Environmental Impact Assessment Report

for the Decommissioning of Units 1 to 4

at Kozloduy Nuclear Power Plant

CHAPTER 3

DESCRIPTION AND ANALYSIS OF THE ENVIRONMENTAL COMPONENTS AND FACTORS UNDER ART.4 AND ART.5 AND THE MATERIAL AND CULTURAL HERITAGE THAT WILL BE SIGNIFICANTLY AFFECTED BY THE INVESTMENT PROPOSAL, AND THEIR INTERACTION

CONTENTS

3. Description and analysis of the environmental components and factors under art.4 and art.5 and the material and cultural heritage that will be significantly affected by the investment proposal, and their interaction

According to the requirements of the Terms of Reference to develop an EIA-R for decommissioning of Units 1-4 of Kozloduy NPP [9] this chapter provides description on different environmental components and factors and important interactions during the implementation of decommissioning activities of the Units. These components and factors include:

- Atmosphere and atmospheric air
- Surface and groundwaters
- Soils
- Earth interior
- Landscape
- Natural objects
- Biodiversity
- Material and cultural heritage
- Health Risk
- Hazardous energy sources
- Waste and hazardous substances
- Discomfort
- Social and economic condition

3.1 Atmosphere

Climatic and meteorological characteristic of the region

According to the climatic division into districts of the country, the investigated site is involved in the Northern Climatic Region of the Danube hilly valley of the Moderate-continental subarea of the European-continental area. Thermal conditions are of well-expressed seasonal prevalence due to the differences of the solar radiation balance in the winter and summer periods, which outline the continental nature of the climate. This seasonal prevalence is also strengthened by the circulation conditions.

During the winter the type of the weather is a result of the continental air masses of the air moderate latitudes. These masses congest mostly to the back of the Mediterranean cyclones, passing towards the East and North-East. Rarely, from the North-East some continental air masses from the transformed arctic air reach the region causing sharp fall of temperature. Warm subtropical masses are pushed in upon passing of cyclones from the area of the Genoa gulf and South and South-West Winds blow. These circulation conditions as well as the negative radiation balance determine the general winter picture. The coldest month is January with average air temperatures appr. 2.1°C. Values of the minimal temperatures are negative from the December to March. In 80% of the cases the absolute minimal temperatures in January are about -10.0°C. Number of the days with negative minimal temperatures above -10.0°C in January is 24 days average, and the number of days with minimal temperatures below

-10.0°C is about 6 days. When the cold air is pushed in from the North and North-East the temperatures sharply go down and the minimal air temperatures reaches -29.9°C. These çoolings are accompanied with frequent winds from the North-West. Winter rainfalls in the investigated territory are about 120mm. In spite of the cold winter the snow coating is unstable and stays only in certain time periods and most often its formation starts in the first 10 days of December. The last snow coating is formed in the beginning of March.

In the beginning of spring and mainly in March the circulation conditions in the region are like the winter ones. However, in compliance with the growth of the day and sun height the radiation balance is increased. Heat conditions in the winter are formed due to the impact of two main factors, i.e. more frequent transfer of hot air masses from the smaller geographic latitudes and the reduction of the total cloudiness and increasing of the duration of the sun shining. Spring in the region comes comparatively early. Average April temperature fluctuates around 12.6^{o}C. In this season the frontal area of the moderate latitudes is displaced more to the North, which causes alternation of fast and frequent warming and cooling down. Cloudiness is substantial, especially in the second half of the spring, which is related to the Atlantic cyclones prevailing in this period of the year causing increase in rainfall. The amount of rainfalls during this season is greater than in the winter at around (160 mm).

In the summer the heat conditions are formed due to the conversion of the Atlantic warm air masses into the continental masses. This process is caused by the impact of the Azores anticyclone on by the considerable inflow of the solar radiation that contributes for the cloudless and dry summer. The average July temperatures for the region are 23.4°C. During the big summer swelterings that are mostly related to the local air overheating and in the anticyclone conditions, the maximal temperatures in the region are about 26.0 - 27.0°C, and the absolute temperature maximums are close to 39.0 - 42.0°C. Usually, such values are metered upon fuzzy baric conditions with its typical small gradients, minor cloudiness and cloudless sky.

In the summer months 80% of the days are with maximum temperatures above 30°C.

Temperature decreases during this season are mainly caused by the pushing in of the colder Atlantic air. This cooling down are quite short due to the increased conversion of the air masses into the continental ones. With such processes the weather could stay cloudy for 2-3 days with frequent rainfalls and drop down of the temperatures to 14.0 – 15.0°C.

Summer rainfall quantity is about 170mm, and the annual maximum occurs in June (72 mm).

In the autumn the total increase of the air temperatures is a result of the reduction of the radiation balance on one part and, on the other part, of the gradual restructuring of the atmosphere circulation. Considerable increase of the meridional circulation is faced when the gush out from the North and North-East becomes more frequent. In October the average air temperature in the region is 12.2°C. Rainfalls during the autumn are within 130 - 140 mm.

Annual development of the wind velocity in the investigated region has a clear maximum in the period of January-April and minimum in the months of September-

November. In the investigated territory the prevailing winds are of northwest-west direction followed by the northeast-east directions (fig.3.1-5). Most strong winds flow from northwest with average velocity of about 6.0 m/s.

In certain years the meteorological conditions strongly fluctuates about the climatic values, which is also considerably determined by the micro climatic features of the ground. For the investigation purposes of the meteorological conditions in the region of Kozloduy the change of the measured values of the meteorological elements is examined for the period 2006 - 2011, received from the automatic station installed in the region. In order to monitor the wind characteristics, the data from three points in the region of Kozloduy NPP are provided (AMC 1, AMC2 и AMC3).

The heat conditions in the region of Kozloduy NPP during the examined period from 2006 to 2011 (fig. 3.1-1) strongly fluctuate around the climate values. The hottest years are 2007, 2009 and 2010 with average annual temperature 13.1°C. The hottest winter was in 2007 and the January and February temperatures are respectively higher by 7.0 and 4.0 °C than the climatic standards. The temperatures in the summer are comparatively higher (average July temperature is by 3.4°C above the norm). Year 2006 is colder (average annual temperature is 12.2°C), especially during the colder part of the year and during the rest months the temperatures are about and above the climatic values. In 2010 the temperatures during the spring-summer period are higher compared to the other years and the average monthly value of the August temperatures reaches 26.2°C. Values of the air temperatures that are closest to the climatic norms are recorded in 2008 except the lower January temperatures (1.3°C below the norm) and the higher February and March temperatures, which are respectively by 2.4 и 3.8°C above the norm.

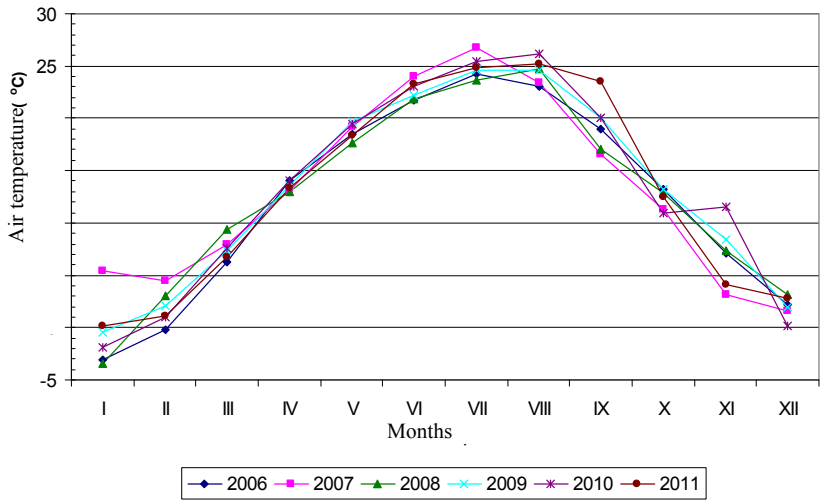


Fig. 3.1-1 Allocation of the average monthly air temperature in the region of Kozloduy NPP within the period 2006 – -2011

The absolute minimums of the air temperature vary from minus 13.6°C (23 December 2007) to minus 22.1°C (5 January 2008), and the absolute maximums in the site area reached 38.0°C (20 August 2006) - 44.1°C (24 July 2007).

The rainfalls during the period 2006-2011 strongly fluctuate and the years 2006 and 2011 are the driest ones (with annual amount from 323 mm and 363 mm

respectively). The most humid year is 2010 (the annual amount is 762.8 mm). The Internal annual allocation of the monthly rainfalls is shown on fig. 3.1-2.

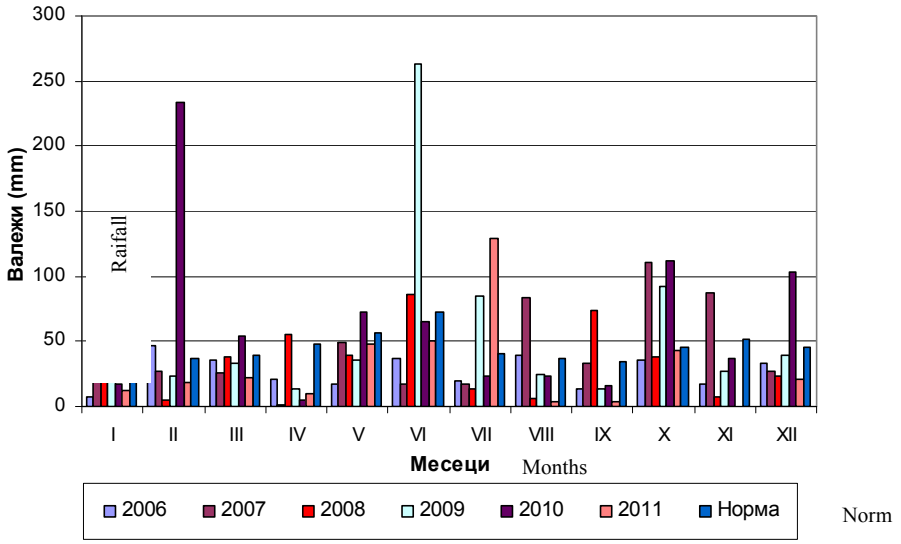


Fig. 3.1-2 Allocation of the monthly rainfalls in the region of Kozloduy NPP within 2006 – 2011

Fig. 3.1-2 clearly shows that the rainfalls in 2006 and 2011 are below the norm during all months of the year. When analyzing the data of the season allocation of the rainfalls during the specified years, it is found out that except the summer rainfalls, during the rest seasons the rainfall quantities were by 1.5 -2 times lower than the norms. The only exception are the July rainfalls (129.6mm), which are three times above the norm due to the intensive rainfalls (2.5-4.7 mm/h) during the second half of the month. The most humid year is 2010 when during the months (February, October and December) the rainfall amount is from 3 to 6 times above the norm. In 2007 the typical the rainfall season allocation was minimum during the spring (75.9mm, which is 50% of the norm) and maximum during the autumn months when their quantities reaches 231.3mm and it is approximately double the norm. In this year there was a displacement of the rainfall maximum from June to October and November. Also, the amounts of the rainfalls fallen down in August are considerable. In 2008 the rainfalls follow their normal development, nevertheless that in some months like February the rainfalls were only 5 mm, which is 7 times less than the February norm and in September the monthly quantities exceed twice the climatic values. In 2008 there were dry winter (seasonable quantity is 61.3mm or 50% of the norm) and humid summer (106.0mm), the other season quantities are close to the climatic values. During the first half and in the end of 2009 the rainfalls are close to or below the norms and in June the biggest rainfall amounts (263mm) are measured for the monitored period.

Typical for the conditions of the atmosphere moistening in the region are the values of the relative air humidity. When analyzing the existing data we found an interesting fact that during the last two years the values of the relative humidity are considerably lower than the norm, especially during the warm part of the year. Only in 2006 the allocation of the air humidity by months is close to the development of the climatic data (fig. 3.1-3).

