN THE AREA OF NUCLEAR ENERGY RATIFIED BY THE REPUBLIC OF BULGARIA

The conventions ratified by the Republic of Bulgaria and the obligations arising from them are as follows:

1. **Treaty on the Non-Proliferation of Nuclear Weapons promulgated SG. 39 on 18/05/1971**

Each State – party to this Treaty enters into an agreement with the International Atomic Energy Agency, which describes the assurances to be provided by the State for verification of the compliance with the obligations assumed by it.

2. **Convention on the Physical Protection of Nuclear Material promulgated SG. 44 on 9.06.1987**

This Convention applies to nuclear material used for peaceful purposes and in the process of international transport. Part of this Convention concerns also nuclear material used for peaceful purposes for the use, storage and transport of such nuclear material within the participating country. The annexes to the Convention present the level of physical protection used in international transport of nuclear material and its classification.

3. **Convention on Early Notification of a Nuclear Accident promulgated SG. 12 on 12/02/1988**

This Convention provides systematic guidance to the States Parties concerning the scope of information and procedures for provision of information in the event accident, which has led or may lead to discharge of radioactive material and which has resulted or may result in an international transboundary release that could from the viewpoint of radiation safety be important to another country.

4. **Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency, SG. 13 on 16/02/1988**

The States Parties to this Convention shall cooperate with the International Atomic Energy Agency in accordance with the provisions of this Convention in order to facilitate the prompt provision of assistance in the event of a nuclear accident or radiological emergency to minimize its consequences and protection of life, property and the environment from the effects of radioactive releases. To facilitate such cooperation States Parties may agree on bilateral or multilateral agreements or, where appropriate, their combination to prevent or minimize the harm and damage that may occur in the event of a nuclear accident or radiological emergency.

5. **Vienna Convention on Civil Liability for Nuclear Damage promulgated SG. 76 of 20.09.1994**

This Convention aims to establish minimum standards to provide financial protection against damage which is the result of some uses of atomic energy for peaceful purposes.

6. **Convention on Nuclear Safety promulgated SG. 93 of 1.11.1996**

This convention aims to:

- Achieve and maintain a high level of nuclear safety worldwide through the enhancement of national measures and international cooperation, including, where appropriate, on the basis of technical cooperation in the area of safety;
- Create and maintain at the nuclear installations effective defences against potential radiological hazards in order to protect individuals, society and the environment from harmful effects of ionizing radiation from such installations;
- Prevent accidents with radiological consequences and mitigate such consequences should they occur.

7. **Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management, promulgated SG. 63 of 17.07.2001**

The objectives of this Convention are:

- To achieve and maintain a high level of safety of spent fuel and radioactive waste in the world by improving the national measures and strengthening international cooperation, including technical cooperation in the field of safety, where appropriate;
- To ensure at all stages of spent fuel and radioactive waste management activities provide effective protection from potential hazards so that individuals, society and the environment are protected from harmful effects of ionizing radiation, now and in the future in such a way that the needs and aspirations of the present generation are met without compromising the ability of future generations to meet their needs and aspirations;

- To prevent accidents with radiological consequences and to mitigate such consequences should they occur during any stage of spent fuel or radioactive waste management activities.

The national laws and regulations related to the implementation of the above conventions in Bulgarian legislation are:

ACT on the Safe Use of Nuclear Energy – SG. 63 of 28 June 2002, last amended SG 38, 18 May 2012

- ✓ Regulation for the procedure for issuing licenses and permits for safe use of nuclear energy 18.05.2004, amended SG 76 of 05.10.2012;
- ✓ Regulation on ensuring the safety of nuclear power plants of 30.07.2004, amended SG 46 of 12.06.2007;
- ✓ Regulation on ensuring the safety of research nuclear installations of 02.09.2004;
- ✓ Regulation on basic norms of radiation protection of 05.10.2012;
- ✓ Regulation for radiation protection during activities with sources of ionizing radiation of 24.08.2004, amended and supplemented SG 76 of 10/08/2012;
- ✓ Regulation on radiation protection during activities with radiation flaw detectors of 04.23.2013;
- ✓ Regulation on radiation protection during work activities with materials with increased concentration of natural radionuclides of 05.10.2012;
- ✓ Regulation on the terms and procedure for obtaining of vocational qualification and on the procedure for issuing of licenses for specialized training and of individual licenses for use of nuclear power of 24.08.2004, amended SG 46 of 12.06.2007;
- ✓ Regulation for the provision of physical protection of nuclear facilities, nuclear material and radioactive substances of 25.08.2004, amended SG 96 of 30.11.2005, supplemented SG 44 of 9.05.2008;
- ✓ Regulation of the conditions and procedure for notification of the Nuclear Regulatory Agency about events in nuclear facilities and sites with sources of ionizing radiation of 13.08.2004, amended SG 46 of 12.06.2007;
- ✓ Regulation on emergency planning and emergency preparedness in case of nuclear and radiological emergencies of 29.11.2011, SG. 94 of 29.11.2011;
- ✓ Regulation for the conditions and procedure for establishing of special-statutory areas around nuclear facilities and facilities with sources of ionizing radiation of 06.08.2004, amended SG 46 of 12.06.2007;
- ✓ Regulation on the conditions and procedure of transport of radioactive material of 22.07.2005;
- ✓ Standard document for the supervision and control of shipments of radioactive waste and spent fuel;

- ✓ Regulation for safety of spent fuel management of 13.08.2004;
- ✓ Regulation on safety during decommissioning of nuclear facilities of 20.08.2004;
- ✓ Regulation for safe management of radioactive waste of 17.08.2004;
- ✓ Regulation on the terms and procedure for delivery of radioactive waste to the Radioactive Waste State-Owned Company of 23.07.2004;
- ✓ Regulation on the terms and the procedure for collection and provision of information and for maintaining registers on the activities pertaining to the application of safeguards in Connection with the Treaty on the Non-proliferation of Nuclear Weapons 24.08.2004;
- ✓ Regulation on the terms and procedure for exemption of small quantities of nuclear material from the application of the Vienna Convention on Civil Liability for Nuclear Damage of 17.08.2004;
- ✓ Regulation on the procedure for payment of the fees collected pursuant to the Act on the Safe Use of Nuclear Energy of 26.09.2003;
- ✓ Regulation no. 1 of 15.11.1999 on standards for radiation protection and safety in relation to the liquidation of the uranium industry in Bulgaria, amended SG 63 of 17.07.2001.

11.3.12 TECHNICAL SPECIFICATIONS (OPERATIONAL LIMITS AND CONDITIONS AND OPERATING PROCEDURES)

The IAEA recommendations for the establishment of limits and conditions for safe operation in A Safety Guide, Safety Series № NS-G-2.2 *"Operational Limits and Conditions and Operating Procedures for Nuclear Power Plants"* of 2000 are implemented by the requirements of the national legislation for the development of Technological Regulation for each nuclear facility. The Technological Regulation is the basic document defining safe operation of the nuclear facility.

Pursuant to the requirements of the Regulation for the procedure for issuing licenses and permits for safe use of nuclear energy, SG. 41 of 18.05.2004, Article 43, paragraph 1, sub-paragraph 9 (Amended – SG. 76 2012) one of the annexes to the application for issuance of a permit for the commissioning of a nuclear installation is:

"Technological Regulation for operation of a nuclear facility, which includes limits and conditions for operation, including: safety margins, parameter values for the activation of the safety systems, operational limits and conditions, tests, inspections, supervision and operational control systems important to safety, minimum number of operational staff under various operating conditions, including qualified and authorized personnel of the main control room, personnel actions in case of deviations."

Similar are the requirements to the Regulations laid down in Art. 120 and Art. 121 of the Regulation on ensuring the safety of nuclear power plants, SG 66/30.07.2004:

"Art. 120. (1) The limits and conditions for operation must cover all operating conditions including generation mode, subcritical condition of the reactor system, refuelling and all the transitional states between these modes and include as a minimum:

1. safety margins;

2. values of the parameters for the actuation of safety systems;

3. operational limits and conditions;

4. testing, inspection, supervision and operational control of SSCs important to safety;

5. minimum operating personnel in the operating conditions, including qualified and MCR staff;

6. Personnel actions when deviations from the limits and conditions for operation occur.

(2) Failure of the limits and conditions for operation must lead to immediate measures to bring the plant into compliance with them.

Such cases need to be analysed and measures must be taken to prevent them in the future.

Art. 121. Limits and conditions for operation, collected in a single document (technological regulation for operation) must be readily accessible to MCR staff and that staff must be familiar with them and their technical foundations. The management staff of the operating organization must clearly realize their importance to safety";

And Art. 74 of the Regulation for safety of spent fuel management, SG 71/13.08.2004. Art. 74:

'(1) The basic document that defines the safe operation of facilities for spent fuel management is a technological regulation for operation.

(2) The Technological Regulation for Operation shall contain:

1. the fundamental methods for safe operation;

2. general procedure for the implementation of technological operations related to

safety of the facility;

3. limits and operating conditions, including: safety margins, parameter values for the activation of the safety systems, operational limits and conditions, tests, inspections, supervision and operational control systems important to safety, a minimum number of staff; personnel action in case of deviations.

(3) The Technological Regulation for Operation is developed on the basis of the design of the facilities and preliminary SAR.

(4) The Technological Regulation for Operation must be adjusted after commissioning, upon changes of the design changes or updates of the SAR.

(5) The Technological Regulation for Operation shall be developed by the operating organization."

Therefore the Regulation contains:

- Limits and conditions of safe and normal operation and the actions to be taken if these limits and conditions are reached and violated, including restrictions in modes with different deviations;
- Procedures and general rules for the conduct of processes and procedures;
- Additional requirements and rules for the implementation of the safe operation of the Unit in design modes including minimum configurations of the CBA for the different modes.

Specific personnel actions are considered in the relevant operating instructions.

The regulation does not address the design-based accidents and personnel actions for their elimination. They are defined in the relevant instructions for emergency response.

Actions of the operators if conditions dangerous to human life and health occur at the site are determined by the "Emergency Plan of the NPP."

Regulations for the operation of nuclear facilities at the site of "Kozloduy" are developed in accordance with the recommendations of the IAEA as per A Safety Guide, Safety Series no. NS-G-2.2 *"Operational Limits and Conditions and Operating Procedures for Nuclear Power Plants"* since 2000. Before 2000 the Technical specifications were developed in accordance with A Safety Guide, Safety Series no. 50-SG-03 "Operational limits and Conditions for Nuclear Power Plants" of 1979.

In summary, the Technological Regulation of a nuclear unit describes:

11.3.12.1 MAIN STATES OF THE REACTOR SYSTEM

The main states of Reactor Systems (RS) are determined on the basis of the technical design, the requirements for performance of CBA, the general parameters determining the operation of the RS and operational experience.

When planning a transition from one state to another, the more stringent conditions of the two states are in force until the new state is reached – for example, when switching from Minimum controllable capacity level to power generation, the more stringent requirements for the performance of the system will apply, i.e. those at Minimum controllable capacity level.

11.3.12.2 SAFETY DEFINITIONS

The Regulation cites certain definitions related to the safety of nuclear installations, the sources of these definitions are National legal framework, i.e. the Act on Safe Use of Nuclear Energy and its implementing regulations.