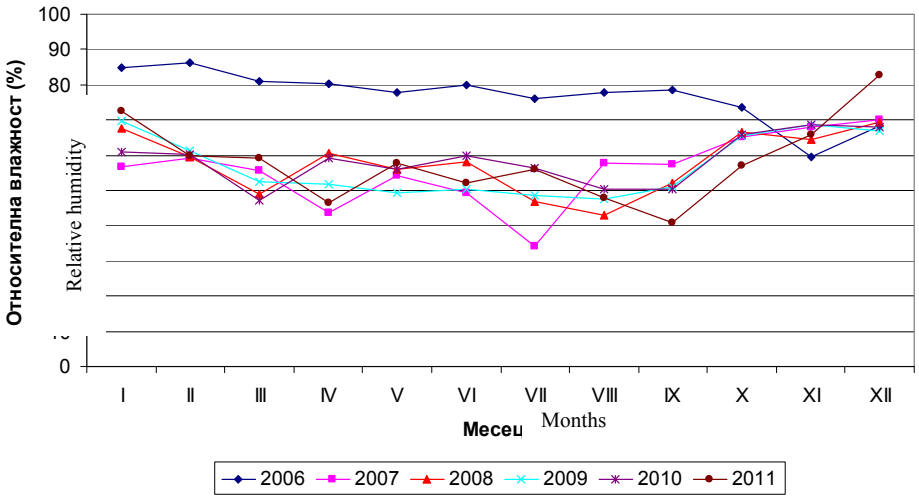


Fig. 3.1-3 Monthly allocation of the values of relative air humidity in the region of Kozloduy NPP within the period 2006 – 2011

The dynamic of the allocation of the monthly values of the wind velocity during the different years of the examined period are presented on fig. 3.1-4.

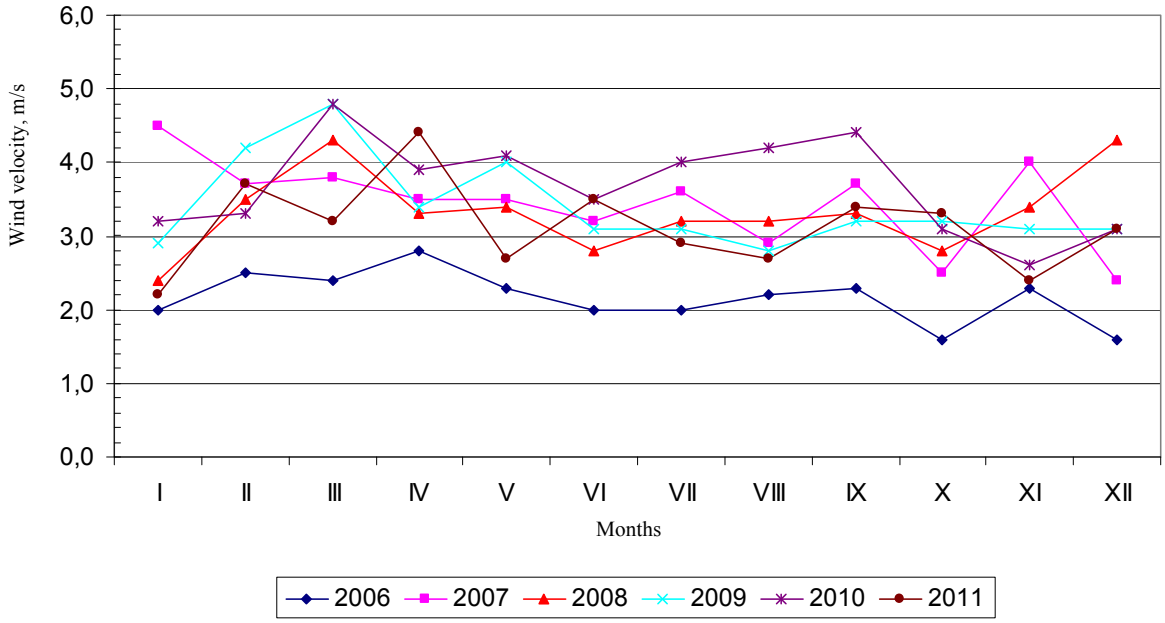


Fig. 3.1-4 Allocation of the average month velocities of the wind in the region of Kozloduy NPP within the period 2006 – 2011

As it is shown on the presented figure the average wind velocity in the different years and months fluctuates from 1.6 to 4.8 m/s. Wind velocities in 2006 are closest to the climatic values. In the other years comparatively stronger winds blow.

Data on the frequency of wind directions over the years have shown that the prevailing winds in western and southwestern component, followed by a southern, northwestern, northeastern and east. As a whole, during the years in the region of Kozloduy NPP the South-East winds are occurred most rarely. In order to prepare clearer picture of the allocation of the wind velocities towards fig. 3.1-5 shows the

annual wind rose for 2008 - 2011, demonstrating the variable wind properties during the years of the examined period.

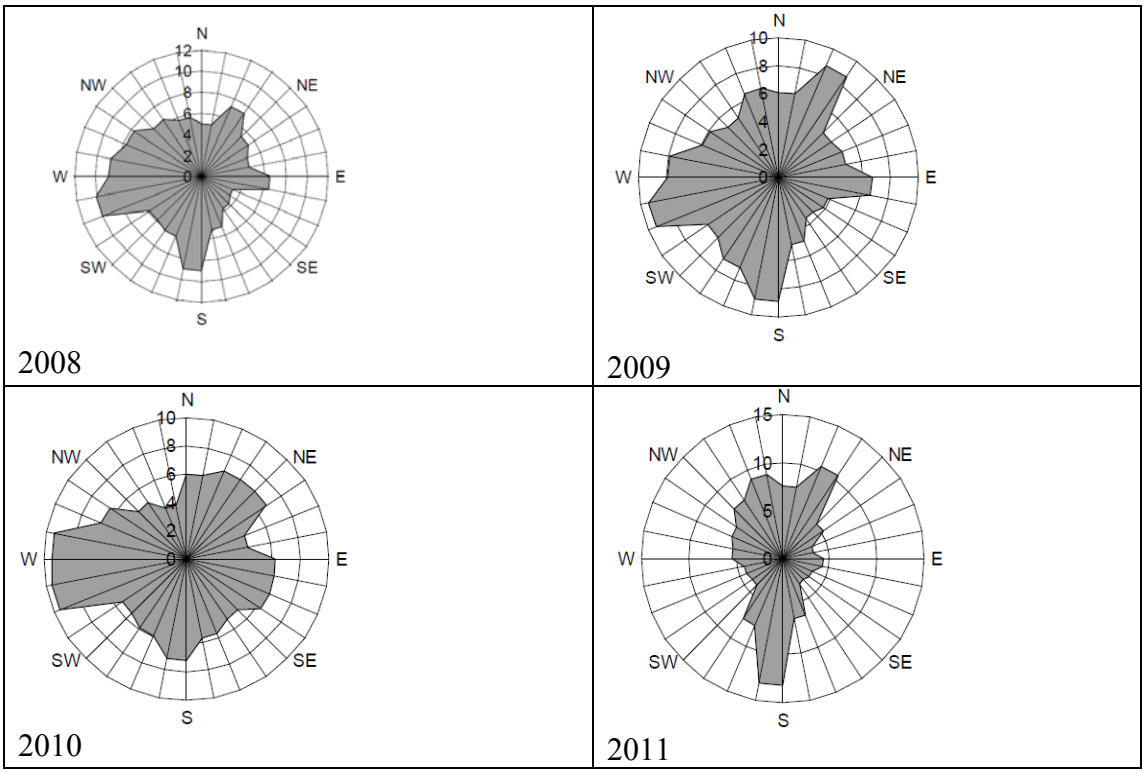
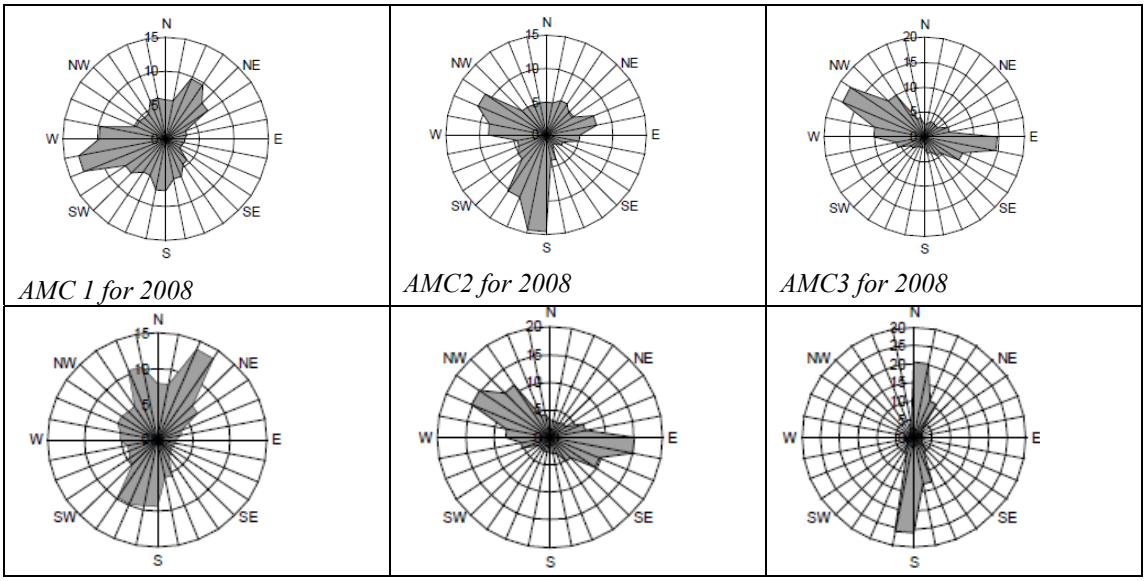


Fig. 3.1-5 Wind frequencies rose for the region of Kozloduy NPP for 2008 - 2011

Due to the importance of the information about the wind regime in the region of Kozloduy NPP for monitoring of the microclimatic features of the wind allocation, three points are used (AMC 1, AMC2 and AMC3). On fig. 3.1-6 the wind frequencies are shown by directions in the three points in 2008 and 2011. As it could be seen the microclimatic ground features have significant impact on the allocation of the prevailing winds depending on the directions.



AMC 1 for 2011	*AMC 2 for 2011*	*AMC 3 for 2011*

Fig. 3.1-6 Wind frequency roses in AMC 1, AMC2 and AMC3 for 2008 and 2011

The important characteristic of the wind regime is the frequency of the strong winds. As a strong wind the wind with velocity equal to or higher than 14m/s is considered.

According to the document "Climate of Bulgaria" (1991) [86], in the region of Kozloduy NPP the prevailing strong winds are from the West to the Northwest, which frequency very often reaches 80% (in some places up to 90%) of the cases with strong winds.

According to the region splitting of the country, presented in the same book the region of Kozloduy NPP is involved in the windy region of the country and its probable maximal wind velocity could reach 33 m/s, and the respective pressure (loading), which such wind could have on the different facilities is up to 550 N/m^2. This information is extremely important, because it is used for the calculation of the dose rate in the region of Kozloduy NPP. Based on the obtained results some actions could be undertaken in case of emergency and an assessment of the impact of Kozloduy NPP on the environment and National Emergency Plan could be elaborated.

For calculation of the dose rates in the region of Kozloduy NPP the information about the condition of the atmosphere turbulence is used, which is the main factor for distribution of admixtures into the atmosphere air. Atmosphere stability is evaluated by the classification of Pasquill. The classes under this specification are six and the first class - class A is typical for the high unstable atmosphere condition and the last sixth class F is typical for the stable condition. Atmospheric stability class is determined in all three microclimatic automatic stations. Data about the allocation of the stability classes by months for the period of 2006-2011 show that the cases of stable and neutral atmosphere condition prevail - class DE. The strong unstable conditions are rare phenomenon for the district of Kozloduy NPP and are monitored mostly in the summer, i.e. in the months of June and July. In the winter period the stable conditions of the atmosphere prevail, which is related to the frequent temperature inversions and mists in the region. The condition in December is the most stable one.

Hurricane winds and whirlwind

Based on the monitoring it has been found that the maximal velocities of the recorded winds in the region of the site do not exceed 30m/s, and with provision of 1% (per 100 years) it is possible a wind with velocity of 37-42 m/s to be faced, but no catastrophic hurricanes or whirlwinds have been recorded in the region.

For the examination, occurrence and dynamic of the whirlwind phenomenon some internationals materials are used. Whirlwind (in some countries it is called "sand-devil" or "tornado") occurs very often on the territory of the North America and less in Europe and Asia. In Europe there are average 2-5 whirlwinds per year, and over 100 – 200 in America.

In Bulgaria the whirlwind is quite rare phenomenon. Even rarely there are some conditions for occurrence of hurricanes or whirlwinds.

It is determined that the recorded hurricane winds and whirlwinds occurred mostly in the mountain and next to the mountain regions or close to the seaside. The whirlwind characteristics are as follows:

- maximal velocity 380 km/h (105 m/s);
- rotation velocity 306 km/h (85 m/s);
- velocity of the progressive motion – 80.5 km/h (22.4 m/s);
- radius complying with the maximal rotation velocity of the air flow 47.5 m;
- difference between the atmosphere pressure in the whirlwind center and its end is about 103 hPa;
- velocity of the drop down of the atmosphere pressure between the center of the whirlwind and the one at its end is about 41 hPa/s.

Probability a whirlwind with such characteristics to occur in Bulgaria and respectively in the site region is P = 9.177E-6 1/year, i.e. approximately 1.E-5 1/year.

Main conclusion that could be made is that the probability a whirlwind with such characteristics to occur over Bulgaria and respectively over the site within one year is quite small. Therefore, the impact of this phenomenon on the site safety may not be taken into consideration.

With provision P = 0.01% (probability 1 per 10000 years), the calculation of the wind velocity is 45m/s, which could be used for stability inspections applying also not combined impacts on the civil constructions and facilities of first category, providing nuclear and radiation safety of Kozloduy NPP. With provision P = 1% (probability 1 per 100.), calculated wind velocity is 37-42 m/s. This value could be used with verification not combined impacts of the rest civil structures and facilities of Kozloduy NPP.

Conclusions:

It can be concluded that the average monthly and annual values of the examined meteorological elements as well as their extreme values are within the range of the climatic ones for the region. The strong unstable conditions are rare phenomenon for the region of Kozloduy NPP and are monitored mostly in the summer. The probability a whirlwind to occur over the site is small.

3.2 Atmospheric air

3.2.1 Quality of the atmosphere air in 30km area around Kozloduy NPP on the territory of the Republic of Bulgaria

Area of urgent protection measures (30 km) covers the municipalities of Kozloduy, Mizia, Oryahovo and Vulchedrum. Quality of the atmosphere air is determined by the industrial activity, motor transport and residential sources.

More considerable emission potential sources in the region are:

- KCH "Mizia" LTD, which currently is hardly in operation or execute some paper packing.
- "Variana" OOD– Oryahovo produces cast iron moulding, but its production is strongly reduced.
- There are some other enterprises in the Oryahovo municipality such as: „Agrotechchast" JSC, "Hydrocom" LTD – they are of small capacity and restricted production and they are of local significance for the atmosphere air.
- "Butan-94" JSC the village of Butan is also a source of local importance as a source of emissions into the atmospheric air.

On the territory of Kozloduy municipality some more important sources of emissions into the atmosphere air are: asphalt facility in the village of Butan with "Putnostroyengineering" JSC, Vratsa; "Atomenergostroyprogress", "Zavodski stroezhi" and "Mechanization and transportation". These are dust sources with local activity. On the territory of the Municipality the main sources of the emissions to the atmosphere air in 2010 were not in operation (Environmental Status Report 2011, Vratsa RIEW). There are two facilities in Kozloduy NPP Municipality controlled pursuant to Ordinance N7 for permissible emission norms of volatile organic substances emitted into the atmosphere air as a result of the use of solvents in some installations: Dry Cleaning Company "Yulian Toshev" and "Atomenergoremont". Exceeding of VOC norm is not determined.

Most considerable source of emissions of oxide, hydrocarbons, nitrogen oxides etc. is the transport. Roads in the municipality have considerably high intensity of the motor traffic. Motor facilities of Kozloduy NPP have a bus, some trucks, cranes, tow-trucks etc. In the peak hours, even for short time there are conditions established for increase of the motor transport emissions.

Vulchedrum municipality is territorially involved in Montana area and the main emission sources are concentrated in the District city and are beyond the examined area. Measurement of the atmosphere pollutants is made only at one point in the town of Montana.

Quality of the atmosphere air in the Vratsa District is monitored by the Automatic Measurement Station (AMS) for the town of Vratsa and Mobile automatic station for quality control of the atmosphere air with the Regional laboratory - Pleven for the rest populated areas.

Territory controlled by Vratsa RIEWIis split in regions. One of the regions is the region of Kozloduy, which includes the municipalities: Kozloduy, Oryahovo and Mizia.

In the last 4 years in the region of Kozloduy some measurements of the concentrations of harmful substances are made by the Mobile Automatic Station for quality control of the atmosphere air in 2008 and 2011.

Results of the measured indicators: carbon dioxide, ozone, sulphur dioxide, nitrogen dioxide, ammonia, hydrogen sulphide, methane and non-methane hydrocarbons meet the permissible concentrations according to the currently effective regulations.

No program for reduction of the levels of the pollutants is required for the region according to Article 30 and Article 31 of Ordinance N 7 for Assessment and Control of the Atmosphere Air Quality [158], thus showing that the measured concentrations and harmful substances are lower not only from the permissible norm but also from the upper and lower assessment limits..

3.2.2 Atmosphere radioactivity in 100km area on the territory of the Republic of Bulgaria

3.2.2.1 Aerosols

Until May 2009 the radioactivity of the atmosphere air is investigated annually at 11 control point within 100 km monitored area (MA) around NPP and after that new type of filters – LB-5211 have been commissioned and sampling period become two weeks. Summarized data about the aerosols monitoring conducted during the period 2009-2011 are shown in table 3.2.2.1-1 (Results of the radio ecological monitoring of Kozloduy NPP, Annual reports 2009, 2010, 2011 [190]).

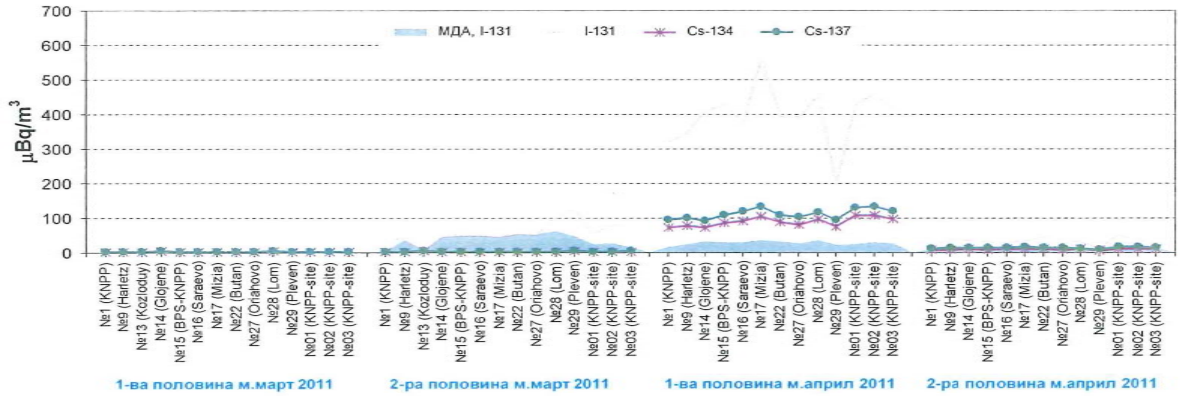
Table 3.2.2.1-1 Data about the conducted aerosols monitoring

Year	Number of analyses	Type of the analyses	Results
2009	231	gamma-spectrophotometric	Within normal limits with reported background values of ^{137}Cs within the range of 0.4- 9,1 µBq/m^3, average 2,0 µBq/m^3 The results of total beta activity (until April) within the range of 0,14-1,95 mBq/m^3, average 0,63 mBq/m^3
2010	264	gamma-spectrophotometric	Within normal limits with reported background values of ^{137}Cs within the range of 0.3- -11.3 µBq/m^3, average 2,8 µBq/m^3
2011	260	gamma-spectrophotometric	Within normal limits with reported background values of ^{137}Cs within the range of 0.8-10 µBq/m^3, average 2,8 µBq/m^3

Year	Number of analyses	Type of the analyses	Results

The results for ^{137}Cs of the gamma-spectrometric analysis in 2009 and 2010 are within the limits of the probable minimal activity (PMA), respectively in the range of 0.4-9.1 µBq/m^3, average 2,0 µBq/m^3 – for 2009 and 0.3-11.3µBq/m^3, average 2.8 µBq/m3 – 2010. These are typical values for the surface air in the region.

In 2011 the exception is the aerosol activity in April as a result of the transboundary transmission of radioactive contaminated air masses in Fukushima NPP. The results show increasing of the anthropogenic activity within the range of – ^{131}I: 31—2240µBq/m^3, ^{134}Cs: 33 – 456µBq/m^3 and of ^{137}Cs: 38 – 6373µBq/m^3 (fig.3.2.2.1-1). The analysis of the results shows that the origin of this pollution is Fucushima NPP, which suffered an accident. Recorded radioactivity of ^{137}Cs in the air is about 10^5-10^6 times lower than the norms in the country (AAPC for ^{137}Cs according to Basic Radiation Protection Norms -2012 is 3.2 Bq/m^3).



Legend: *1-ва половина м.март 2011 – 1st half of March 2011*
2-ра половина м.март 2011 – 2nd half of March 2011
1-ва половина м.април 2011 – 1st half of April 2011
2-ра половина м.април 2011 – 2nd half of April 2011

Fig. 3.2.2.1-1. Radioactivity of the aerosols in 100 km area of Kozloduy NPP Mart-April 2011, Basic norms on radiation protection (BNRP): ^{131}I – 7.3 Bq/m^3, ^{134}Cs – 6.0 Bq/m^3, ^{137}Cs – 3.2 Bq/m^3

On fig. 3.2.2.1-1 are shown long-term results of the activity of ^{137}Cs and ^{7}Be in the surface air of post 9 (village of Hurlets), located on the border of 3km of the Preventive Protection Measures Zone (PPMZ) from the wind side of Kozloduy NPP The figure shows the background activity of ^{137}Cs (appr. 1000 times less) compared with the natural radioactivity of the cosmogeneous ^{7}Be.

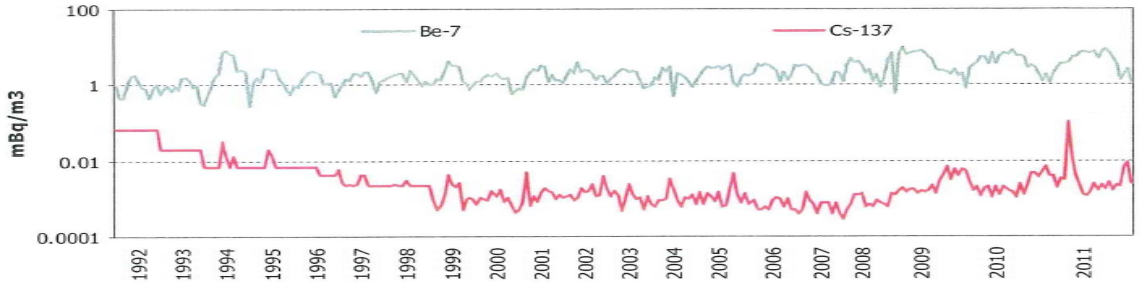


Fig. 3.2.2.1-2. Radioactivity of the surface air (mBq/m^3) from the region of Kozloduy NPP, post 9 (village of Hurlets), 1992-2011

It can be concluded that all measured activities in the aerosols are hundred up to thousand times lower than the permissible norms.

3.2.2.2 Atmosphere settlements

Atmosphere settlements are controlled monthly at 33 of 36 control points within 100km monitored area around the Kozloduy NPP. Summarized data about the aerosols monitoring conducted during the period 2009-2011 are shown in table 3.1.2.2.2-1 (Results of the radio ecological monitoring of Kozloduy NPP, Annual reports 2009, 2010, 2011 [190].

Table 3.2.2.2-1 Data about the monitoring conducted of the atmosphere settlements.