11.3.12.3 DESIGN-BASED LIMITS

The design bases according to Art. 7 of the Regulation on ensuring the safety of nuclear power plants adopted by Council of Ministers Decree no. 172 of 19.07.2004, published SG 66 of 30.07.2004 are:

"The design bases determine the qualities of the plant that provide for all operational states and ensure that design-based accidents do not exceed the established limits for internal and external exposure of workers and the public and the limits for radioactive releases to the environment. Design bases include design-based limits, operational states of the plant, safety classification of SSCs, important assumptions in the design and in some cases special methods of analysis. ";

And according to Article 9 of the same Regulation:

"The design-based limits shall include as a minimum:

1. Radiological and other technical acceptance criteria for all operational and emergency conditions;

2. Criteria for protection of the shell of the fuel rods, including temperatures of the fuel, allowance up to heat-exchange failure, cladding temperature, tightness of the shell of the fuel rods and maximum allowable fuel damage under all operating states and design-based accidents;

3. Criteria for the protection of the cooling loop of the reactor, including maximum pressure, maximum temperature, thermal and mechanical transients and loads;

4. Criteria for protection of the containment system, including temperature, pressure and rate of leaks in the containment structure, by providing the necessary resources to ensure its integrity and tightness under extreme external events, major accidents in combination of initiating events. "

Therefore, the design-based limits are threshold parameters, which, if not reached in normal and emergency conditions, ensure primarily preservation of the integrity of the barriers.

It is particularly important to ensure the integrity of the first two barriers – the fuel matrix and the shell of the fuel rods.

11.3.12.4 DESIGN LIMITS, SAFETY LIMITS AND OPERATIONAL LIMITS

According to the Concluding provisions of the Regulation on ensuring the safety of nuclear power plants adopted by Council of Ministers Decree no. 172 of 19.07.2004, promulgated, SG 66 of 30.07.2004:

According to the provisions of the Final according to Regulation on ensuring the safety of nuclear power plants, approved by Decree № 172 of 19.07.2004, promulgated, SG. 66 of 30.07.2004:

"37. "Safety limits" are the parameters of the process as specified in the designs, the deviations from which could lead to an accident.

38. "Limits and operating conditions" is a set of rules defining the limits of the parameters, the functionality and behaviour of the SSC and staff which are approved in accordance with the established procedures to ensure safe operation of the nuclear plant.

40. "Design-based limits" are the values of the parameters and characteristics of the condition of SSCs important to safety and the NP as a whole, defined in the design for all operational states and accident conditions. "

Often the design-based limits are non-measurable parameters (temperature of the fuel rod shells, fuel temperature, etc.). Their behaviour is controlled by the related parameters – e.g. the behaviour of T of the shell of the fuel rods within certain limits, can be controlled by the behaviour of the T of the coolant outlet from the cartridge.

The principle of determining the levels of locks and protections is shown in **Figure 11.3-33**.

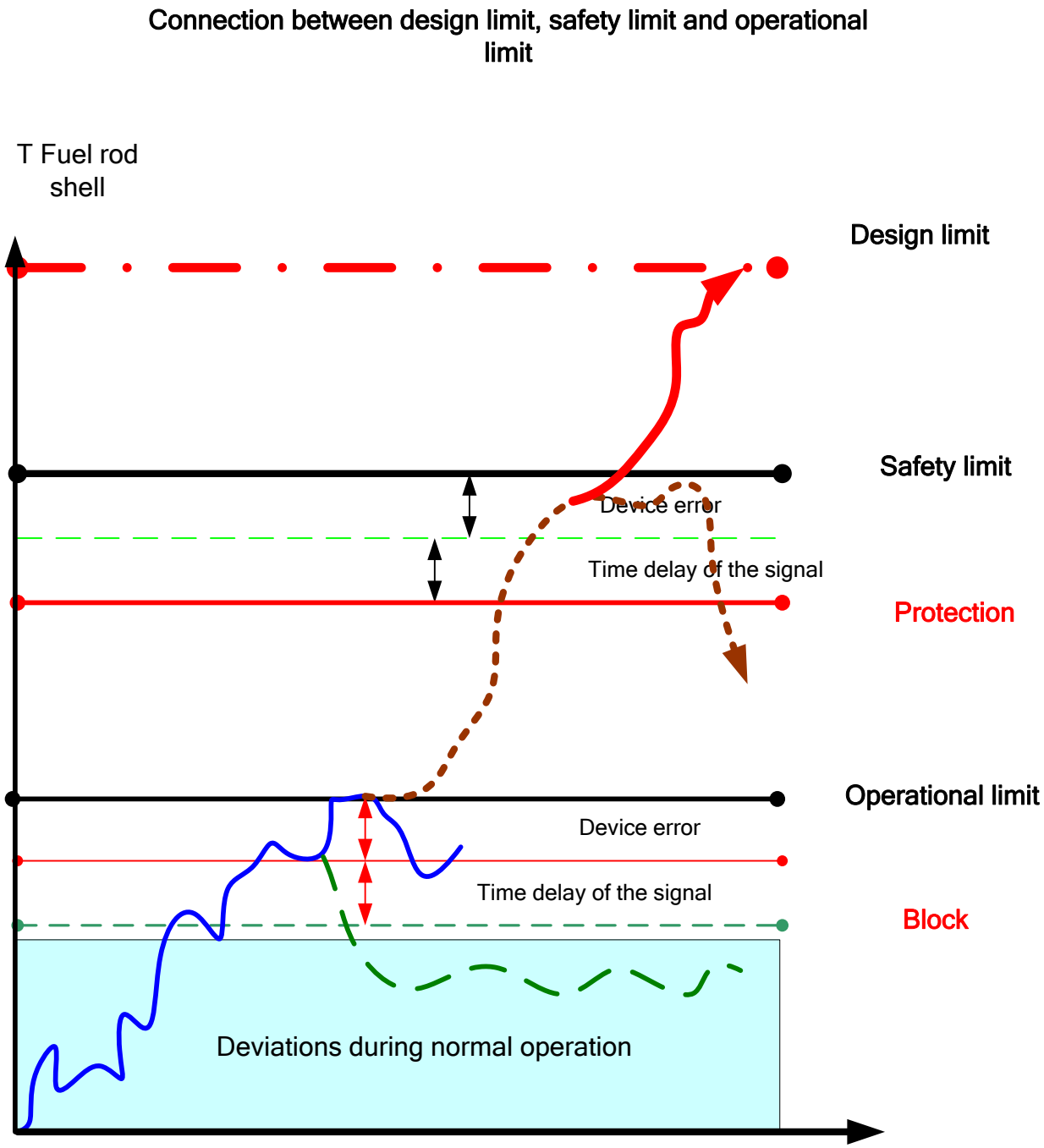


FIGURE 11.3-33: LOCKS AND PROTECTIONS LEVELS

Values of design-based limits, safety limits and operational limits are defined for every possible operating condition of the facility. These values are set out in the technical design of the facility. Any change in the value of a limit due to accumulated service experience, design changes or other valid reasons must be justified to the NRA, including by assessment of the impact of change on safety of the facility.

11.3.12.5 AVAILABILITY OF THE SAFETY SYSTEMS

According to the Regulation on ensuring the safety of nuclear power plants adopted by Council of Ministers Decree no. 172 of 19.07.2004, promulgated, SG 66 of 30.07.2004.:

"Safety system" is a system important to safety, providing for safe shutdown of the reactor or residual heat removal from the core, or for mitigation of the consequences of anticipated operational occurrences and design-based accidents."

The Technological Regulation shall specify the required availability of safety systems, e.g. the number operable channels or operation of the facility for a specified operating condition. The measures to be taken in the absence of the condition must also be specified.

11.3.12.6 AVAILABILITY OF THE SYSTEMS IMPORTANT TO SAFETY

According to the Regulation on ensuring the safety of nuclear power plants adopted by Council of Ministers Decree no. 172 of 19.07.2004, promulgated, SG 66 of 30.07.2004.:

"Structures, systems and components important to safety are safety systems, as well as the SSC for normal operation, failures in which comprise the normal operation of a nuclear power plant or prevent the resolution of deviations from normal operation and can lead to design-based accidents and beyond."

The Technological Regulation shall specify the required availability of *structures, systems and components important to safety,* for operation of the facility at a given operating condition. The measures to be taken in the absence of the condition must also be specified.

11.3.12.7 GENERAL RESTRICTIONS ON THE OPERATION OF THE UNIT

General restrictions on use of the block are all summarized principles which provide for the safe operation of the unit in all states and regimes.

11.3.12.8 ADMINISTRATIVE REQUIREMENTS

Administrative and organizational measures, approved by the NRA, relating to the safe operation of the facility.

11.3.12.9 OTHER RESTRICTIONS

Additional restrictions specific to certain operating modes, and limits the availability of structures, systems and components classified as important to safety. This includes the limitations imposed by the regulatory framework not directly related to operating modes.

11.3.12.10 LIST OF NUCLEAR HAZARDOUS WORK

These are works in the reactor system, which could lead to a nuclear incident.

The list includes all nuclear dangerous jobs that require specific organization and control.

11.3.12.11 ORGANIZATIONAL MEASURES DURING PERFORMANCE OF NUCLEAR HAZARDOUS WORK

This part describes the specific requirements, including control and documentation procedures.

11.3.12.12 ORGANISATION OF THE SURVEILLANCE PROGRAM

Pursuant to the requirements of A Safety Guide, Safety Series no. NS-G-2.2 *Operational Limits and Conditions and Operating Procedures for Nuclear Power Plants* of 2000, the Technological Regulation must also provide for technical surveillance of the facilities. Due to the volume and variety of surveillance activities and the specific requirements of the normative technical documents in the specific areas of supervisory control, the system for management of the activities in the surveillance program is developed at four levels, and Level 1 is included in the Technological Regulation. It lays down:

- ✓ limits and conditions of safe operation and operating limits and conditions;
- ✓ basic requirements for control and surveillance;
- ✓ general requirements for monitoring the status of the systems;
- ✓ general requirements for control of the protective barriers;
- ✓ total amount of periodic and functional tests and checks;
- ✓ frequency of tests and permissible deviations from that frequency;
- ✓ mandatory minimum volume and frequency of metal control, maintenance and other repairs;
- ✓ requirements for instrumentation and systems for setting thresholds, tolerances, metrological certification and calibration;
- ✓ general requirements for the control of radiation in the controlled area;
- ✓ general requirements for chemical, radiochemical and radiation monitoring of main and auxiliary systems and equipment;
- ✓ requirements to the control of radioactive discharges into the environment;
- ✓ specific requirements for the control of certain limits and conditions (subcriticality of the core, leakage from I to II Cmdr etc.).

11.3.12.13 ORGANISATION OF THE OPERATION

This part specifies the organization of operations for all operating modes, including training and personnel responsibilities. It also establishes the composition of the operational staff for all operating modes.

11.3.12.14 DOCUMENTATION

This part specifies the arrangements for keeping the records as well as the scope and completeness of the documentation.

11.3.13 COMPLIANCE WITH THE REQUIREMENTS OF THE ROMANIAN MOEF

In accordance with the requirements contained in the letter of the Ministry of Environment and Forests of Romania with outgoing ref. no. 3672/RP/18.10.2012 as provided by the Contracting Authority, the EIAR includes the results of all studies, analyses and forecasts made as part of the EIA for identification of areas at risk of significant impact on the territory of the Republic of Romania as a concerned state within the meaning of the Espoo Convention.

In this context, ***the scope of the assessment of transboundary impacts*** within the EIA study includes the possible impacts on the environment and human health due to the realization of the investment proposal in the monitored area (within 30 km radius around the site of the Kozloduy NPP), which encompasses 19 populated settlements in the territory of Romania. The assessment process included a joint team comprised of Bulgarian and Romanian experts in order to ensure collection and analysis of the information required for an objective assessment.