Year	Number of samples	Number of analyses	Type of the analyses	Results
2009	396	806	396- gamma-spectrophotometric 806 - radiometry by total beta activity 14 – with radiochemical isolation of strontium	Within normal limits – values by total beta activity within the range of 0.046-2.39Bq/m^2*d with average annual value 0.42Bq/m^2*d
2010	394	802	394- gamma-spectrophotometric 394 - radiometry by total beta activity 14 – with radiochemical isolation of strontium	Within normal limits – values by total beta activity within the range of 0.043-1.84Bq/m^2*d, with average annual value 0.48Bq/m^2*d
2011	396	820	396 - gamma-spectrophotometric 396 - radiometry by total beta activity 28 – with radiochemical isolation of strontium	Within normal limits – values by total beta activity within the range of 0.058-1.96Bq/m^2*d, with average annual value 0.43Bq/m^2*d

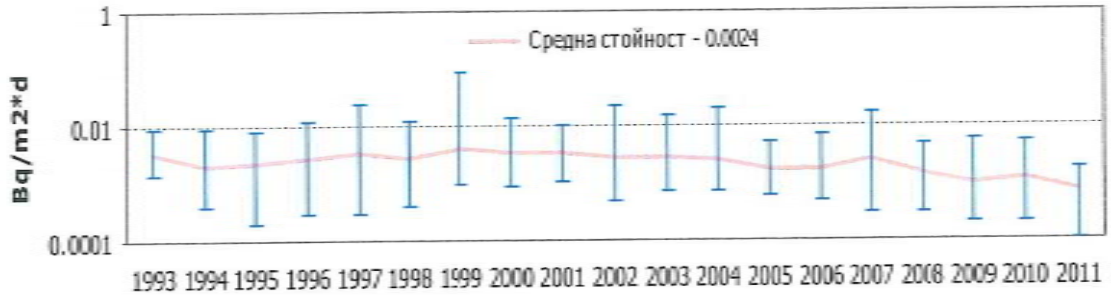
The presented data show that the total beta activity has the natural values typical for the region. Slightly seasonable dependence is detected with small values during the winter months and spring-summer period that is a result of the intensive rainfalls and self-purification of the atmosphere leading to reduction of the activities of the settlements.

The presented data of the analysis of ^{90}Sr in the atmosphere settlements for radii and reference points in 100km area show that the measured values are much lower than PDA (Annual reports on the radioecological monitoring of Kozloduy NPP (2009, 2010, 2011) [190], respectively:

In 2009 – are within 0.2-5.8 Bq/m^2*d, with average for all 33 points – 1.0 Bq/m^2*d. The maximal value is measured in 2 half-year at point 30 in the town of Berkovitsa

In 2010 – they are within 0.2-5.0 Bq/m^2*d, with average for all 33 points – 1.2Bq/m^2*d. The maximal value is measured in 2 half-year at point 30 in the town of Berkovitsa. The higher activities in the samples from this point are related to the wind transfer of dust from the surface soil layer, which at this point has higher anthropogenic activity. Similar less effect is monitored at point 29 (Pleven) and at point 28 (Lom).

In 2011 – they are within 0.1-1.8 Bq/m^2*d,, with average for all 33 points – 0.7 Bq/m^2*d. The maximal value is measured in 2 half-year under first radius (points from 1 to 4). These results are ones of the lowest recent results and they are lower than the ones for pre-commissioning period 1974-1981 (fig.3.2.2.2.-1).



Legend: Средна стойност – average value

Fig 3.2.2.2.-1. Summarized data about ^{90}Sr in the atmosphere settlements (Bq/m^2*d) from the control points of the site and 100 km monitored area, 1993-2011.

As a whole it is reported that the radioactivity of the atmosphere settlements within 100 km area is in normal limits and is not impacted by Kozloduy NPP activity.

3.2.3 Condition of the atmosphere air in 30km area on the territory of the Republic of Romania

According to the official information received from Romania for the purposes of EIA-R within 30-kilometer zone around the Kozloduy NPP a matter of interest are Dolj up to the Danube River, Romanatilor, plane Bailesti, the rivers Jiu, Jiet and their inflows with an area of 133035 ha.

The populated areas included in 30 km area around Kozloduy NPP are 23 : Bechet, Nedeia, Gighera, Zaval, Ostroveni, Sarata, Calarasi, Dabuleni, Listeava, Piscu Sadovei, Sadova, Gangiova, Macesu de Jos, Macesu de Sus, Sapata, Plosca, Bistret, Brandusa, Goicea, Barca, Horezu Poenari, Toceni, Valea Stanciului. The territory of 30-km area includes mostly the agricultural lands. According to the information provided by Romania the biggest part of the industrial sites is located in Craiova and Isalnita, only one of the sites, described in the information, is involved in the area -

this is the foundry for non-ferrous metals in Bailesti. The main pollutants are sulphur dioxide, nitrogen oxides and dust particles, bag filters are in operation. Considering the lack of big industrial emission sources and the prevailing existence of small populated areas in the region it could be said that the air quality is good.

In the neighbour territory (at a distance from Kozloduy NPP between > 30 and < 100km) 15 main industrial enterprises are located, which generate non-radioactive emissions. They are listed below depending on their size.

Table 3.2.3-1 List of the main industrial enterprises and sources of non-radioactive emissions

Company name	Activity	Location	Pollutant	Approximate distance form the site of the NPP [km]
SC ComplexulEnergetic Craiova SA-Sucursala Electrocentrale Işalniţa	Electricity Production	Işalniţa,	SO_2, NOx, FDP, CO2	70
SC ComplexulEnergetic Craiova SA-Sucursala Electrocentrale Craiova II	Production of electricity and heat	Craiova	SO_2, NOx, FDP,	65
SC GuardianEco Burn SRL	Hazardous waste incineration plant	Işalniţa	dust, TOC, HCl, HF, SO2, NO, NO2, Tl, Cd, Hg and other heavy metals (Sb, As, Pb, Cr, Co, Cu, Mn, Ni, V), dioxins and furans	70

Company name	**Activity**	**Location**	**Pollutant**	**Approximate distance form the site of the NPP [km]**
SC Fulcri SA	Nonferrous foundry	Băileşti	SO_2, NOx, FDP,	50
SC Moviplast SA	Production of plastic packaging	Craiova	VOC	65
SCElectroputere SA	Manufacture of electric equipment, engines and generators, transformers	Craiova	VOC, CO, NOx, particles in suspension	65
SC Reloc SA	Rolling Stock Repair	Craiova	VOC, CO, NOx, FDP	65
SC Cargill Oils SA	Production vegetable oils	Podari	VOC, CO, NOx, SOx, particles in suspension	60
SC Avi SRL	polyester resin reinforced with fiberglass	Craiova	VOC	65

Company name	**Activity**	**Location**	**Pollutant**	**Approximate distance form the site of the NPP [km]**
SC NewageAVK Romania SA	Production of electric generators and electrical and mechanical parts for generators	Craiova	VOC, CO, NOx, FDP	65
SC OD Tehnic SRL	Production parts polyester resin reinforced with fiberglass	Podari	VOC	60
SC RTDTrading SRL	Production vegetable oils	Craiova	VOC, CO, NOx, SOx, particles in suspension	65
SC FordRomania SA	Car production	Craiova	VOC, CO, NOx, FDP	65
SC MecanicaFibra de Sticla MB SRL	Production parts polyester resin reinforced with fiberglass	Calafat	VOCs, particulate matter	80
SC RoquetteRomania SRL	Production of corn starch and glucose	Calafat	VOC, CO, NOx, SOx, particles in suspension	80

3.2.4 Atmosphere radioactivity in 30km area on the territory of the Romania

In the area of impact of Kozloduy NPP the National Environmental Radioactivity Surveillance Network (NERSN) in Romania permorms two Environmental Radioactivity Programs, working in parallel:

- Standard monitoring of the environment under the Program for Determination of the Radioactivity Simultaneously from all Stations for Surveillance and Control of the Radiation (SSRM) under schedule.
- Special surveys under an ecological program for the Radioactivity individually from each SSRM coordinated by NEPA. Each laboratory has its own Monitoring Program within the framework of its competency.

In Romania the National Environmental Radioactivity Surveillance Network (NERSN) performs monitoring of the radioactivity for the purposes of assessment of Kozloduy NPP Bulgaria in 4 laboratories, - Stations for Surveillance and Control of the Radioactivity SSRM. SSRM Bechet, SSRM Craiova, SSRM Drobeta Turnu Severin и SSRM Zimnicea and 13 automatic monitoring stations (11 in the District of Dolj, 1 in the district of Mehedinti and in the District of 1 in the District of Teleorman) for determination of gamma background. Tables from 3.2.4-1 to 3.2.4-.4 show the results of the radiological monitoring.

Table 3.2.4-1 Results of radiological monitoring in Romania within 30km range far from Kozloduy NPP

Sample	Year	District	Location	Measuring unit	Total beta activity
Deposits	2008	Dj	Gighera	Bq/m^2	20.1±5
Deposits	2009	Dj	Gighera	Bq/m^2	19.8±4.8
Deposits	2010	Dj	Gighera	Bq/m^2	21.8±7.8
Aerosols	2008	Dj	Gighera	Bq/m^3	0,44±0,14
Aerosols	2009	Dj	Gighera	Bq/m^3	0,42±0,13
Aerosols	2010	Dj	Gighera	Bq/m^3	0,45±0,14

Table 3.2.4-2 Total beta activity of the atmosphere aerosols, ^{222}Rn and ^{220}Rn in the atmospheric aerosols and total beta activity of atmosphere settlements

Year	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
SSRM	**Atmospheric aerosols - total β activity (Bq/m^3); limit in compliance with Decree N 1978/2010 is 10 Bq/m^3**									
Drobeta Turnu Severin	1.766	1.826	3.085	2.353	2.289	2.396	3.486	3.385	3.218	3.000
Bechet	2.370	2.139	1.729	1.429	1.644	1.573	1.629	2.053	1.918	3.030
Craiova	2.679	2.808	2.480	2.117	2.042	1.780	2.303	2.408	2.600	2.847
Zimnicea	4.767	3.799	4.258	3.861	4.240	2.738	3.790	4.639	4.209	4.666
	Atmosphere aerosols – ^{222}Rn (mBq/m^3); no limits for ^{222}Rn									
Drobeta Turnu Severin	4986.053	5421.903	8451.128	6629.46	6571.589	7048.585	6519.055	9801.274	9155.479	9103.423
Bechet	5797.802	5465.81	4349.672	3639.333	4121.448	4052.204	2884.572	5596.374	6071.962	8635.423
Craiova	6959.803	9536.414	7023.563	5582.686	5269.72	4870.556	4578.481	6439.815	7097.788	7861.726
Zimnicea	12097.7	9424.84	14947.65	10605.96	11181.7	7435.316	6737.538	12352.37	10771.81	12318.12
	Atmosphere aerosols – ^{220}Rn (mBq/m^3); no limits for ^{220}Rn									

Drobeta Turnu Severin	119.923	121.728	274.950	151.073	157.203	141.661	254.729	209.123	187.370	169.412
Bechet	337.978	234.855	86.347	169.046	252.910	187.266	156.991	271.208	215.025	291.747
Craiova	80.600	69.479	97.267	195.856	247.012	167.953	150.820	271.002	291.928	298.204
Zimnicea	603.975	525.307	494.048	422.204	399.395	275.032	320.058	470.364	475.219	500.112
	Atmospheric precipitates - total β activity (Bq/m^3); limit in compliance with Decree N 1978/2010 is 200 Bq/m^2									
Drobeta Turnu Severin	1,108	1.405	3,527	1,412	1,031	1,454	0,464	1,409	1,446	1,113
Bechet	1,253	1,387	1,577	2,904	1,225	1,913	1,572	2,036	1,962	3,933
Craiova	1,253	1,565	1,043	1,171	1,098	1,490	1,566	4,294	8,834	5,202
Zimnicea	0,766	0,903	1,009	1,095	0,776	0,947	0,410	0,844	0,774	0,957
	Gamma background (μSv/h); limit in compliance with Decree N 1978/2010 is 0.250 μSv/h									
Drobeta Turnu Severin	0.066	0.067	0.067	0.067	0.069	0.068	0.075	0.093	0.068	0.065
Bechet	0.090	0.88	0.088	0.085	0.089	0.094	0.094	0.089	0.097	0.098
Craiova	0.083	0.090	0.086	0.085	0.092	0.094	0.097	0.088	0.097	0.097
Zimnicea	0.094	0.095	0.094	0.094	0.094	0.080	0.094	0.094	0.095	0.095

Table 3.2.4-3 Measurement of gamma background from 13 automatic monitoring stations

Site	**Gamma background (μSv/h) – automatic stations-limita, in compliance with Decree N. 1978/2010 is 0.250 μSv/h**						
	2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
Sediu Politia Ianca	0.094	0.093	0.094	0.090	0.090	0.094	0.090
SCDPPN Dabuleni	0.096	0.095	0.096	0.100	0.100	0.100	0.100
Primaria Calarasi	0.107	0.093	0.107	0.090	0.096	0.096	0.090
SPET Port Bechet	0.102	0.100	0.097	0.103	0.102	0.096	0.100
SSRT Bechet	0.107	0.099	0.097	0.099	0.097	0.098	-
Primaria Ostroveni	0.106	0.105	0.107	0.110	0.110	0.110	0.110
Pepiniera Zaval	0.103	0.104	0.105	0.110	0.107	0.110	0.110
Primaria Gighera	0.116	0.106	0.106	0.107	-	-	0.100
CEZ DISTRIBUTIE Nedeia	0.101	0.099	0.100	0.101	0.100	0.100	0.100
Primaria Macesul de Jos	0.108	0.106	0.106	0.110	0.110	0.110	0.100
Biserica Sapata	0.113	0.101	0.114	0.120	0.110	0.120	0.110
PISCICOLA Dunareni (Carna)	0.100	0.099	0.101	-	-	-	-
Scoala Ploska	0.103	0.102	0.097	0.100	0.100	0.100	0.100
ARPM Craiova	0.106	0.095	0.109	0.110	0.110	0.110	0.110
SSRM Craiova	0.101	0.108	0.109	0.095	0.093	0.110	0.100

Table 3.2.4-4 Gamma spectrum analysis of atmospheric aerosols and atmospheric precipitates

Site	**PAE**	**2007**	**2008**	**2009**	**2010**
	Atmospheric aerosols – gamma spectrum analysis (mBq/m^3)				

Drobeta	**^{7}Be**	4.454	1.832	3.057	3.385
	^{131}I	<LD*	<LD*	<LD*	<LD*
	^{137}Cs	<LD*	<LD*	<LD*	<LD*
Bechet	**^{7}Be**	3.201	4.677	4.467	4.360
	^{131}I	<LD*	<LD*	<LD*	<LD*
	^{137}Cs	<LD*	<LD*	<LD*	<LD*
Craiova	**^{7}Be**	4.282	4.628	4.759	6.522
	^{131}I	<LD*	<LD*	<LD*	<LD*
	^{137}Cs	<LD*	<LD*	<LD*	<LD*
Zimnicea	**^{7}Be**	6.130	2.132	4.775	3.411
	^{131}I	<LD*	<LD*	<LD*	<LD*
	^{137}Cs	<LD*	<LD*	<LD*	<LD*
	Atmospheric settlements – gamma spectrum analysis (mBq/m^3 on day)				
Drobeta	**^{7}Be**	0.454	0.084	0.276	1.002
	^{210}Pb	0.156	0.095	0.124	0.250
	^{137}Cs	<LD*	<LD*	<LD*	<LD*
Bechet	**^{7}Be**	0.927	0.724	0.660	0.782
	^{210}Pb	0.171	0.101	0.104	0.281
	^{137}Cs	<LD*	<LD*	<LD*	<LD*
Craiova	**^{7}Be**	2.025	1.121	1.186	1.731
	^{210}Pb	0.194	0.127	0.154	0.278
	^{137}Cs	<LD*	<LD*	<LD*	<LD*
Zimnicea	**^{7}Be**	0.875	0.430	1.655	0.540
	^{210}Pb	0.195	0.141	0.312	0.134
	^{137}Cs	<LD*	<LD*	<LD*	<LD*

Based on the data presented in the tables it is determined that for the period 2000-2009 the total beta activity and gamma background, as measured during the execution of the radiological monitoring in Romania in connection with the impact of Kozloduy NPP, are in compliance with the norms accepted with Decree N. 1978/2010.

Gamma spectrum analyses of the atmospheric settlements and aerosols show that the values of ^{137}Cs and ^{131}I are lower than the limits of determination.

Conclusions:

1. The measured values of the indicators: carbon dioxide, ozone, sulphur dioxide, nitrogen dioxide, ammonium, hydrogen sulphide, methane and non-methane hydrocarbons in the region of Kozloduy meet the permissible concentrations according to the currently effective regulations.
2. During the period 2009-2011 it is reported that the radioactivity of the atmosphere **settlements** in 100 km area is within normal limits and **it** is not impacted by Kozloduy NPP **operation**.
3. It has been proven that the increased aerosol activity registered in the end of Ma**rch** and beginning of April 2011 is a result of the transboundary transfer of contaminated air masses from the Fukushima NPP, which suffered an accident.
4. The radioactivity in the Monitored Area and in 100km area is within normal background limits. The analysis of ^{90}Sr in the atmosphere precipitates shows that the metered values are quite lower than PDA.

5. The total beta activity and the gamma background as measured during the radiological monitor in Romania are in compliance with the norms adopted with Decree N. 1978/2010. Values of ^{137}Cs and ^{131}I in the atmospheric deposits and the aerosols are lower than the limits of determination.

3.3. Waters

3.3.1 Surface waters

3.3.1.1 Hydrology

Plant site is located on the right bank of the Danube River between the towns of Kozloduy and Oryahovo. The site is located on the first not overflowed terrace of the Danube River and the ground elevations to the river bank are approximately 26.0 – 26.5 m, and in the low land they are approximately 25.0 – 26.0 m. **The site elevation is at 35.00 m altitude and covers** an area of approximately 2.2 km^2 and together with the channels for circulation and service water supply reaches 4.5 km^2. To the North the power plant borders the Danube side low land. Southern from the site the slope of the watershed table is relatively high (100–110 m), to the West it is approximately 90 m and to the East it is lower and is decreased up to 30 m altitude. The whole low land is protected with earth embankment dike, the elevations of which are from 31.80 m to 33.00 m. Between the site of the power plant and the. Danube River some dikes are constructed dimensioned for running of 1000 -year high water along the Danube River with the needed normative reserve. Drainage systems in the region are dimensioned for drainage of surface waters caused by heavy rain with different duration and provision of the rainfall height 0.01% (once per10 000).

Rivers

There are no river flows available on the territory of Kozloduy NPP. On the site of the Nuclear Power Plant the rivers Ogosta, Skut and Tsibritsa flow, which are situated on the territory of Bulgaria and inflow into the Danube River. In vicinity – 3 km away from the North of the NPP site the Danube River flows. 10 to 30 km far to the South and to the South-East from the site flows the river of Ogosta At 10 to 30 km to the East and South from the site flows the Skut river; and at 20 to 30 km to the West from the site Tsibritsa river flows; Lom river flows 40 km away to the West and Iskur river is 60 km away to the East from the site. On the Romanian territory against the site the Zhiu River flows into.

Legend:

Козлодуй - Kozloduy
Оряхово - Oryahovo
Мизия - Mizia
Хайредин - Hayredin

Fig. 3.3.1.1-1 Location of the site of Kozloduy NPP

River bed and mouth of the Ogosta are corrected in connection with the organization of the service water supply of Kozloduy NPP. The mouth is displaced to the East under the Bank Pumping Station (BPS) and protection dikes are constructed respectively. Average annual river outflow does not exceed 20m^3/s. Outflow regime is formed by small streams in the region and mostly by Ogosta Dam located 60 km South-West away from it.

The natural topographic conditions and the distance of the rivers in the region flowing into the Danube River, provide grounds to reject the option they to impact the operation of the nuclear power plant as well as to reject the impact of the power plant on them. Only the Danube River is of decisive importance for the operation and security of Kozloduy NPP.

Water sources

In the region there are some small dams constructed, which are of different designation: a part of them are retention ones for damping of the extreme fluctuations of the rivers of debacle regime and the others are used for irrigation purposes. In 10km zone above the NPP site Shishmanov Val dam is constructed, which is fed from the Danube River by floating pump station. The water source is used for irrigation of the agricultural lands on the Kozloduy Territory. Besides, this water source through its channel system allows the service water to be supplied to Kozloduy NPP in emergency regimes.

Hydrological examination of the Danube River

The river is of decisive importance for the normal and safety operation of Kozloduy NPP.

Danube River is one of the rivers with the highest water and is one of the longest rivers in Europe. Its original source is located in the Shwartsvald Mountain in Germany. From there up to its inflow into the Black Sea, Danube crosses ten

countries - Germany, Slovak, Austria, Hungary, Croatia, Serbia, Bulgaria, Romania, Ukraine and Moldova. The river length is about 2880 km. It has closed-meshed and high water river network - above 120 tributaries, 34 of which are shipping ones. Its total water catchment area is 817 000 km^2.

The contribution of the Republic of Bulgaria into the formation of the river outflow is about 3.0 %, and regarding the pollution of the different substances - about 3.5 %.

In the hydrological stations next to Kozloduy (703.5 km with elevation „0" – 21.77 m) and Oryahovo (678.0 km with elevation „0" – 21.34 m) a regime monitoring of the main hydraulic characteristics is performed. Daily measurements of the water levels of the Danube River are made in the hydrological stations next to the town of Kozloduy as executed by the National Hydrology Institute Next to the bank pump stations (BPS 1, 2 and 3) also the waters of the Danube River and the channels are measured daily. In case of high water levels in the Danube River in the beginning of the peak of the high wave and after that, when it drops down, the frequency of the measurements is increased and then hourly measurement is carried out.

Region hydrology is reviewed comprehensively in EIA-R of Kozloduy NPP made by Scientific Research Sector with the Technical University in Sofia (1999 [82]).

The Hydrological Assessment is based on official information by reference books of the Danube Commission, hydrological manual for the Danube River, Division for management of the shipping way and maintenance of the Danube River in Russe, Energoproekt and National Institute for Hydrology and Meteorology - Sofia as well as on the data by field measurements.

In the allocation of the annual outflow of the river two long consequences of 12-years each of reduced outflow are monitored (1942-1954 and 1981-1993), as well as one long period of low-water level of 26 years (1955-1980). After 1994 river outflow shows an increasing trend.

There are no unconditional evidences regarding the anthropogenic impacts on the monthly outflow of the Danube River. Iron Gate hydro-junctions do not regulate the outflow for a period longer than 1 week due to a shortage of regulating capacities. This is the reason their impact on the monthly and annual outflow of the river not to be significant.

Considering the above statements it is determined that during the operation of Kozloduy NPP on full capacity (3760 MW) before the shutdown of Units 1-4 and given a deviation of the river waters flowing with a velocity of 180 m^3/s, even in a year of severe low-water level (provision 99 %) the water use of the power plant from the Danube River is very low - only 4.5 % of the river outflow.

Also, it is determined that in normal operation mode of average capacity of 2500 - 3000 MW, the water quantity needed for the cooling system of the power plant is 110 - 140 m^3/s or 2.7 – 3.5 %. In view of the average long standing water quantity (5719 m^3/s) this assessment is 3.1 % with full-load continuous operation and 1.9 - 2.4 % in normal operation condition.

Water losses due to the increased evaporation as a result of the water warming up by the plant cooling system are estimated as 1 200 000 m^3/y for average long standing temperatures of the water, air as well as the wind velocity, out of which:

- from hot water channel 550 000 m^3/y.
- from the Danube River 650 000 m^3/y.

These losses are 0.038 m^3/s average in the year, which is of the order less than the error applied for determination of the water quantity used for the water cooling system. It should be considered that the cooling system from the most external circuit has not practically caused any irreversible water losses and the irreversible water losses from the residential water supply as well as from the service water do not exceed 0.015 m^3/s.

The real irreversible water losses of Kozloduy NPP are estimated as 0,00092% of the Danube outflow and 0,044 % of all waters used by the power plant. i.e. Kozloduy NPP practically does not have any impact on the Danube outflow.