The assessment of the environmental impact in transboundary context is made in accordance with the requirements of the Bulgarian, European and international legislation on EIA in a Transboundary Context and is designed to meet the basic and specific requirements of Romania set out in Letter no. 3672/RP/18.10.2012 and Letter no. 3072/RP/06.08.2013.

In this regard, the EIA report includes:

11.3.13.1 MAIN REQUIREMENTS AS PER LETTER NO. 3672/RP/18.10.2012

No.	REQUIREMENT	COMMENTS
1.	**The EIAR should include:**	
1.1.	Information regarding the site characteristics that may be relevant to nuclear safety	The main characteristics of the sites are detailed in Chapter 1: ANNOTATION OF THE INVESTMENT PROPOSAL FOR CONSTRUCTION, ACTIVITIES AND TECHNOLOGIES, section 1.2: *Description of the physical characteristics of the project and the necessary areas* of this report. This section provides detailed information about the four alternative sites and the existing infrastructure built on them. Additional information in the EIAR is presented in Chapter 2: STUDY OF LOCATION ALTERNATIVES (WITH SKETCH AND COORDINATES OF THE CHARACTERISTIC POINTS IN THE APPROVED COORDINATE SYSTEM FOR THE COUNTRY) AND / OR ALTERNATIVES OF TECHNOLOGY AND REASONS FOR THE CHOICE MADE FOR STUDY, WITH

		REGARD TO THE ENVIRONMENTAL IMPACT, INCLUDING "ZERO OPTION", sections 2.1: Location and Alternatives and 2.2: Alternatives for supporting infrastructure during construction and operation. Chapter 6 of the report: CHARACTERISTICS OF ENVIRONMENTAL RISKS IN THE EVENT OF POTENTIAL ACCIDENTS AND INCIDENTS provides an assessment of the risk of accidents (internal impacts), accidents caused by human error, impacts caused by natural disasters, external influences caused by man. This Chapter 11: TRANSBOUNDARY IMPACTS presents the information which is relevant for the territory of Romania, including assessment of the environmental impact on that area.
1.2.	Information concerning the analysis of accidents, including major accidents (especially the possibility of radiological consequences on Romanian territory). Also state the acceptable dose for every possible emergency scenario, in air and water of the Danube;	Chapter 6 of the EIAR: DESCRIPTION OF ENVIRONMENTAL RISKS IN POTENTIAL ACCIDENTS AND INCIDENTS presents a detailed analysis of the reviewed design-based and major accidents in accordance with the Bulgarian and European legislation / Appendix 4: Legislation /. Radiological results of the analysed accidents, as can be inferred from analyses, testify to the acceptability of environmental risks. Results of the design-based accidents show that for any hypothetical design-based accident human exposure does not cause the need for the adoption of any emergency protective measures, even the nearest habitable zone of NNU. The models of the radiological effects of major accidents did not exceed the thresholds for urgent precautionary measures beyond the existing emergency planning zones of Kozloduy NPP. As concerns follow-up measures, permanent resettlement is not envisaged even in the nearest populated area around the NNU. In this case one should not exclude the regulation of the distribution and consumption of agricultural produce in a distance up to 30 kilometers from the source depending on the direction of the contamination. In conclusion, it should be stated that in accordance with the expectations more than half of the total value of the exposure will occur through ingestion. From this it is concluded that the introduction of short-term restrictions of the consumption of locally grown products would be extremely significant in reducing the dose received. The actual scope and place of subsequent precautions will depend on the movement and development of the accident and the actual weather conditions, and in the case of long-term measures – on comprehensive monitoring of the territory.
1.3.	Information on the emissions to air and water of the Danube	The analysis of emissions from the NNU in non-radiation and radiation aspects shows that transboundary

	during normal operation of the new unit	environmental impact on the territory of Romania is not expected. Thermal effects on the Danube are not expected either. EIAR sections 4.1: *Climate and atmospheric air* and 4.2: *Surface and groundwater* present a detailed forecast of the expected impact of the emissions from the construction and operation of the NNU. Section 4.9.4 of EIAR also presents the estimated thermal impacts on the Danube from the construction and operation of the NNU. This Chapter 11: TRANSBOUNDARY IMPACT presents the information that applies to the territory of the Republic of Romania, including information on emissions into air and water of the Danube during normal operation of the new unit.
2.	**There are Natura 2000 sites on both sides of the Danube in the area of Kozloduy. On the Romanian side there are the following Natura 2000 sites, protected respectively by the Habitats Directive and the Birds Directive**	
2.1	ROSPA0010 Bistrets river ROSPA0023 Jiu River-Danube River confluences ROSCI0045 Corridor of Jiu River; ROSPA00135 Sands of Dabuleni	The NNU is not expected to impact the Romanian NATURA 2000 sites in the 30 km zone This Chapter 11: TRANSBOUNDARY IMPACT presents analysis and assessment of the following areas protected by the Habitats Directive and the Birds Directive: ✓ ROSPA0010 Bistret River; ✓ ROSPA0023 Jiu River-Danube River Confluences; ✓ ROSCI0045 Corridor of Jiu River; ✓ ROSPA00135 Sands of Dabuleni. The analysis is based on studies carried out in accordance with the Regulation on the conditions and procedures for assessing the compatibility of plans, programs, projects and investment proposals with the target and purpose of the conservation of protected areas (adopted by Council of Ministers Decree 201 of 31.08.2007, SG 73 of 11 September 2007)
3	**The EIAR provides an answer to the following questions:**	
3.1.	Impact on biodiversity, on both sides of the Danube River in the scope of the assessment of environmental impact (30 km zone), outside the protected areas NATURA 2000	No NNU impact expected outside of protected areas included in the Natura 2000 network. The EIS section 4.6: *Biodiversity* provides an analysis of the impact on biodiversity from the construction, operation and decommissioning of the NNU on the Bulgarian side of the Danube. This Chapter 11: TRANSBOUNDARY IMPACT contains an analysis of the impact on biodiversity within the 30 km zone of the Romanian side outside the Natura 2000 network from the construction, operation and decommissioning of the NNU.

3.2.	Cumulative impacts from other projects implemented at Kozloduy NPP and its surroundings, which can have harmful effects on biodiversity of both countries	NNU is not expected to have cumulative with other projects carried out at the site of Kozloduy NPP, which can have harmful effects on biodiversity of both countries. EIAR Chapter 5: CUMULATIVE EFFECT presents an assessment of the cumulative impact of all components and environmental factors, including biodiversity. The same chapter analyses and assesses the possible cumulative effect of the construction, operation and decommissioning of the NNU and other current and future facilities at Kozloduy NPP in the context of potential impacts, including on biodiversity.
3.3.	Measures to reduce the impact on biodiversity and impact assessment after their implementation	Based on the analysis, forecasting and evaluation of impacts on biodiversity in the 30 km zone under consideration, measures are proposed to reduce the impact on biodiversity and assess the impact after their implementation. It was found that there is no need to propose measures in respect to biodiversity for the Romanian territory. EIAR CHAPTER 8: DESCRIPTION OF THE MEASURES ENVISAGED TO PREVENT, REDUCE OR WHERE POSSIBLE ELIMINATE ANY SIGNIFICANT ADVERSE EFFECTS IN BOTH RADIATION AND NON-RADIATION ASPECTS ON THE ENVIRONMENT, AND A PLAN FOR IMPLEMENTATION OF THESE MEASURES proposes concrete measures to reduce and/or prevent a possible impact both during construction and during operation of the new nuclear unit in Bulgarian territory.
4.	Names of geographical locations of the maps in Latin characters, maps to contain the Romanian localities included in the assessment	This CHAPTER 11: TRANSBOUNDARY IMPACT, in its English and Romanian versions, presents maps and graphical Latin-script names of geographical sites and Romanian localities included in the assessment.
5.	Since the Monitored area (30km around Kozloduy NPP in Romanian territory) has a population of 77 197 inhabitants in 18 settlements in the counties of Dolj and Olt there is need to assess the environmental impact and the radiological impact on human health.	The assessment of environmental impacts, including the radiological effects on human health does not demonstrate high degree of significance. There is no additional risk in all operating conditions of the new nuclear power plant. Synergistic impacts of ambient emission, emissions to ground- and surface water on the local population are not expected, both during the construction of the NNU and during its operation and decommissioning.
6.	Assess the impact on human health in order to estimate the additional risk during normal operation of the new nuclear unit, including in the event of accidents, based on the recommendations of the International Commission on Radiological Protection (ICRP	The cumulative impact on the health of the Romanian population within the 30 km zone of Kozloduy NPP by the NNU and the existing units 1÷4 which are currently in the process of decommissioning and will generate nuclear waste in the future is negligible. EIAR Chapter 4: DESCRIPTION, ANALYSIS AND EVALUATION OF THE LIKELY SIGNIFICANT IMPACTS ON THE POPULATION AND THE ENVIRONMENT, IN

	103/2007), on diseases associated with exposure to ionizing radiation (morbidity and mortality from malignant diseases, birth defects, developmental defects). These assessments should include both the normal operation of the plants and nuclear emergencies	RADIATION OR NON-RADIATION ASPECT, AS A RESULT OF THE IMPLEMENTATION OF THE INVESTMENT PROPOSAL, USAGE OF NATURAL RESOURCES, EMISSIONS OF HARMFUL SUBSTANCES DURING NORMAL OPERATION AND EMERGENCIES, WASTE GENERATION AND DISTURBANCE, sections 4.10: *Health and hygienic aspects of human health* and 4.11: *Radiological risk to the population in the event of radioactive release* presents a detailed assessment of the health impacts from the construction, operation and decommissioning of NNU.
7.	Given the levels of contamination in the environmental media (air emissions, emissions to groundwater and surface water), it is necessary to investigate the synergistic effect of their impact on the local population, both during the construction of the unit and during its operation.	Chapter 5: CUMULATIVE IMPACT provides an analysis and assessment of the cumulative impact of the NNU and the other nuclear facilities at Kozloduy NPP. Chapter 6: DESCRIPTION OF ENVIRONMENTAL RISKS IN THE EVENT OF POTENTIAL ACCIDENTS AND INCIDENTS provides a detailed assessment of the risk of accidents (internal impacts), accidents caused by human error, impacts caused by natural disasters, external influences caused by man.
8.	In assessing the health effects on the Romanian population in the Kozloduy NPP area take into account the existence at the same site of the old units 1÷4 of Kozloduy NPP, which are currently in the process of decommissioning and will generate radioactive waste in the future. This means that it is necessary to examine the cumulative effect on the Romanian population living in UAZ.	This Chapter 11: TRANSBOUNDARY IMPACT presents the conclusions of these chapters relating to the Romanian part of the 30 km zone covered by the assessment.
9.	It is necessary to calculate the cumulative increase in risk to human health from the operation of all these systems.	