In the area of Kozloduy NPP the climatic conditions and the complicated morphology of the river bed are favourable for the formation of icing phenomena. Most unfavorable type of such phenomena is the ice blockages. Upon their occurrence as a result of the accumulation of the ice blocks some zones or sections of the river with considerable backwatering are formed.

For the period 1900 – 1985 the number of the years with ice phenomena is 65 and during this period there was a complete freezing recorded in twenty years. Within the period 1900-1937 complete river freezing happened every 13 years and within the period 1938 – 1970 – in 7 years of the examined period and after 1971 practically no complete freezing is recorded except one for 24 hours in 1985. There is a trend for reduction of the number and duration of the ice phenomena. Possibly, this reduction is caused by the anthropogenic activity and global warming.

Even rarer there are some backwatering phenomena close to the NPP – at km 660-678, section Island-Oryahovo. It is assumed that the impact of the backwatering phenomena on the water levels in the area of Kozloduy NPP could have more unfavourable impact on the elevations of the water levels than during the period of high waters.

Temperature regime Danube River

The water temperature of Danube is a hydrological element / indicator, for which monitoring regimes began relatively late - after 1941.

There are only a few publications of studies on the temperature regime of the Danube River.

Distribution of the water temperature across the width of the river depends on the flow rate, season and hydraulic characteristics of the river section. The maximal measured temperature differences across the width of the river are 0.2-0.4°C and they are the highest in the early morning hours. During the warm season the cross-section of the river is practically isothermal. In the lower part of the Danube in Bulgaria the average temperatures are by 1.6^0C-2^0C higher than the normal climatic ones for the most regions (expressed as long-term average ones d.. 1961-1990) and the winter of 2006-2007 is the warmest one that have been ever recorded.

Also, the heat impact [129] of Kozloduy NPP on the waters of the Danube River is determined and the following assumptions are made in this regard. During the normal operation of Kozloduy NPP and referred to the average efficiency of 2500-3000 MW, the needed cooling water flow rate is 110-140 m^3/s, corresponding to about 2% of the average flow rate of the river in long term forecast (5719 m^3/s). In case of full load operation of Kozloduy NPP (3760 MW and 180 m^3/s) the water consumption is approximately 3% of the water outflow of the Danube River.

In this case the increasing of the temperature in the discharge hot channel is maximal - 11.6°C (usually this increasing is approximately 7.5 - 8.5 °C). After the

homogenization with the water of the Danube River (average flow rate of 5719 m^3/s, determined on long-term basis), the increasing of the temperature is approximately 0.37°C. The thermally polluted spot in the Danube River is monitored several kilometers downstream from the intake point of the waters from the hot channel.
The thermally impacted area (with temperature rising of 3°C over the natural temperature of Danube River) covers an area of some kilometers of length and 100 m of width. This thermal polluted spot occurs in single months of the year depending on the loading of the Power Plant and the river flow rate.

Floods

Flooding of the site of Kozloduy NPP may be caused by:

- heavy rains and forming of catastrophic high water levels of the Danube River;
- damage of the dam walls blocking the Danube River (in the upper and medium part of the Danube River) constructed upstream after the Kozloduy NPP;
- other critical activities: combination of the above two phenomena or discharge of waters from the water reservoir;
- formation of ice in the Danube River.

Detailed surveys of the above phenomena are shown in [29] from [31]. The main conclusions are as follows:

- the elevation of the water level in case of flooding caused by heavy rain is lower than the elevation of the crown level of the facilities for service water supply (bank pump stations and dikes of the double channel);
- the duration on the peak of the high water is very small (1-2 hrs), after which it starts decreasing;
- maximal water quantity is p = 0.01%, which is not possible to occur during the whole operational period of Kozloduy NPP, taking into account that the maximal outflows for 400 years are 15 500-16 000 m^3/s;
- on the tributaries of the Danube River a lot of HPP cascades are constructed, which regulated the high waters and smooth the peak values.

Conclusions:

1. Danube River is of decisive importance for the operation and safety of Kozloduy NPP.
2. The natural topographic conditions and the distance of the rivers in the region inflowing into the Danube River provide grounds to exclude the option they to impact the operation of the nuclear power plant as well as the impact of the power plant on them.
3. The site of Kozloduy NPP is not threatened by a flood coming from the Danube River. High water levels are lower than the elevation of the crown of the onsite facilities.
4. It is possible the impact of the backwatering phenomena on the water levels in the area of Kozloduy NPP to have more unfavourable impact on the elevations of the water levels than during the period of high waters.

3.3.1.2 Quality of the surface waters

Non-radioactive contamination of the surface water

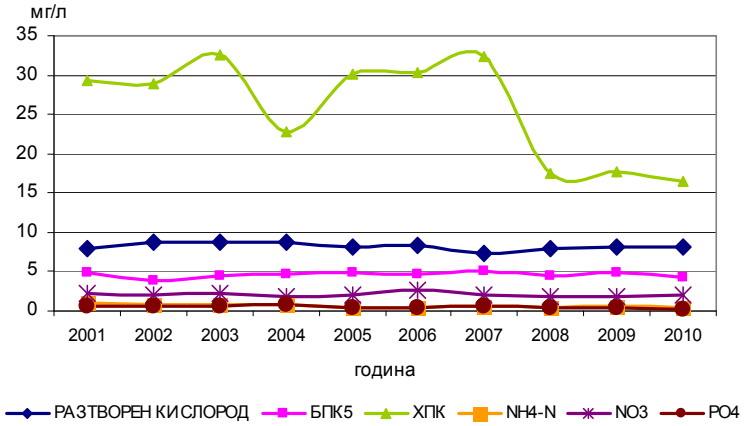
Main indicators applied for assessment of the chemical condition of the surface waters on national and European level are the average annual concentrations of the following

main parameters: dissolved oxygen (SO), BOD5, permanent oxidizability (BOD-Mn), ammonium (NH_4- N) and (NO_3- N) nitrogen, phosphates (PO_4).
Due to the lack of National classification system of the chemical condition of the surface waters the evaluation of the water quantities is made in compliance with the quality norms pursuant to *Ordinance N7/86 for the indicators and norms of determination of the quality of the surface running waters* [112].
Used data are provided by the monitoring networks about the physical and chemical condition of the surface waters and hydro-biological monitoring, which are a part of the National Environmental Monitoring System (NEMS).

Table 3.3.1.2-1 Norms of the main indicators for assessment of the chemical condition of the surface running waters

Indicators	Unit measured	Categories		
		I	II	III
Dissolved oxygen	mg/l	6	4	2
Nitrohen/ammonium	mg/l	0.1	2.0	5
Nitrite Nitrogen	mg/l	0.002	0.04	0.06
Nitrate Nitrogen	mg/l	5	10	20
Phosphates /PO_4/	mg/l	0.2	1.0	2
Permanganate oxidization	mg/l	10	30	40
BOD5	mg/l	5	15	25

In 2010 new Order for Monitoring came in force (РД N715/02.08.2010) issued by the Minister of Environment and Waters, which regulates monitoring programs in compliance with the goals under the first Plans for management of the river basins (PMRB). Subject to monitoring of the chemical condition are 174 points on the territory of the Danube region for basin management of the waters where are a trend for keeping of the good quality of the waters under the main indicators – fig. **3.3.1.2-1**.



Legend:
Разтворен кислород - Dissolved oxygen
БПК - BOD5
ХПК - COD (bichromatic)

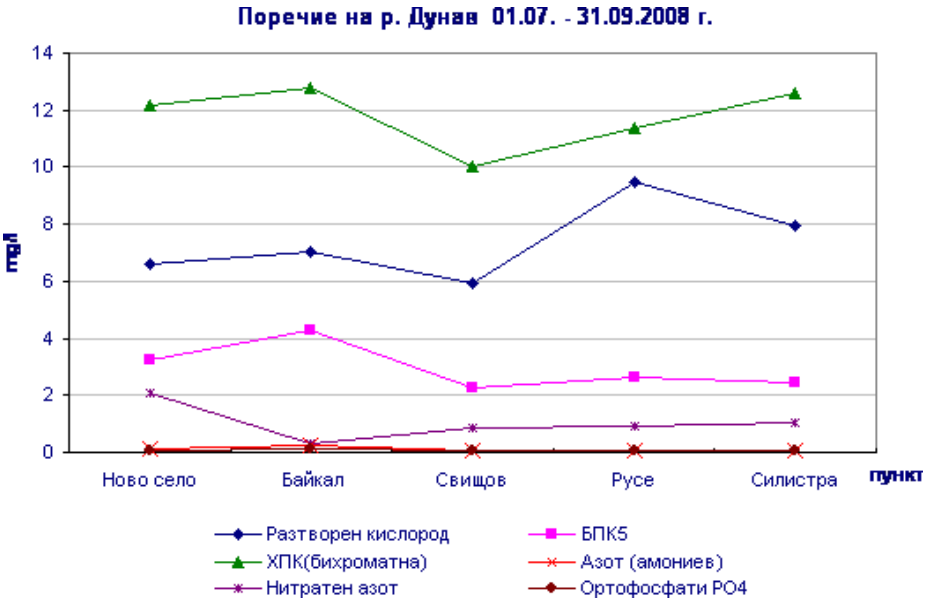
Fig. 3.3.1.2-1. Change of concentration of the main indicators of the surface waters on the territory of the Danube region of the Basin Directorate, *Source: Executive Environmental Agency*

For the period up to 1996-2010 the recently monitored trend is kept, namely for improvement of the water quality, but in spite of this there are still water bodies in risk. For these bodies the respective programs of measures are prepared aiming to achieve better ecological condition until 2015.
For the period 1996-2010 the concentrations of NH_4-N (Ammonium Nitrogen), BOD_5 (Biochemical Oxygen Demand) and PO_4 (Orthophosphates) show reduction. During the period 1996-2010 there is no considerable change of solved Oxygen and NO_3 (Nitrate Nitrogen).
In 2010 there is a clear trend for improvement of the quality of the surface waters regarding the main physical and chemical indicators both in short term and long term aspect.
In 2009-2010 bigger part such as 80% of the monitored river points of the main river valleys in Bulgaria are within the range of good-moderate condition. There are still water bodies in risk and for this sources the respective program of measures are prepared aiming to achieve better ecological condition until 2015.
In the ***Regional development strategy for Vratsa District 2005 -2015*** [173] the following categories of the river valleys of the Rivers Danube and Ogosta are presented in the specified sections.

Table 3.3.1.2-2. Categories of the river valleys of the Rivers Danube and Ogosta

	Beginning	**End**	**Categories**
	Danube, village of Novo selo - border	Danube River, Silistra - border	III
2.1.	Ogosta River after the confluence of Botunya River	Ogosta River till the confluence of Skat River	II
2.2.	Ogosta River after the confluence of Skat River	Ogosta River till it confluence into Danube River	III

Source: Regional development strategy for Vratsa district 2005 -2015



Legend:

Novo Selo *Baykal* *Svishtov* *Russe* *Silistra* *Station*

Поречие на р. Дунав - Danube River Valley

Разтворен кислород - Dissolved oxygen

ХПК (бихроматна) - COD (bichromatic)

Нитратен азот - Nitric nitrogen

БПК5 - BOD5

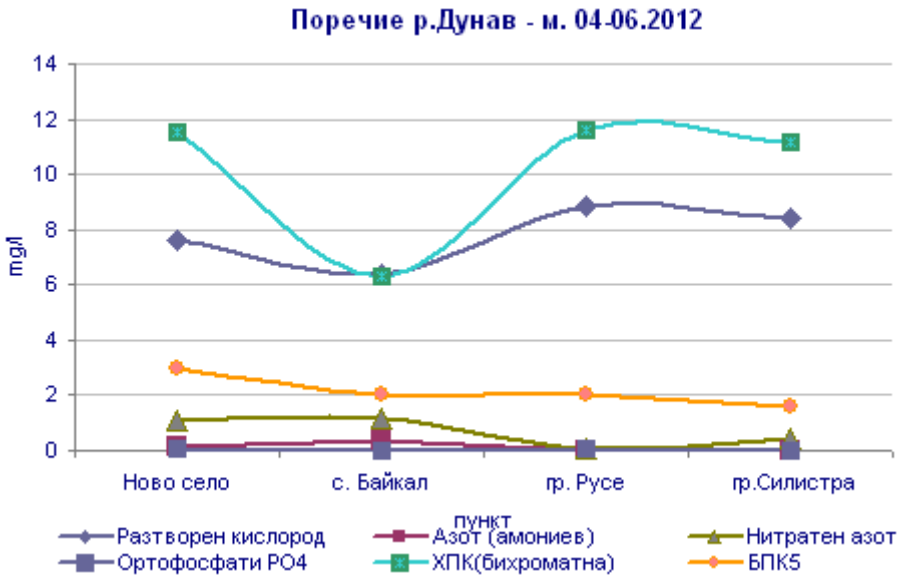
Азот (амониев) - Nitrogen (ammonia)

Ортофосфати PO4 - Orophosphates PO4

Fig. 3.3.1.2-2 Quality of the surface waters in the river valley of Danube in the third quarter of 2008.