11.3.13.2 SPECIFIC TECHNICAL REQUIREMENTS, LETTER NO. 3672/RP/18.10.2012

No.	REQUIREMENT	COMMENTS
1.	Present the technological characteristics of NNU, which will be implemented in Kozloduy NPP, comparing them with the latest requirements for nuclear safety after the Fukushima accident, as well as the	EIAR Chapter 1: ANNOTATION OF THE INVESTMENT PROPOSAL FOR CONSTRUCTION, ACTIVITIES AND TECHNOLOGIES describes the existing nuclear facilities and general-purpose plant of Kozloduy NPP, presents the main characteristics of the production process of the NNU-technology, the type and quantity of materials used, the expected waste, emissions and harmful radiation.

	significant differences with current technology, as a result of which the project is entitled "Nuclear reactor of NEXT GENERATION."	EIAR Chapter 2: STUDY OF LOCATION ALTERNATIVES (WITH SKETCH AND COORDINATES OF THE CHARACTERISTIC POINTS IN THE APPROVED COORDINATE SYSTEM FOR THE COUNTRY) AND / OR ALTERNATIVES OF TECHNOLOGY AND REASONS FOR THE CHOICE MADE FOR STUDY, WITH REGARD TO THE ENVIRONMENTAL IMPACT, INCLUDING "ZERO OPTION", section 2.3: *Alternatives options for building new nuclear unit* describes the nuclear safety of the NNU with regard to: ✓ Systems implementing the concept of defence in depth in all operating modes; ✓ Fundamental safety functions – control of reactivity, removal of heat from the reactor core, confinement of radioactive substances within specified limits under all operating and emergency conditions; ✓ Technical means which exclude human errors and / or mitigate their consequences; ✓ Degree of resistance to internal and external impacts, including earthquakes, aircraft crashes, floods, etc.; ✓ Safety functions and control of the energy unit in cases of fire; ✓ Passive safety systems; ✓ Devices and solutions for managing design-based accidents and minimizing their consequences; ✓ Additional solution for the concept of capturing the molten core. EIAR Chapter 6: CHARACTERISTICS OF ENVIRONMENTAL RISKS IN THE EVENT OF POTENTIAL ACCIDENTS AND INCIDENTS presents a risk assessment of accidents (internal impacts), accidents caused by human error, impacts caused by natural disasters, external influences caused by man.
2.	Present the design-based and nuclear safety, which form the structural framework of the NNU, which will be built at sites with several existing facilities (e.g. safety concept and principles, key safety features, regulatory requirements, integrated management)	
3.	Present the protective and auxiliary systems, including administrative measures designed to ensure the safety and security of the nuclear unit, including justification of the specific requirements to nuclear safety	
4.	Present the technical specifications (known as Restrictive working conditions – Limiting Conditions for Operation – LCOs), highlighting their importance as supporting documentation for licensing and during the operational modes of the nuclear unit	In accordance with NS-G-2.2 "Operational Limits and Conditions and Operating Procedures for Nuclear Power Plants", OLCs are developed based on the results of safety analyses and the recommendation is that the initial designs are made jointly by the designer and the operator. The thresholds from EUR and the Bulgarian regulations, which are the limiting of NNU, have been used for the purposes of the EIAR. This Chapter 11: TRANSBOUNDARY IMPACT presents the restrictive conditions -" Operational Limits and Conditions and Operating Procedures for Nuclear Power Plants "(OLCs).

5.	Brief but comprehensive presentation of the relationship between the essential requirements of European treaties or other international recommendations (e.g. IAEA, US-NRC), ratified by Bulgaria, on nuclear safety, safe management of radioactive waste and spent nuclear fuel, environmental assessment in a transboundary context, public information participation in decision-making process, etc., and their coverage by Bulgarian laws, rules and standards.	This Chapter 11: TRANSBOUNDARY IMPACT contains a list of international conventions ratified by Bulgaria, which are indispensably integrated in the Bulgarian legislation governing the safe use of nuclear energy.
6.	Present the system for management of radioactive waste, including information on spent nuclear fuel, its classification; details on where and how they are transported, and specification of transport containers.	EIAR Chapter 1: ANNOTATION OF THE INVESTMENT PROPOSAL FOR CONSTRUCTION, ACTIVITIES AND TECHNOLOGIES provides information regarding spent nuclear fuel, its classification; details on where and how they are transported, and specification of transport containers. EIAR Chapter 2: STUDY OF LOCATION ALTERNATIVES (WITH SKETCH AND COORDINATES OF THE CHARACTERISTIC POINTS IN THE APPROVED COORDINATE SYSTEM FOR THE COUNTRY) AND / OR ALTERNATIVES OF TECHNOLOGY AND REASONS FOR THE CHOICE MADE FOR STUDY, WITH REGARD TO THE ENVIRONMENTAL IMPACT, INCLUDING "ZERO OPTION", presents the estimated RAW amounts for the relevant reactor type. EIAR Chapter 4: DESCRIPTION, ANALYSIS AND EVALUATION OF THE LIKELY SIGNIFICANT IMPACTS ON THE POPULATION AND THE ENVIRONMENT, IN RADIATION OR NON-RADIATION ASPECT, AS A RESULT OF THE IMPLEMENTATION OF THE INVESTMENT PROPOSAL, USAGE OF NATURAL RESOURCES, EMISSIONS OF HARMFUL SUBSTANCES DURING NORMAL OPERATION AND EMERGENCIES, WASTE GENERATION AND DISTURBANCE, section 4.7.2.: *Radioactive waste* analyses inter alia the RAW management system of the NNU at the Kozloduy NPP site. This Chapter 11: TRANSBOUNDARY IMPACT, section 11.3.8 – *Description of radioactive waste management activities at Kozloduy NPP in their technological sequence* presents: the treatment of solid and liquid waste, packaging of conditioned RAW, transportation of solid RAW and containers used to transport spent nuclear fuel.

7.	Description of nuclear and radiological characteristics in terms of safety of the plant, in the context of the implementation of an Integrated Management System (Safety Management, Quality Management, safeguards and security, environmental protection, health and safety at the workplace, financial agreements).	This Chapter 11: TRANSBOUNDARY IMPACT presents the existing Integrated Management System (IMS) at Kozloduy NPP that integrates all management aspects and ensures consistency in the implementation of all safety, occupational health and safety, environment, security, quality and economic requirements, so as to ensure highest priority to safety. An IMS for the new nuclear unit is under implementation.
8.	Analyze the result of the assessment of the impact of the operation of the new nuclear unit on existing and functioning capacities (and vice versa) at the site of the nuclear power plant, as a whole.	An assessment of the impact of the operation of the new nuclear unit on existing and functioning capacities (and vice versa) will be made at the stage of development of a preliminary report on the safety analysis required at the stage of issuing an order for licensing of the selected site.
9.	Present the main aspects of the environmental monitoring system in accordance with the international, European and national nuclear regulations.	The monitoring system is in accordance with the international, European and national nuclear regulations. EIAR Chapter 9: MONITORING presents the current system for radiation and non-radiation environmental monitoring of Kozloduy NPP EAD in its various components and factors, and proposes updates of the existing system for self-monitoring of the environment after the construction of the NNU.
10.	Compile a detailed list of possible emergency scenarios including design-based accidents (Design-based Accidents – DBA) and beyond design-based accidents (Beyond Design-based Accidents – BDBA, plus major accidents)	An indicative list of postulated initiating events and the categories to be considered in the safety analysis of NPs with pressurized water reactors as required by the Regulation on ensuring the safety of nuclear power plants issued by the NRA: 1. Category 1. Steady and transient states during normal operation: 1.1. Start up. 1.2. Power operation. 1.3. Keeping in hot condition. 1.4. Stop until hot. 1.5. Stop until cold. 1.6. Reload. 1.7. Operation with an inactive loop. 1.8. Temperature increase and decrease at maximum permissible speed. 1.9. Step load (10%). 1.10. Variation of the load (at a rate of 5% per minute) in the power range between 15 and 100%. 1.11. Derating 100% to own needs using the dump. 1.12. Permissible limit states according to the limits and conditions for operation. 2. Category 2. Estimated operational events at a frequency

		of occurrence of more than 10^{-2} per year: 2.1. Inadvertent withdrawal of a control rod group at subcritical reactor. 2.2. Inadvertent withdrawal of a control rod group with reactor power. 2.3. Static misalignment in height of a control rod or drop a control group. 2.4. Inadvertent reduction in the concentration of boron in the coolant, partial loss of flow through the core. 2.5. Inadvertent closure of main steam isolation valve. 2.6. Complete loss of load and / or turbine generator. 2.7. Loss of main feedwater flow to the steam generators. 2.8. Improper functioning of the system for main feedwater to the steam generators. 2.9. Complete loss of offsite power (up to 2 hours). 2.10. Increase in turbine generator load above the rated one. 2.11. Temporarily lowering the pressure in the coolant of the reactor (inadvertent injection in the pressure compensator). 2.12. Inadvertent opening of a steam generator safety valve or pressure relief in the secondary circuit due to a single failure. 2.13. Inadvertent activation of the system for emergency heat removal from the core. 2.14. Malfunctioning of the system for normal topping of coolant of the reactor. 2.15. Very little loss of reactor coolant (e.g. vie pulse line). 3. Category 3. Accidents of low frequency of occurrence in the range between 10^{-2} and 10^{-4} per year: 3.1. Loss of coolant from the coolant of the reactor (small leak). 3.2. Pipeline rupture in the secondary circuit (small leak). 3.3. Forced reduction of coolant flow in the reactor. 3.4. Improper loading and subsequent operation of the fuel assembly in the core. 3.5. Withdrawal of a control rod group in power operation. 3.6. Inadvertent opening and sticking of safety valve of the pressure compensator. 3.7. Leak from tank of the system for normal feeding of coolant of the reactor. 3.8. Leak from tank of a system of gaseous radioactive release. 3.9. Leak from tank of a system for storage of liquid radioactive waste. 3.10. Rupture of a steam generator tube without previous iodine spiking. 3.11. Complete loss of offsite power (up to 72 hours). 4. Category 4. Design-based accidents with very low frequency of occurrence in the range between 10^{-4} and 10^{-6} per year: 4.1. Rupture of main steam pipe. 4.2. Rupture of main feedwater pipe.

		4.3. Jammed rotor of the main circulation pump. 4.4. Ejection of any control rod group. 4.5. Loss of coolant from the coolant of the reactor, including bilateral guillotine break of the pipeline with the largest diameter. 4.6. Accidents during fuel handling. 4.7. Rupture of a steam generator tube with previous iodine spiking. EIAR Chapter 6: CHARACTERISTICS OF ENVIRONMENTAL RISKS IN THE EVENT OF POTENTIAL ACCIDENTS AND INCIDENTS provides an assessment of the risk of accidents (internal impacts), accidents caused by human error, impacts caused by natural disasters, external influences caused by man, including classification of the accidents – design-based or major. As regards the assessment of **beyond design-based accidents** it should be pointed out that this early stage of project development (stage of feasibility study) does not involve the full scope of data required for the assessment in the context of the specific technical requirements raised by the Republic of Romania – they will be available at a later stage, when a particular model of reactor is selected, and when the documents relating to the licensing of the project are developed in accordance with the harmonized Bulgarian legislation in the field of the safe use of nuclear energy for peaceful purposes. These documents include a Statement of safety analysis (SSA), Probabilistic Safety Analysis (PSA) and Technological Regulation (TR), and will be prepared at the detailed design stage for the selected model PWR of latest generation, taking into account the particular conditions at the site of Kozloduy NPP.
11.	Analysis of the main results of the probabilistic assessment of nuclear safety, with emphasis on beyond design-based accidents (BDBA), events that can cause them, and description of major accidents	In order to achieve probabilistic safety targets, reactor manufacturers perform probabilistic safety analyses (PSAs) level 1 and 2 during the design of nuclear power plants. These tools for safety assessment identify weaknesses in the design or conditions that may endanger the safety of the plant. PSA Level 1 analysis determines the frequency of accidents or events that could lead to core damage. Level 1 considers initiating events such as equipment failures, transient operating conditions of the plant, as well as internal and external events and fires. PSA Level 2 analysis determines the frequencies and levels of radioactive releases. These analyses include additional failures and events that cause core meltdown, damage to hull, loss of control of the fission products and loss of integrity of the containment. The information (including probabilities) from PSA Level 1 analysis is used to analyze accident sequences defined in the PSA level 2. As regards the assessment of beyond design-based