For the purposes of control of the qualities of the Danube River in the common Bulgarian and Romanian section of the Executive Environmental Agency with the MoEW conducts monitoring and for the whole Danube basin the monitoring is made at 76 points. In the international monitoring network there are 11 points included and 5 of which are located on the Danube River (next to Novo selo, Baikal, Svishtov, Russe and Silistra) and the rest of them are located in the tributaries

The values of the indicators measured at the points on the riverside of Danube, which are monitored by the EEA in the third quarter of 2008 are shown on Fig. 3.3.1.2-2. The Quality of the surface waters in the river valley of Danube for the second quarter of 2012 are presented **on Fig. 3.3.1.2-3.**



Legend:

Novo Selo *Baykal* *Russe* *Silistra*

Поречие на р. Дунав - Danube River Valley

Разтворен кислород - Dissolved oxygen

Азот (амониев) - Nitrogen (ammonia)

Нитратен азот - Nitric nitrogen

Ортофосфати PO4 - Orophosphates PO4

ХПК (бихроматна) - COD (bichromatic)

БПК5 - BOD5

Fig. 3.3.1.2-3 Values of the indicators measured in some points on the riverside of Danube River

The change of the concentrations and registered exceeding for the second quarter of 2012 are as follows:

- Solved oxygen - Number of the samples for I category is 80.5%, for II category is 17.7%, the samples included in III category are 1.2%. Samples included beyond third category - 0.6%.

- BOD_5 - Number of the samples for I category is 90.3%, for II category it is 9.1%, and for III it is 0.6%. There are no single exceeds

- COD (dichromate) - Number of the samples for I category is 92,1%, for II category 7.9% , there are no points included in III category. Single exceed is 0% of the inspected points.

-Ammonium Nitrogen - In I category of water sources 56.5% of the analyzed points are included, II category includes 42.2%, and III category includes 0%. Single exceed of the norms is monitored in 1.3% of the points.

Nitrate Nitrogen - In I category of water sources 88.5% are of the analyzed points are included, II category includes 10.9%, and III category includes 0,6%. There are no single exceeds

PO_4 - Number of the samples for I category 73.4%, for II category it is 32%, and for III it is 3.6%. There are no single exceeds

The concentrations of nutrients including phosphorus and nitrogen in the waters of the Danube and its larger tributaries are very important from an international point of

view, because they are directly responsible for eutrophication processes within the river and in the Black Sea. There are some indications that the nutrient concentrations along Danube River today are substantially higher than the natural background levels.
The key nutrients affecting the Danube ecosystems and leading to eutrophication processes are phosphorus and nitrogen and both of which enter the river basin from point sources such as municipal, industrial and agricultural facilities, as well as diffusive sources throughout the catchment area, where nutrients originate from erosion and surface runoff, groundwater inflow and atmospheric depositions. A significant share of the nutrients from diffusive sources is of natural origin, but excess nutrients are also widely released due to human activities, notably farming. While point source emissions from wastewater treatment plants and industrial sources are discharged directly into the rivers, the emissions from uncontrolled sources that end up in surface waters, have many different pathways. About a half of the nutrients, discharged into the river, are from agricultural sources, a quarter is from industrial sources, and a similar proportion is from settlements. The main pollution sources in addition to industrial and municipal wastewater include chemical fertilizers and manure from intensive farming operations, petrochemical processing plants, iron and metal processing plants, timber, paper and pulp plants, and municipal solid waste disposal sites.
In 2007 higher concentrations of nitrates and mostly lower concentrations of orthophosphates were detected comparing with the results from 2001. In general, the average concentrations of the priority substances show a tend to be lower than those, measured in 2001, especially for organic substances.
Chemical analysis shows significant decreasing of the nitrates concentrations in the lower flow of the Danube River. Analysis of the waters from the rivers Ogosta and Tsibritsa within the period 2003 – 2008 shows that there is a systematic pollution with biogenic matters: the waters of the Ogosta River are polluted mostly with nitrites and orthophosphates and the ones of Tsibritsa River are polluted with ammonia nitrogen and othophosphates. Nevertheless, the content of the oxygen dissolved in the water is very high. (Appendix 11.3.1).

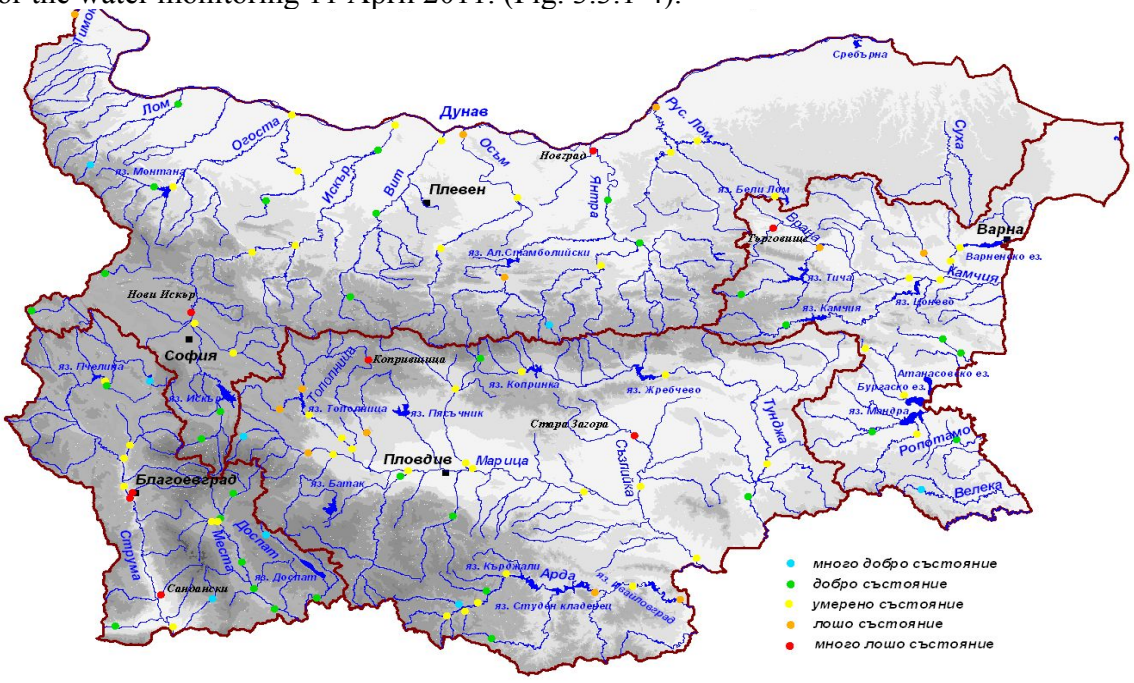
Ecological condition of the river waters

Ordinance N 13 from 2 April 2007 [113] regulates the conditions and order for making characteristics of the surface water bodies. In order to classify the ecological condition of the rivers several groups of quality elements are implemented as follows:

- *Biological elements*: composition and abundance of the water flora, bottom, invertebrate fauna, fish fauna;
- *Hydro-morphological elements* supporting the biological elements;
- Hydrological mode;
- Chemical and physicochemical elements supporting the biological elements, incl. common elements: temperature conditions, oxidizability, salinity, acidification as well as specific pollution.

With an order of the Minister of Environment and Waters N 867/29.11.2007 a hydro-biological monitoring is made of the surface waters.
The *Biological quality elements*, which are used in the hydro-biological monitoring of the surface waters are stipulated in the Framework Water Directive 2000/60/EC (Article 8, Appendix V) [114] and Ordinance N1 for Water Monitoring [115] (11

April 2011) 1) *phytoplankton and other aquatic flora (macrovegetation), 2) macro-invertebrates and 3) fishes.*
It is used for monitoring of the change of the number and diversity of indicator groups of macrozoobenthos in the rivers assessed by *biotic index.* The index is sensitive to organic and toxic pollution.
Used data are from the Program for hydrobiological monitoring of the surface waters, which is a part of the National System for Environmental Monitoring of the EEA.
The ecological assessment of the river types is made based on single water samples during the optimal season (summer-autumn) under the methodology approved with Order N РД - 412/15.06.11 by the Minister of Environment and Waters. The ecological assessment is made based on the data extract for the period 2009 – 2010 for 110 points, which are reference points for the main river valleys in Bulgaria. The assessment is presented in 5 classes (very good, good, moderate, bad, very bad condition) with the respective colour according to the requirements of Ordinance N 1 for the water monitoring 11 April 2011. (Fig. 3.3.1-4).



Legend:
Много добро състояние – very good condition
Добро състояние – good condition
Умерено състояние – moderate condition
Лошо състояние – poor condition
Много лошо състояние – very good condition

Fig. 3.3.1.2-4 The ecological assessment of the river types is made based on macrozoobenthos 2009 – 2010 Source: Executive Environmental Agency

Within the framework of the examined region (the region of Danube) the Ogosta River and the upstream of Lom River are in very good and good condition, and the condition of the Ogosta River after the Ogosta dam up to the mouth is in moderate condition.
During the period 2007-2011 in the EEA in the in the hydro-biological monitoring of the surface waters macro-invertebrates are used as a biologically quality element for

category of rivers [116]. Gradual implementation of other biological quality elements will be made. Monitoring results are sent to EEA and Basin Directorates.
Ecotoxicological analysis of the river sediment does not show availability of significant toxic effects. Only at three places alongside the river valley some metal concentrations have been determined in the water, which do not meet the quality requirements.
Surface water body ***of the Danube River code BG1DU000R001*** is determined as highly modified water body, river category. The ecological potential of the surface river body is moderate and its chemical condition is poor.
Ecological objective for this surface water source code ***BG1DU000R001 is „Prevention of worsening of the ecological potential and achievement of better potential in 2021. Prevention of worsening of the chemical condition and achievement of better condition until 2027" For this water body an exception is applied until the achievement of the environmental objectives, because of its considerable anthropogenic impact***. On the Bulgarian territory there are 95 point sources of pollutions intake into this water source.
With an order of the Minister of Environment and Waters the geographic borders of these ***vulnerable areas*** are determined, where a big part of the Danube valley is included, i.e. the Danube region of the Basin Water Directorate, including the rivers in the examined region. The determination of the identification criteria of the vulnerable areas subject to or jeopardized by a pollution as a result of agricultural activity is based on the statement that the increased nitrogen loading of the agricultural sources is focused on territories with intensive crops and stock breeding.

Fig. 3.3.1.2-5 Vulnerable areas within the Danube River Basin Directorate
According to the Order of the Minister of the Environment and Waters as sensitive areas on the territory of the Basin Directorate of the Danube Region are determined

the Danube River and all waters involved in the water catchment area of the Danube River.

The agglomerations with population exceeding 10 000 people and which are directly intaken into the sensitive area, shall foresee in the town sewage treatment station a facility for elimination of the biogenic elements of the nitrogen and phosphor. Based on the assessment of the considerable loading on the water bodies and their vulnerability a preliminary identification is made of the water sources, for which there is a risk not to achieve the ecological objectives for good conditions as stipulated in Article 4 of the Water Framework Directive. For this purpose the existing monitoring data about the surface waters and emissions are used and in the cases when there is no sufficient data or there is no such data and expert assessment is used.