		accidents it should be pointed out that this early stage of project development (stage of feasibility study) does not involve the full scope of data required for the assessment in the context of the specific technical requirements raised by the Republic of Romania. They will be available at a later stage, when a particular model of reactor is selected, and when the documents relating to the licensing of the project are developed in accordance with the harmonized Bulgarian legislation in the field of the safe use of nuclear energy for peaceful purposes. These documents include a Statement of safety analysis (SSA), Probabilistic Safety Analysis (PSA) and Technological Regulation (TR), and will be prepared at the detailed design stage for the selected model PWR of latest generation, taking into account the particular conditions at the site of Kozloduy NPP. Probabilistic safety assessments (PSA Level 1 and PSA Level 2) carried out for reference designs for the considered models of Generation III and III+ nuclear installations, revealed the following major findings and conclusions: • Probability of core damage at rated internal initiating events, internal and external natural and human impacts (including earthquakes, fires, floods, impact of aircraft, etc.) – within $5.0x10^{-7}$ to $6.0x10^{-7}$ 1/year (events per reactor year). These results show much better level of safety, given the statutory criteria of $1.0x10^{-5}$ 1/year according to the Bulgarian legislation harmonized with the recommendations of the IAEA; • Frequency of major radioactive releases into the environment where it is necessary to take emergency protective measures for the population – within $1.0x10^{-7}$ to $6.0x10^{-8}$ 1/year. Against statutory requirement $<1.0x10^{-6}$ 1/year this means that modern reactors provide wide margin of probability of occurrence of accident sequences that could lead to taking urgent protective measures for the population. The estimates of radioactive releases from beyond design-based accidents (BDBA), made for reference models of nuclear installations, demonstrate that they comply with the legal requirements of the Bulgarian legislation (for major accidents, the limit of cesium-137 in the atmosphere, which does not require long-term restrictions on the use of soil and water in the monitored area is 30 TBq), and to limited impact criteria of EUR for beyond design-based accidents (BDBA): (1) No action on emergency protection beyond 800 m. (2) No delayed action beyond 3 km. (3) Without long-term action beyond 800 m. (4) Limited economic impact.
12.	Discussion of the main results of the analysis of the risk of	Main conclusions and findings of stress tests of Kozloduy NPP associated with estimates of seismic hazard for the

	events such as earthquakes, floods, fire, explosions, extreme weather conditions, missiles, plane crashes, human activities in the vicinity of the plant, etc.	site. The present seismic characteristics of Kozloduy NPP were defined in the period 1990 – 1992, and apply to all facilities at the site. **Reassessment of the seismic design basis** New seismic characteristics were determined for Kozloduy NPP in the period 1990 – 1992 in a joint project with the IAEA – BUL 9/012 'Site and Seismic Safety of Kozloduy and Belene NPPs' with additional analysis of the influence of local earthquakes and other specific parameters. Probabilistic and deterministic methods were used to define seismic levels for recurrence periods respectively 100 and 10,000 years based on the tectonic, geological, geomorphological, seismic and geophysical data. Thus, the following values for the Kozloduy NPP site were determined: • Recurrence level 100 years peak ground acceleration (PGA) -0.10g, • Recurrence level 10,000 years peak ground acceleration (PGA) – 0:20g, • Design floor response spectra for the free surface and the corresponding three-component accelerograms lasting 61s. On the recommendation of the IAEA, the impact of local earthquake was also investigated. Specific response spectra for the free surface of local earthquakes and the corresponding ternary accelerograms (lasting 20 s) were determined. Seismic data – seismic levels, design floor response spectra free surface and the corresponding three-component accelerograms were reviewed and confirmed by IAEA experts in the period 1992 -2008. The so-called Review Level Earthquake (RLE) was also defined. This is the level against which all Structures, Systems and Components (SSC) of first seismic category are checked; it applies to already designed and commissioned plants (such as Kozloduy NPP). **Methodology to reassess the seismic design basis** The reassessment of the seismic characteristics of Kozloduy NPP was carried out under the IAEA project 'BUL' in the period 1990-1994 on the basis of then applicable IAEA documents[46] [47]. Two standard levels of peak acceleration with recurrence periods respectively 100 (Seismic Level -1) and 10,000 years (Seismic Level 2) are defined on the basis of tectonic, geological, geomorphological, seismic and geophysical data using probabilistic and deterministic methods. The RLE is

[46] Safety Series No.50-SG-S1 (rev.1) "Earthquake and associated topics in relation to nuclear power plant siting".

[47] Safety Series No.50-SG-D15 "Seismic Design and Qualification for NPP", replaced by Series No NS-G-1.6 Seismic Design and Qualification for Nuclear Power Plants Safety Guide, IAEA, 2003.

defined according to the rules for defining Seismic level -2.
The methodology of probabilistic seismic hazard analysis is based on the standardized mathematical model Cornel and the software products McGuire 1976 and Toro and McGuire 1988.
Seismotectonic characteristics of the local and regional area of Kozloduy NPP are defined on the basis of integrated geological, geophysical, geodetic, geomorphologic, seismic, seismologic, etc. studies and the results are presented in the scope and scale required in[1].
In summary, the result led to the following main conclusions:

- in the surveyed area there are no major fault structures with high energy potential (no evidence of active 'capable' fault);
- Kozloduy NPP is located in the relatively most stable part of the Moesian platform. This conclusion is confirmed by the database, which is being complied in the course of 14 years already by the local seismological network around the site.

The used earthquake catalogue covers the period 375-1990. Catalogue data are statutory and standardized in accordance with the existing requirements. The intensity of earthquakes is measured by the MSK-64 scale. The catalogue contains 812 independent seismic events.

Evaluating the adequacy of the reassessed seismic design basis of the Kozloduy NPP

All aspects and stages of the reassessment of the seismic characteristics have been discussed on numerous missions involving IAEA experts and leading professionals from Bulgaria, Macedonia and Romania as well as representatives of the NRA and Kozloduy NPP. Estimates presented in the final report of the IAEA missions conducted in 1992 – 2002 can be regarded as sufficient to certify the adequacy of the seismic design basis. Indirectly, the so determined seismic input is validated and adopted by the evaluation of subsequent activities with international participation that are reviewed and approved by organized missions of international experts.

Conformity with current regulations and standards

The reassessment of the seismic characteristics of the site is mainly based on the IAEA Safety Standard[48] . After performing a comparative analysis on the basis of the presently applicable standard[49] and that from the time of the reassessment[50], it was found that the seismic characteristics reassessed in 1992 and the additional

[48] Safety Series No.50-SG-S1 (rev.1) "Earthquake and associated topics in relation to nuclear power plant siting".

[49] IAEA Safety Standards Series No. SSG-9 "Seismic Hazards in Site Evaluation for Nuclear Installations", 2010.

[50] Safety Series No.50-SG-S1 (rev.1) "Earthquake and associated topics in relation to nuclear power plant siting".

studies in 1995 satisfy the requirements of the current document and of the Regulation on ensuring the safety of nuclear power plants, in force since 2004**,** as follows:

- The site must not be located directly on an active fault;
- The peak ground acceleration at the free surface in an earthquake (PGA) with a recurrence period of 10,000 years must be less than 0.4g.

Adequacy of the current design basis

The seismic characteristics of the Kozloduy NPP site, reassessed in 1992, together the additional studies in 1995 for local earthquakes and probabilistic determination of seismic effects, comply with current regulations. The requirements [51] are satisfied as follows:

- In the surveyed area of Kozloduy NPP there are no major fault structures with high energy potential (no evidence of active 'capable' fault)
- The Kozloduy NPP site is assessed for recurrence period of 10,000 years and PGA 0.2g.

Floods

After the stress tests of nuclear facilities at Kozloduy NPP, one of the required assessment metrics is for probabilistic assessment of extreme weather events as well as a combination of them. Such assessments will be made for the NNU and will be taken into account at the implementation stage. As regards the risk of flooding at the site it can be said that the maximum water level of the Danube in the analysis of natural phenomena (including extreme ones) and the anthropogenic causes will be considered in the context of the implementation of NNU at the relevant site. It is planned to use a methodology in accordance with IAEA recommendations set out in the Meteorological and Hydrological Hazards in Site Evaluation for Nuclear Installations, IAEA Specific Safety Guide No. SSG-18, IAEA, Vienna, (2011).

Risk of anthropogenic events

The risk analysis of the possible hazardous events in the 30-kilometer zone of Kozloduy NPP has confirmed the absence of significant industries, civil airports, military airports and polygons, major warehouses / depots for combustible liquids and gases. It can be concluded that by their nature the industries and infrastructures involve zero or predominantly low risk impacts at the existing four potential new sites. The most significant potential sources of dangerous anthropogenic impacts (outside the existing NPPs) are the proposed pipelines: UGS Chiren-NPP-Oryahovo, "Nabucco" and "South Stream". Although at the time these pipelines are at a "proposed project," phase, referring to the long horizon of the design-construction-operation of a new nuclear power plant, they should be considered when choosing a suitable site.

The analysis of potential sources of anthropogenic impacts

[51] Regulation on ensuring the safety of nuclear power plants, Council of Ministers Decree 172/19 July 2004.

		established the following main sources of dangerous anthropogenic impact in the 30-kilometer zone around the assessed four sites: ✓ Air traffic in the 30-kilometer zone ✓ Kozloduy NPP ✓ Pipeline UGS Chiren – NPP – Oryahovo – at proposed project phase ✓ Gas pipeline "Nabucco" – at proposed project phase ✓ Gas pipeline "South Stream" – at proposed project phase The evaluation of the parameters of the described anthropogenic impacts at the site of the NNU can be summarized as follows: (1) Aircraft impact – The probability of falling plane is calculated at > $1.0x10^{-6}$ which means that this event should be considered in the assessment of safety. In addition, as a requirement under the national law, aircraft impact must be considered in the design of SSCs of the nuclear facility. (2) The analysis of potential impacts (fire, explosions, gassing) from the facilities located at the Kozloduy site demonstrates that they do not pose a danger to the other sites. (3) The analysis of the worst-case natural gas explosion from the described pipelines demonstrates that their impact at the Kozloduy NPP site does not constitute a hazard.
13.	Present the thresholds of different doses (e.g. individual, collective, annual etc.) and the resulting emission levels of radioactive substances into the air and water during normal operation and accidents, compared to European standards and taking into account the impacts on the environment and population in the Republic of Romania. Clarify the validity of the assumptions used in the calculations; the method of determining the resulting emission limits, identify the critical groups of the population; scenarios and description of routes of exposure of the population.	This report presents estimates of individual and collective doses to the population in the 30 km zone of gas-aerosol and liquid radioactive releases from the NNU. Under all operating conditions of the NNU the individual annual effective dose from internal and external exposure of the population, caused by the impact of liquid and gaseous releases to the environment must not be higher than 0.05 mSv (instructions in NRA letter no. 47-00-171/12.02.2013). **(1)** The assessment of the individual and collective doses examines all possible routes of exposure (internal and external). The assessment of external and internal exposure to gas-aerosol releases takes into account the following routes of impact: • External exposure to radioactive cloud; • External exposure resulting from deposits on the ground; • Internal exposure by inhalation; • Internal exposure during consumption of radioactive contaminated foodstuffs. The assessment of external and internal exposure to liquid releases takes into account the following routes of impact: • Presence in the waters of the Danube – external exposure during swimming and boating;

- Contact with coastal sediment at the Danube River – external exposure due to bottom sediments and presence on the beach;
- Ingestion of products (fish) from the water of the Danube – internal exposure due to consumption of fish;
- Presence on areas irrigated with water from the Danube – external exposure;
- Ingestion of vegetable products irrigated with water from the Danube (fruits, vegetables, etc.) – internal exposure;
- Ingestion of meat and milk from livestock that use drinking water from the Danube – internal exposure;
- ingestion of meat and milk from animals fed with animal feeds irrigated with water from the Danube – internal exposure;
- Consumption of drinking water – internal exposure.

Estimates of radiation risk are in the following range:

a. Risk of radiation-induced cancer for the entire population and for persons in working age;
b. Risk for hereditary diseases for the entire population and for persons in working age;
c. Risks and damage to certain tissues of the entire population;
d. Risks of hereditary diseases for first generation and for two generations;
e. Risks of hereditary diseases of the reproductive part of the population evaluated for two generations with the first generation irradiated before the second one;
f. Risks of hereditary diseases of the reproductive part of the population, estimated in the first generation after exposure.

(2) The Bulgarian thresholds for the various individual doses are provided in the Regulation on the basic norms of radiation protection – BNRP-2012. The Regulation was issued in 2012 and implements a number of important amendments and additions, taking into account the new and amended documents of the International Atomic Energy Agency (IAEA) and the International Commission on Radiological Protection (ICRP) published after 2006, and changes in international conventions and treaties. The Regulation lays down:

- main (primary) level of doses from external and internal exposure (i.e. the annual effective dose limits for personnel and the population and the equivalent doses to the eye lens, skin and limbs);
- secondary (derivative) limits for external and internal exposure of personnel and population;
- limits for the purposes of radiation control and defence planning (control levels).

The EIAR estimates of the annual effective dose per capita were compared with: the permissible limit for the national

		population of 1 mSv/a (BNRP-2012); the limit of clearance 10 μSv/a (BNRP-2012); the limit of exposure by radioactive discharges from the NNU under all operating conditions 0.05 mSv/a (instructions as per NRA letter no. 47-00-171/12.02.2013) and the background radiation typical for this geographic area 2.33 mSv/a. The statutory collective doses were compared with average data for PWR reactors in the world (UNSCEAR Report-2000, 2008). As regards the gas-aerosol releases, AES-92 and AES-2006 have lower design values than AP-1000, but this may be due to the highly conservative approach of Westinghouse in their determination. The models demonstrated that the proportion of individual effective dose of gaseous releases into the environment from NNU model AP-1000 is well below the values of administrative quota of 0.05 mSv, determined by NRA (letter no. 47-00-171/12.02.2013), namely 1.198%. For AES-92 and AES-2006 the proportion of the individual effective dose from gaseous releases into the environment is 0.0358%. Therefore, all three models of reactors meet the legal requirements. As regards the gas-aerosol releases, the modelling demonstrated that the maximum individual dose within the 30 km zone of the design base liquid releases of AP-1000 for all operational states are only 2% of the administrative quota of 0.05 mSv. Against the limit of EUR for design-based liquid discharges, the modelling As regards the gaseous and aerosol releases that at all operational states of the new unit the maximum dose is about 0.6% of it. Because the reactors AES-92 and AES-2006 fully meet the requirements of the EUR, the latter shows that they also comply with the regulatory requirements. The maximum annual effective dose to the population within the 30 km zone off Kozloduy NPP from liquid and gaseous radioactive emissions limits as per the EUR, is estimated at 0.92 μSv/a, which is 1.84% of the quota 0.05 mSv/a and is about 0.04% of the natural background radiation (2.33 mSv). The maximum annual effective dose to the population within the 30 km zone of Kozloduy NPP from liquid and gaseous emissions into the environment of AP 1000 is estimated at 1.59 μSv/a, which is 3.18% of the quota 0.05 mSv/a and is about 0.07% of the natural background radiation (2.33 mSv). The analysis demonstrates that the implementation of the project is not expected to have cross-border environmental impact on the territory of Romania. The underlying mathematical models and estimates demonstrate that the additional radiation exposure of the population within the

		30 km zone from the operation of the NNU is negligible and is not expected to have cross-border impact. EIAR Chapter 6: DESCRIPTION OF ENVIRONMENTAL RISKS IN POTENTIAL ACCIDENTS AND INCIDENTS presents a risk assessment of accidents taking into account the impacts on the environment and population in the Republic of Romania, and the results were compared with the European norms. Radiological results of the analyzed accidents, as can be inferred from analyses, testify to the acceptability of environmental risks. Results of the design-based accidents demonstrate that for any hypothetical design-based accident the human exposure does require adoption of any emergency protective measures, even the nearest habitable zone of the NNU. The models of the radiological effects of major accidents do not exceed the threshold for urgent protective measures beyond the existing emergency planning zones of Kozloduy NPP. As concerns follow-up protective measures, permanent resettlement will not be necessary even in the nearest populated area around the NNU. In this case, one cannot exclude regulation of distribution and consumption of agricultural products within 30 kilometers from the source, depending on the direction of the contamination. In conclusion is should be summarized that in accordance with the expectations more than half of the total value of the exposure will occur through ingestion. From this it is concluded that the introduction of short-term restrictions of the consumption of locally grown products would be extremely significant in reducing the dose received. The actual scope and place of subsequent protective measures will depend on the movement and development of the accident and the actual weather conditions, and in the case of long-term measures – on the comprehensive monitoring of the territory. **(3)** The dose models used have been developed in ICRP and the transfer models are contained in the methodology CREAM (Consequences of Releases to the Environment Assessment Methodology) Radiation Protection 72-Methodology for assessing the radiological consequences of routine releases of radionuclides to the environment, which is adopted in the European Union (EU). These models are validated, verified and applied in practice by the NPP for the purposes of its annual reports.
14.	Identify, present and analyze the environmental factors	The factors and components of the environment that were assessed in the EIAR are set out in the EPA (2002, last

	affected by the construction of new nuclear unit.	amended on 15.02.2013) and specified in the Regulation on conditions and procedures for assessing the environmental impact (2003, last amended 30.11.2012), and the instructions given by the Ministry of Environment and Water (MoEW) on the basis of the notification of the IP (MoEW letter no. OVOS-220/05.07.2012) and the additional information to the notification, MoEW letter OVOS-220/09.01.2013. EIAR Chapter 4: DESCRIPTION, ANALYSIS AND EVALUATION OF THE LIKELY SIGNIFICANT IMPACTS ON THE POPULATION AND THE ENVIRONMENT, IN RADIATION OR NON-RADIATION ASPECT, AS A RESULT OF THE IMPLEMENTATION OF THE INVESTMENT PROPOSAL, USAGE OF NATURAL RESOURCES, EMISSIONS OF HARMFUL SUBSTANCES DURING NORMAL OPERATION AND EMERGENCIES, WASTE GENERATION AND DISTURBANCE provides an analysis of the environmental factors affected by the construction of new nuclear unit.
15.	Summary (list) of the basic program products (programs and software) used in performing safety analysis (deterministic and probabilistic) and description of methodologies and criteria for acceptance of the results of the analysis of the consequences and likelihood of accidents	According to the Bulgarian legislation on safe use of nuclear energy, the documents Statement of safety analysis and Probabilistic safety analysis will be developed at the stage of detailed design for the specific PWR model of latest generation, taking into account the specific conditions at the site of the Kozloduy NPP. The deterministic and probabilistic analyses must be made with software products that have passed appropriate validation for such assessments. The performance of deterministic and probabilistic safety analyses is regulated in the Regulation to ensure safety of nuclear power plants and specified in the safety guides for implementing the statutory requirements, issued by the NRA: RR-5/2010 "UNDERLYING DETERMINISTIC SAFETY ASSESSMENT TA", PP-6 / 2010 "USE OF PSA SUPPORTING THE MANAGEMENT OF SAFETY OF NUCLEAR PLANTS," and RR-7/2010 "PROBABILISTIC SAFETY ANALYSIS OF NUCLEAR POWER PLANTS." The methodologies in these guidelines have been developed on the basis of the recommendations of the IAEA and those presented in EUR. The acceptability criteria for the analytical results are set out in the Regulation to ensure safety of nuclear power plants: Art. 10. (1) In all operating conditions of the plant the annual individual effective dose from internal and external exposure of the population induced by liquid and gaseous releases into the environment from all nuclear facilities at the plant site must not be greater than 0,15 mSv. (a limit of 0,25 mSv is determined for the site of the Kozloduy NPP according to the transitional and concluding provisions of the Regulation relating to nuclear plants already built by the time of entry into force of the Regulation) (2) The individual effective dose of the internal and external exposure of the population at the boundary of the

		radiation protection area and beyond must not be greater than 5 mSv in the first year following a design-based accident. (3) In major accidents, the limit of cesium-137 releases in the atmosphere, which does not require long-term restrictions on the use of soil and water in the monitored area, is 30 TBq. The combined release of radionuclides other than cesium isotopes must not cause long-term risk, starting three months after the accident, which is greater than the risk set for cesium releases within that limit. (4) The frequency of major radioactive releases into the environment, which require emergency protective measures for the population, must not be greater than 10^{-6} NP events in a year.
16.	Present information regarding the use and management of toxic and non-radioactive hazardous chemicals at the plant, as well as information on how legislative requirements in force will be applied to reduce their impact on the environment.	EIAR Chapter 4: DESCRIPTION, ANALYSIS AND EVALUATION OF THE LIKELY SIGNIFICANT IMPACTS ON THE POPULATION AND THE ENVIRONMENT, IN RADIATION OR NON-RADIATION ASPECT, AS A RESULT OF THE IMPLEMENTATION OF THE INVESTMENT PROPOSAL, USAGE OF NATURAL RESOURCES, EMISSIONS OF HARMFUL SUBSTANCES DURING NORMAL OPERATION AND EMERGENCIES, WASTE GENERATION AND DISTURBANCE, section 4.8: *Hazardous substances* provides information on the use and management of toxic and non-radioactive hazardous chemicals at the plant, as well as information on how legislative requirements in force will be applied to reduce their impact on the environment during construction, operation and decommissioning.
17.	Present an assessment of the cumulative impact of the plant on the environment in the short, medium and long term and how it will change the emergency planning zone, which will include the Romanian territory.	EIAR Chapter 4: DESCRIPTION, ANALYSIS AND EVALUATION OF THE LIKELY SIGNIFICANT IMPACTS ON THE POPULATION AND THE ENVIRONMENT, IN RADIATION OR NON-RADIATION ASPECT, AS A RESULT OF THE IMPLEMENTATION OF THE INVESTMENT PROPOSAL, USAGE OF NATURAL RESOURCES, EMISSIONS OF HARMFUL SUBSTANCES DURING NORMAL OPERATION AND EMERGENCIES, WASTE GENERATION AND DISTURBANCE analyses the impact on the components and environmental factors and confirms that the implementation of the investment proposal is not expected to have cumulative environmental impact on the territory of Romania. Underlying mathematical model-estimates demonstrate that the additional radiation exposure of the population within the 30 km zone of operation of the NNU is negligible and transboundary impact is not expected. This Chapter 11: TRANSBOUNDARY IMPACT, section *11.3.4 – Summary of the possible cumulative radiation risk in the Romanian part of the 30 km zone of surveillance* analyses and assesses the possible cumulative effect of the construction, operation and decommissioning of the NNU

		and other current and future nuclear facilities of the Kozloduy NPP. The next stages of the implementation of the new nuclear unit project after the preparation of the EIAR will include technical design for a particular PWR model of latest generation adapted to the particular conditions of the Kozloduy NPP site and its positioning. The need to review the boundaries of the Prevention and Protection Measures Zone (PPMZ) will be assessed at that time, but in any case it will not affect the territory of the Republic of Romania. The specific conditions in the area of the Kozloduy NPP for building a NNU of generation III and III + are such that the closest populated settlement is much further off the perimeter of 800 meters that provides the safety barriers in the event of a radiation accident with probability 10^{-6}/ Year, which do not require evacuation of the population. It should be noted that 30 km surveillance zone will not be enlarged after the implementation of the NNU, on the contrary it will be reduced after the decommissioning of Units 5 and 6.
18.	Description of the results of the assessment of the radiological impact on the Romanian territory, both during normal and emergency modes: design and beyond design-based accidents, including major accident	The analysis in EIAR Chapter 4: DESCRIPTION, ANALYSIS AND EVALUATION OF THE LIKELY SIGNIFICANT IMPACTS ON THE POPULATION AND THE ENVIRONMENT, IN RADIATION OR NON-RADIATION ASPECT, AS A RESULT OF THE IMPLEMENTATION OF THE INVESTMENT PROPOSAL, USAGE OF NATURAL RESOURCES, EMISSIONS OF HARMFUL SUBSTANCES DURING NORMAL OPERATION AND EMERGENCIES, WASTE GENERATION AND DISTURBANCE 4.11: *Radiological risk to the population in the event of radioactive releases* demonstrates that the implementation of the project is not expected to have radiological impact on the territory of Romania during normal operation. EIAR Chapter 6: DESCRIPTION OF ENVIRONMENTAL RISKS IN POTENTIAL ACCIDENTS AND INCIDENTS presents risk assessment of accidents (internal impacts), accidents caused by human error, impacts caused by natural disasters, external influences caused by man, including classification of the accidents – design-based and major. The radiological results of the analyzed accidents, as can be inferred from analyses, testify to the acceptability of the environmental risks. The assessment of design-based accidents demonstrates that for any hypothetical design-based accident human exposure does not cause the need for the adoption of any emergency protective measures, even the nearest habitable zone around the NNU. The models of the radiological effects of major accidents do

		not exceed the threshold for urgent protective measures beyond the existing emergency planning zones of the Kozloduy NPP. As concerns follow-up protective measures, permanent resettlement will not be necessary even in the nearest populated area around the NNU. In this case, one cannot exclude regulation of distribution and consumption of agricultural products within 30 kilometers from the source, depending on the direction of the contamination. In conclusion is should be summarized that in accordance with the expectations more than half of the total value of the exposure will occur through ingestion. From this it is concluded that the introduction of short-term restrictions of the consumption of locally grown products would be extremely significant in reducing the dose received. The actual scope and place of subsequent protective measures will depend on the movement and development of the accident and the actual weather conditions, and in the case of long-term measures – on the comprehensive monitoring of the territory. As regards the assessment of beyond design-based accidents it should be pointed out that this early stage of project development (stage of feasibility study) does not involve the full scope of data required for the assessment in the context of the specific technical requirements raised by the Republic of Romania – they will be available at a later stage, when a particular model of reactor is selected, and when the documents relating to the licensing of the project are developed in accordance with the harmonized Bulgarian legislation in the field of the safe use of nuclear energy for peaceful purposes. These documents include a Statement of safety analysis (SSA), Probabilistic Safety Analysis (PSA) and Technological Regulation (TR), and will be prepared at the detailed design stage for the selected model PWR of latest generation, taking into account the particular conditions at the site of Kozloduy NPP. Despite the more limited information available at this stage, it is nevertheless sufficient to produce the assessment of the transboundary impact from the cumulative effect of the operation of the nuclear facilities at the site of Kozloduy NPP.
19.	Description of the technical, procedural and administrative measures designed to reduce transboundary impacts both during construction and during operation	Chapter 8: DESCRIPTION OF THE MEASURES ENVISAGED TO PREVENT, REDUCE OR WHERE POSSIBLE ELIMINATE ANY SIGNIFICANT ADVERSE EFFECTS IN BOTH RADIATION AND NON-RADIATION ASPECTS ON THE ENVIRONMENT, AND A PLAN FOR IMPLEMENTATION OF THESE MEASURES describes the measures proposed to address the identified impacts.
20.	Provide a model of the spread (dispersion) of air pollutants (Dispersion modelling study for air pollutants) in adverse weather conditions and	EIA section 4.11: *Radiological risk to the population in the event of radioactive releases* presents the radiobiological effects and radiation risks for a reference individual and for estimation of the doses to the population from liquid and gaseous radioactive emissions in the Romanian territory

	analyze the impact for the Romanian territory	falling within the 30 km zone. The section also presents the modelling software as per ICRP Publication 103, The 2007 Recommendations of the International Commission on Radiological Protection – model CREAM. The models are adapted to the Bulgarian conditions, using detailed weather data (for more than 10 years) collected in the project area. This Chapter 11: TRANSBOUNDARY IMPACT also presents the diffusion model AERMOD for gaseous and dust emissions during the construction of the NNU and the resulting estimate that pollution in transboundary aspect is not expected.

11.3.13.3 ADDITIONAL REQUIREMENTS OF THE REPUBLIC OF ROMANIA AFTER CONSULTATIONS ON THE TERMS OF REFERENCE, LETTER NO. 3072/RP/06.08.2013

No.	REQUIREMENT	COMMENTS
1.	Assess the impact of water with high temperature, which is discharged into the Danube, on the various fish species that are under legal protection, with particular emphasis on the specie *Alosa Sp*. Special technical measures must be implemented by the Bulgarian side, as these fish species should not be endangered by the warm stream of discharged water. The same issue raised in NPP Cernavoda was solved by technical measures, too.	The analysis in EIAR Chapter 4: DESCRIPTION, ANALYSIS AND EVALUATION OF THE LIKELY SIGNIFICANT IMPACTS ON THE POPULATION AND THE ENVIRONMENT, IN RADIATION OR NON-RADIATION ASPECT, AS A RESULT OF THE IMPLEMENTATION OF THE INVESTMENT PROPOSAL, USAGE OF NATURAL RESOURCES, EMISSIONS OF HARMFUL SUBSTANCES DURING NORMAL OPERATION AND EMERGENCIES, WASTE GENERATION AND DISTURBANCE, section 4.9.4: *Thermal effects of the Danube* the analysis demonstrates that: If units 5 and 6 and the NNU are operated at up to 3200 MW combined capacity and the corresponding amount of warmed-up water is up to 160 m^3/s, the length of the 3°C thermal impact zone will vary in the different months from 5.0 to 20 km at maximum width 250 m. The size of the thermal impact zone is the largest typically in October. It has been found that the thermal stream moves relatively quickly to the bank and at 7-7.5 km after the discharge point the difference between the temperature of the water and the thermal stream reaches 1.8°C (dissipation of about 80%). Based on the above results it can be concluded that for water inflows up to Q_T = 160 m^3/s the impact of heat exchange between the warmed-up water coming from Kozloduy NPP in the Danube River section from kilometer 687 (discharge of the warm channel) to 678 km (port Oryahovo) and the environment is negligible and can be ignored. Even the connection of the new unit will not cause the warm stream to reach the maximum parameters measured in natural conditions at the time when six units of the plant were operational (until 2002) and Q_T was180 m^3/s. After the commissioning of Kozloduy NPP some extent of thermal load is observed at Oryahovo (km678)

		compared to Lom (km743.3), which does not exceed the regulatory threshold of 3°C. This Chapter 11: TRANSBOUNDARY IMPACT, section *11.2.8.2.4.1 Own observations* investigates Danube mackerel (*Alosa Sp.*), which is included in the Standard form of area ROSCI0045 Corridor of Jiu River (724-661 river km). Its presence in the 30 km zone off NPP was also confirmed by Romanian fishermen responding to a questionnaire (Fish Fauna Report, Romania, Grigore Davideanu 2013). The species is a thoroughfare one and enters the Danube for breeding in May by moving in large passages in the upper layers of the water. In the past it was a valuable commercial species and has fished extensively in the Danube. In recent years, a reduction of spawning grounds and migration routes has been observed, which causes reduction of populations of Danube mackerel. In 2000, catches are considerably lower than in 1970-1980 and even from 1990-1998, the reasons are waterworks and strong variations in the water level of the Danube River, overfishing and pollution (Tatole et al. 2009). EIAR Chapter 5: DESCRIPTION AND ANALYSIS OF THE LIKELIHOOD AND DEGREE OF IMPACT OF THE INVESTMENT PROPOSAL ON THE TARGET AND PURPOSE OF CONSERVATION IN PROTECTED AREAS CONCERNED section *5.2.2.1.1 Invertebrates. Fish of the genus Alosa* assesses the NNU impact on that fish as weak, with limited scope during operation (score 2). This score does not require specific mitigation measures beyond compliance with best practices and the legal requirements for construction and operation.
2.	Assess the stage of development and expansion of the population of non-native invasive species (e.g. *Corbicula fulminea*) and their potential impact they may have on biodiversity.	This CHAPTER 11: TRANSBOUNDARY IMPACT, section *11.2.8.2.5 Details regarding protected species in the Danube that are likely to occur in the 30 km stretch (downstream or upstream the NPP area)* describes the specie *Corbicula fulminea.* The species was found for the first time in the Romanian part of the Danube in 1997 and then proliferated widely throughout the area (Popa, 2006). It was found at the delta of the Jiu in 2004, as well as downstream the river at km 510-480 (Popa 2005). Counts and trends of the population in the Romanian stretch of the Danube within the 30 km zone off the NPP are not available. High counts since the onset of the invasion in 2004 were found in the lower stream of the river in Romania.
3.	Assess the impact on flora and fauna in the project area, on both sides of the Danube, located in and outside protected areas.	This Chapter 11: TRANSBOUNDARY IMPACT, contains all information on this point in section 11.2.8.2, *Current status of flora and fauna* and section *11.2.8.2.1.2-Own observations* A summary assessment is developed so *11.3.5 – Summary assessment of the impact of the implementation of NNU on*

		biodiversity in the Romanian part of the 30 km surveillance zone.
4.	Assess the impact of the project on biodiversity in each alternative, including "zero option", i.e. if the project would not be implemented	EIAR Chapter 7: CONSIDERATION OF ALTERNATIVES AND ASSESSMENT OF THEIR IMPACT ON PROTECTED AREAS, INCLUDING THE ZERO OPTION evaluates all alternatives. In the "zero option" the natural processes of development of the habitats and species in the area are not expected to change. Due to the remoteness of protected areas and the lack of unique features at the potential sites for constructing NNU they are irrelevant as habitats and habitats of species subject to protection. For vertebrates, particularly birds, the zero option will have a positive effect given the limited human presence and the absence of disturbing noise, light, etc. Agricultural practices will continue to evolve, and arable and non-arable land will not be subject to change of land-use.
5.	Assess the cumulative impacts with other projects developed at the proposed site and its surroundings, which can harm the natural capital of Romania and Bulgaria.	In connection with the development of the EIAR, by its letter ref. OVOS-220/23.01.2013 the MoEW requested from the Romanian Ministry actual data for the territory of Romania falling in the 30 km zone around Kozloduy NPP. The answer was provided by "Kozloduy NPP-New Build" EAD to the Contractor in letter no. 297/01.04.2013, where in Section 22 "Investment plans and which ones are completed" (within 30 km around Kozloduy NPP) it was replied that there was <u>no information.</u> In this Chapter 11: TRANSBOUNDARY IMPACT, section *11.3.5.4 Cumulative impact in combination with other projects implemented at the proposed site and its surroundings, which can be harmful to the natural capital of the two states* it is concluded that in this sense, the NPP is the major industrial facility in the 30 km zone of the 4 considered sites. The site of the existing plant accommodates many diverse facilities that will not have significant cumulative effects on the Romanian protected areas. It can therefore be concluded that the potential sites for deployment of NNU cannot have any direct or indirect impact due to the fact that they are located in PA and are not sources of harmful emissions to the environment. Data from regular radiation and non-radiation monitoring of the environment in recent years also gives reason to conclude that cumulative impacts are not expected. On this basis it can be concluded that the realization of the NNU on the territory is not expected to have a significant negative impact and cumulative impact on biodiversity and the target species in the four protected areas ROSPA0010 Bistreţ (Bistrets), ROSPA0023 Confluenţă Jiu-Dunăre şi (Confluence of Jiu and Danube Rivers), ROSPA 0135 Nisipurile de la Dăbuleni şi (Sands of Dabuleni), ROSCI0045 Coridorul Jiului (Corridor of Jiu River). The impact of the realization of the NNU within the 30 kilometer surveillance range and on the integrity of the four protected areas ROSPA0010 Bistreţ (Bistrets),

		ROSPA0023 Confluenţă Jiu-Dunăre şi (Confluence of Jiu and Danube Rivers), ROSPA 0135 Nisipurile de la Dăbuleni şi (Sands of Dabuleni), ROSCI0045 Coridorul Jiului (Corridor of Jiu River) is not expected, having regard to their structure, functions and conservation purposes is. Transboundary effect is not expected.
6.	What are the measures to reduce the impact on biodiversity and the data for residual impacts after their implementation.	EIAR Chapter 8: DESCRIPTION OF THE MEASURES ENVISAGED TO PREVENT, REDUCE OR WHERE POSSIBLE ELIMINATE ANY SIGNIFICANT ADVERSE EFFECTS IN BOTH RADIATION AND NON-RADIATION ASPECTS ON THE ENVIRONMENT, AND A PLAN FOR IMPLEMENTATION OF THESE MEASURES describes the arrangements in *Table 8.1-1: Plan for implementation of measure, sub-sections* 6.1 to 6.11. This Chapter 11: TRANSBOUNDARY IMPACT, section *11.3.6.1 Measures to reduce the impact on protected areas in the Romanian part of the 30 km surveillance zone of Kozloduy NPP and the influence of residual effects after implementation* also provides detailed description of the measures together with the frequency and places of their implementation.
7.	Programme for monitoring of biodiversity, including invasive species.	EIAR Chapter 9: MONITORING, section *9.3.8.1 – Monitoring of ecological status of waters in the 30 km zone of Kozloduy NPP* describes the Programme for monitoring of biodiversity, including invasive species.

11.4 REQUIREMENTS OF THE AUSTRIAN MINISTRY OF AGRICULTURE, FORESTRY, ENVIRONMENT AND WATER MANAGEMENT (MAFEWM)

The MAFEWM has sent a letter to the MoEW, filed under refl. 99-00-68/19.03.2013, whereby Austria requests Bulgaria to provide information regarding the IP under the Convention on Environmental Impact Assessment in a Transboundary Context (Espoo Convention). Austria wishes to receive a notification and documentation regarding the scope of the EIA in order to determine whether there is potential for significant adverse environmental impacts of its territory.

As a result of consultation as per the Terms of Reference concerning the scope and content of the EIAR, a letter was received from the Austrian Ministry of Agriculture, Forestry, Environment and Water Management, ref. no. 541402 of 26.06.2013 which states that Austria will participate in the EIA transboundary procedure and lists the specific requirements.

11.4.1 RADIATION RISK DUE TO MAJOR ACCIDENT FOR THE REPUBLIC OF AUSTRIA

Detailed description of the radiological risks to the environment and of the methodology for assessment of accidents in 30 km zone off Kozloduy NPP is provided in **section 1.3.3**.

As concerns the assessment of the risk to the Republic of Austria, which is more than 750 km away, the methodology for assessment of the risk of radiological contamination in

major accidents consists of the following steps – identification of the source and subsequent calculation of the spread and impact of radioactive materials to the environment.

The estimates of the radiological consequences of major accidents are based on the system ESTE EU Kozloduy, which is adapted to reactors 5 and 6 of Kozloduy NPP and its purpose is to evaluate in parallel an emergency situation of the two reactors. ESTE EU Kozloduy contains database of sources of releases calculated and prepared specifically for emergency response at units 5 and 6 of Kozloduy NPP. The database contains sources of releases for emergencies related to spent fuel pools and emergency events at different levels of damage to the containment (leaks in the containment).

11.4.1.1 DATA INPUTS IN THE MODEL

Nuclide vector

The values of the radionuclides releases to the environment are provided in **Table 11.4-1.**

TABLE 11.4-1. TABLE OF THE SOURCE IN MAJOR ACCIDENT

Radionuclide	TBq
Xe-133	770 000
I-131	1 000
Cs-137	30

Parameters of the releases

The following input parameters were selected for calculation of the radiological consequences in accident situations – **Table 11.4-2.**

TABLE 11.4-2. TABLE OF THE INPUT PARAMETERS USED FOR CALCULATION OF THE RADIOLOGICAL CONSEQUENCES IN ACCIDENT SITUATIONS

Height of release	For major accident: 45 m and 100 m
Distribution of Iodine forms	Aerosol: 5 % Organic: 5 % Elementary: 90 %
Release time	6 hours
Thermal super-elevation of particulate matter	Zero

Weather scenarios

Typical weather conditions were used for each calculation.

TABLE 11.4-3. TABLE OF WEATHER SCENARIOS

Weather scenario	1	2	3
Wind speed [m/s]	1	5	2
Atmosphere resistance class	A	D	F
Rainfall [mm/h]	0	0	0

11.4.1.2 RESULTS

The ESTE Kozloduy software calculates prognoses and doses for each hour until the 168th hour. Tabular data of radiation parameters is provided only for the points that are in the trace of the cloud up to 48 hours.

Thus, in respect to Vienna, which is 781 km away from Kozloduy by straight line, the estimates of the effective dose for all routes of exposure and the equivalent thyroid dose for adults and children are provided in the next tables - **Table 11.4-4** for the 45 m releases and – **Table 11.4-5** for100 m releases.

TABLE 11.4-4: ESTIMATE OF THE EFFECTIVE DOSE BY ALL ROUTES OF EXPOSURE AND DOSE EQUIVALENT TO THE THYROID GLAND FOR ADULTS AND CHILDREN, 24 HOUR FORECAST IN [SV], HEIGHT OF RELEASE 45 METERS

Pasquill Class	Site			2 km – PAZ			30 km – UPMS			Maximum distance 48 hours (≈ 200 km)		
	Effective dose	Effective dose thyroid gland		Effective dose	Effective dose thyroid gland		Effective dose	Effective dose thyroid gland		Effective dose	Effective dose thyroid gland	
		Adults	Children		Adults	Children		Adults	Children		Adults	Children
A	4.28E-02	5.63E-01	1.28E-00	3.24E-03	4.18E-02	9.49E-02	9.64E-05	1.17E-03	2.67E-03	1.37E-07	1.46E-05	3.32E-05
D	6,65E-02	3.74E-01	1.31E-00	1.31E02	1.71E-01	3.87E-01	1.47E-03	1.79E-02	4.08E-02	1.16E-05	1.07E-04	2.43E-04
F	1.12E-03	1.54 E-02	3.50E-02	9.87E-03	1.30E-01	2.96E-01	9.34E-04	7.04E-03	1.60E-02	5.68E-05	2.94E-04	6.58E04

TABLE 11.4-5: ESTIMATE OF THE EFFECTIVE DOSE BY ALL ROUTES OF EXPOSURE AND DOSE EQUIVALENT TO THE THYROID GLAND FOR ADULTS AND CHILDREN, 24 HOUR FORECAST IN [SV], HEIGHT OF RELEASE 100 METERS

Pasquill Class	Site			2 km – PAZ			30 km – UPMS			Maximum distance 48 hours (≈ 200 km)		
	Effective dose	Effective dose thyroid gland		Effective dose	Effective dose thyroid gland		Effective dose	Effective dose thyroid gland		Effective dose	Effective dose thyroid gland	
		Adults	Children		Adults	Children		Adults	Children		Adults	Children
A	6.60E-04	6.85E-03	1.56E-02	4.78E-03	1.15E-03	6.04E-02	8.62E-04	6.64E-03	1.51E-03	2.59E-05	3.68E-04	6.99E-04
D	6,65E-02	8.74E-01	1.99E00	6.99E-03	9.06E-02	2.06E-01	5.04E-04	5.79E-03	1.32E-02	1.16E-05	1.07E-04	2.43E-04
F	6.02E-03	7.94 E-02	1.80E-01	9.79E-03	1.20E-01	4.54E-01	9.31E-04	6.78E-03	1.34E-02	4.50E-05	2. 30E-04	5.24E-04

The analysis of design-based accidents demonstrates that in any hypothetical design-based accident human exposure does not cause the need for adoption of any urgent protective measures, even the nearest habitable zone around the NNU.

The models of the radiological effects of major accidents did not exceed the thresholds for urgent precautionary measures beyond the existing emergency planning zones of Kozloduy NPP.

The estimates of basic radiological parameters demonstrated that protective measures must be applied in the following cases:

- ✓ **On-site:** the following urgent protective measures must be applied: *sheltering, evacuation, iodine prophylaxis, radiation control and use of personal protective equipment*,
- ✓ **in the 2 km Precautionary protective action planning zone** (PAZ) – *sheltering, evacuation and iodine prophylaxis for children and adults*,
- ✓ **in the 30 km Urgent protective action planning zone** (UAZ) – *only iodine prophylaxis for children and pregnant women*; other protective measures **not applicable**;
- ✓ **distance of 200 km** – **no protective measures required whatever** and the predicted values are about 100 times lower than the criteria for the application of protective measures.

The actual scope and place of subsequent precautions will depend on the movement and development of the accident and the actual weather conditions, and in the case of long-term measures – on comprehensive monitoring of the territory.

A widely recognized international criterion for limiting the significant release of radioactive substances into the environment is the probability of occurrence of such circumstances at least once in every 1 million years, i.e. 10^6/reactor years. The probable radiological consequences of a major accident are limited by safety requirements for new nuclear power plants in such a way that the radioactive substances must not cause any serious radiation or damage to the health of the population in the immediate vicinity of the nuclear power plant, nor lead to the imposition of long-term and wide-area restrictions in the regulation of food chains and in the use of soil or water bodies. The limitation of radiological consequences should lead to a situation where even a major accident would not require evacuation of the populated area in the nearest vicinity of the plant, nor other urgent protective measures (shelters, iodine prophylaxis) outside the emergency planning nuclear areas of the power plant.

In respect to Vienna (781 km by straight line from the Kozloduy site), the obtained estimates are lower than **1.10^{-9} Sv/h** – a value multiple times lower than the natural background radiation. It can be stated that effective doses above the negligible dose of **1.10^{-5} Sv** are not expected.

The presented results, as can be concluded from the underlying analysis, confirm the **absence of radiological risk to the Republic of Austria.**

The replies to the requirements of the Austrian Ministry of Agriculture, Forestry, Environment and Water Management in letter ref. no. 541402 of 26.06.2013 are summarized as follows:

No.	REQUIREMENT	COMMENTS
1.	The environmental impact assessment documentation should contain information regarding public participation (e.g. opportunities for public participation, time frames) to give the Austrian public equivalent options, according to Art. 2, paragraph 6 of the Espoo Convention. Austria requested that the documentation be sent in German language.	Accepted and the EIAR will comply with this requirement.
2.	As regards the scope of the EIA, Austria expects the EIA report to provide complete analysis of major accidents with long-range impact.	The presented results from modelling and analytical work demonstrate the absence of radiological risk to Austria.