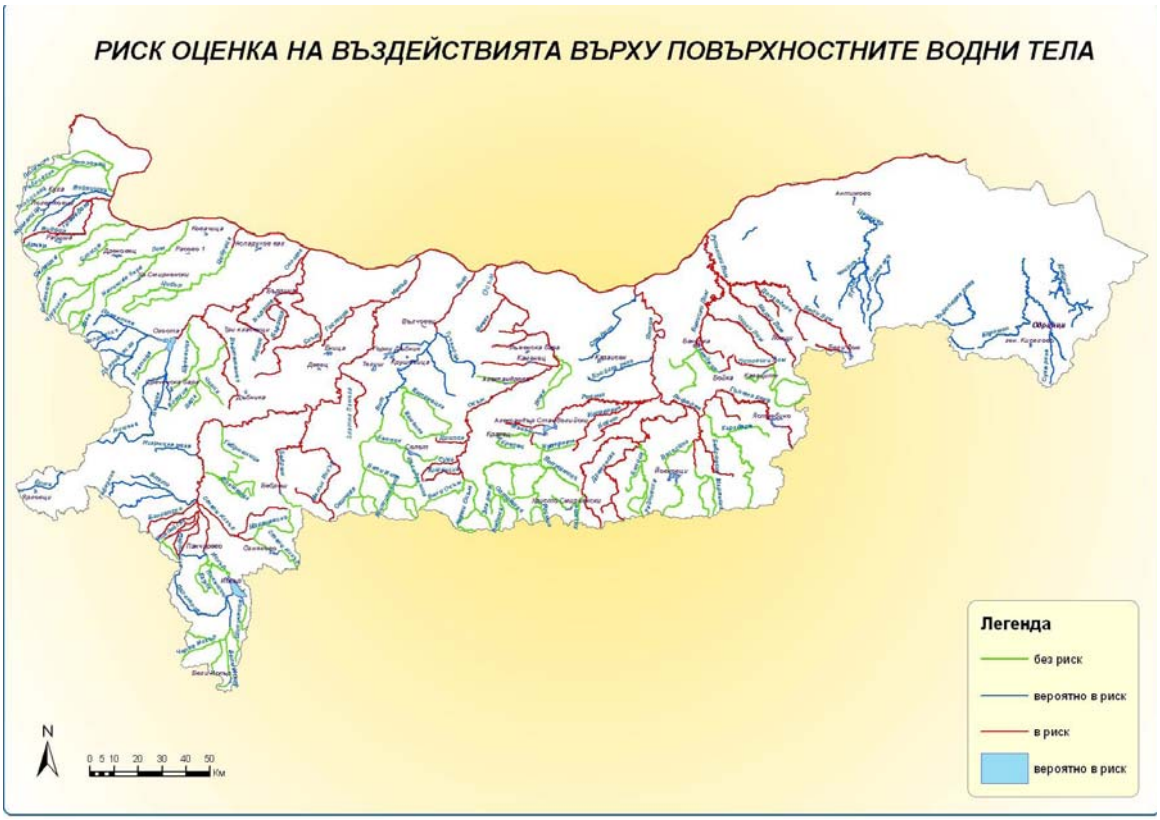


Fig. 3.3.1.2-6 Risk assessment of the impacts on surface water bodies

The attached map shows that the surface water body of the Danube River ***Danube River code BG1DU000R001*** may not achieve the objectives for good ecological condition stipulated in the Plans for Management of the River Basins (PMRB).

Conclusions:

1. Surface water body ***of the Danube River code BG1DU000R001*** is determined as highly modified water source, river category.

2. The ecological potential of the surface river body is moderate and its chemical condition is poor.

3. The ecological objective for surface water source ***Danube River BG1DU000R001*** is „Prevention of worsening of the ecological potential and

achievement of better potential until 2021. „Prevention of worsening of the chemical condition and achievement of better condition until 2027".

4. For the water body Danube River code BG1DU000R001 an exception is applied until achievement of the environmental objectives, because of the considerable anthropogenic impact.

3.3.1.3 Self non-radiation monitoring of the emissions in the waters from Kozloduy NPP

In compliance with the programs of Kozloduy NPP a monitoring of the underground and sewage waters in the region of the power plant is carried out. For the purposes of completeness some data are included from the control of the quantities and qualities of the used surface and groundwaters resulted from the conditions of the issued permits.

For the purposes of the assessment detailed results about the quality of the surface waters have been provided, which are collected by the monitoring of Kozloduy NPP and summarized in "***Annual reports on the results of in house non-radiation environmental monitoring in the region of Kozloduy NPP*** for 2009, 2010 and 2011 [191].

Control of the used surface and groundwaters

Utilization of the surface and groundwaters by the Company is made in compliance with the provisions of the permits issued for water use as follows:

- Permit 0562/14.03.2005 for use of waters from the Danube River for cooling, production of chemical demineralized water and electricity generation by HPP of HC-1 of 5 MW capacities.
- Permit 11530127/30.05.2008 for production of groundwaters through SW-1-6 for back up (emergency) service water supply of units 5 and 6 (spray ponds) of Kozloduy NPP;
- Permit 1530128/30.05.2008 for production of ground waters through shaft well „Raney-5" for industrial and firefighting purposes;
- Permit 11590203/30.05.2008 for production of groundwaters through shaft well „Valiata" for hygiene-residential purposes of Units 1 to 4.
- Table 3.3.1.3-1 below shows the needed water quantities used for service and residential water supply during the period of 2006-2011 of Kozloduy NPP.

Table 3.3.1.3-1 Annual water quantities used for service and residential water supply

Water inlet place	Permitted quantity [thousand m^3]	Utilized quantity [thousand m^3]					
		2006.	2007	2008	2009	2010	2011
Surface waters of the Danube River	5 000 000	3 334 722	2 323 800	2 629 876	2 593 459	2 564 530	2 660 788
Six shaft wells (SW 1– -6)	788.4	0	0	0	0	0	25
Well "Raney – 5"	7 884	190	314	75	16	24	2.7
Shaft well "Valiata"	1 600	291	183	204	192	193	216.7

Source: Annual report on IHNRM of the environment in Kozloduy NPP for a period 2006, 2007, 2008 and 2009 [191].

According to the attached table 3.3.1.3-1, the quantity of the surface waters taken from the Danube River in 2011 is 53,2% of the permitted water quantity, respectively for 2010 it is appr. 51.2 % and appr. 52% for 2009 and of the groundwaters it is only 2,38 % of the quantity permitted for 2011, 9 % in 2010 and 2 % in 2009.
The groundwater consumption is insignificant compared with the total amount of the water consumption by KNPP. This consumption is relatively constant and is predetermined by the lowering of the groundwater table and on the trend to keep it constant.

Drinking and residential water supply

For drinking residential needs mainly water from the town water supply network of the town of Kozloduy is used and there is a contract signed with "Water supply and sewage pipelines" Ltd. in the town of Vratsa as well as waters from own water sources are used.
During the period 1995–1998 the water supply of the town of Kozloduy and Kozloduy NPP with water for drinking and residential needs is made by three Raney wells located on the terrace of the Danube River before the town of Kozloduy. The maximal supplied quantity is 115 l/s.
For the residential needs in EP 1 also water from one drill well in Valiata area is used, which is not drinking, but could be used for residential needs). The designed water quantity is 25 l/s.
In the Bank pump station for residential needs the waters from drill well Raney 5 are used.

Table 3.3.1.3-2 Specific water flow rate for drinking and residential needs in Kozloduy NPP, m^3/man/day.

Year	Consumed water quantity, m^3/y	Number of the employees in the power plant	Specific consumption, m^3/man/d
1995*	1 670 000	5 000	1.149
1997	1 680 000	6 400	0.860
1998	800 000	6 100	0.418
2005	2 581 790**	5 000	1.415
2006	1 805 000	4796	1.031
2007	1 846 000	4654	1.087
2008	1,259,156	4485	0.769

* Data for 1995 – 1998 are from the EIA-R of Kozloduy NPP, 1999 [82].
** Water consumption from the drill wells Valiata (252 280 m^3/y) and Raney (111 278 m^3/y) is not included.

Above data show that during the last four years the water consumption for drinking water and residential needs is considerably decreased. In spite of that the specific water consumption for the drinking residential needs during the last years is quite high. Regardless the shutdown of Units 1-4 and reduced staff number due to that, both reduced total water consumption and specific consumption in 2007 are higher comparing with the period before the shutdown of the reactors. Reasons for such big specific water consumption rate could be the failure of the water discharge valves and devices.

Service water supply of Kozloduy NPP from the Danube River

Diagram of the service water supply of Kozloduy NPP from the Danube River is of direct flow type. It provides:

- Circulation water: for cooling of the turbine condensers;
- service water for cooling of other facilities.

By the means of the *bank pump stations* (BPS 1, 2 and 3) in the *cold channel,* service water is supplied from the river with flow rate up to 180m^3/s. 4 units of *circulation pump stations* from it (CPS) supply water through pipelines to the consumers in the main bodies. By a system of pipelines and low-head channels (LHC) the water in them is deviated into the hot channel (HC 1), and from there it is directed to the Danube River. According to a design for auxiliary service water supply second hot channel is constructed - HC 2, where the water of the consumers in Units 5 and 6 could be directed to the Danube River.

CC 1 and HC 1 are parallel ones and in a combination they form so called *double channel*. The double channel is the main equipment of the NPP service water supply.

Table 3.3.1.3-3Consumption of service water from Kozloduy NPP.

Year	**Service water, thsnd m^3/y**		
	Danube, Danube River	**Shaft wells**	**Total**
1995	3734581	21	3734602
1997	4845854	28	4845882
1998	2200002	13	2200015
2006	3334722	481	4115722
2007	2323800	497	2820800
2008	2629795	278	2898235
2009	2,593,459	208	2593667
2010	2 564 530	227	2564757
2011	2 660 788	244.4	2661032.4
Permitted water use*	5000000	9484**	-

* "Raney – 5"well - 7 884 tsnd m^3/y; Shaft well "Valiata" - 1 600 thsnd. m^3/y

** Since 2008 a permit for water use is granted for all six shaft wells (SW 1– 6) - 788.4 thsnd m^3/y.

Total reduction of the water consumption for service purposes in 2011 compared with 2006 before the shutdown of Units 3 and 4 is 35.3%.. However, the big water consumption in 2006 should be considered in comparison with the 3 years preceding the shutdown of Units 1 and 2.

Within the period 2006 – 2011 the main quantity of the incoming water masses is used for cooling. Quantity of the taken surface waters of the Danube River during the period are about the half of the permitted quantity, namely: in 2006 it is about 67 % of the one permitted in 2007. – appr.46 % of the one permitted in 2008- about 53 % of the permitted one. appr. 52% for 2009 and 53.2% for 2011. The extracted groundwater is 5 % of the quantity permitted in 2006 and 2007 and it is only 2.7 % of the quantity permitted for 2008, .2 % of the permitted in 2009 year. 9 % of the quantity permitted in 2010 and 2.38 % of the one, permitted for 2011.

As a whole after the shutdown of reactors 3 and 4 in 2006 a sharp reduction of the service water is monitored and this is considerably lower than the permitted quantities. However, in comparison with 1998 when all reactors 1 – 6 were in operation, i.e. before the shutdown of the reactors 1 and 2, no positive change of the water consumption is determined, in spite the reduced water quantity of chemically demineralized water (DW) and disbalanced waters.

The quantity of the DW water from the Danube River used during the period 2002 – 2011 is reduced by 50 %, which is mostly a result of the shutdown of Units 1-4.

- Conclusions:

1. The main water quantity for process needs is from and the surface waters taken from the Danube amounts average to 51-53% of the permitted water quantity;
2. The quantity of the used groundwaters do not exceed 2 to 4 % of the permitted one;
   - 3. During the last four years a reduction is metered of the consumption of water for drinking and residential needs;
   - 4. After the shutdown of reactors 3 and 4 in 2006 sharp reduction of the service water is monitored

Monitoring of the sewage waters.

Generated sewage waters are intake in the Danube River by HC-1 and HC-2 and in the main drainage channel (MDC). The waters from the MDC are also received by the Danube River. The Company has permits issued for intake of sewage waters as follows:

- Permit N 13120037/22.11.2010 for intake of the sewage waters by the means of HC-1 and HC-2 in the Danube River;
- Permit N 13750001/20.04.2007 for use of water source for intake of sewage waters in surface waters (intake in the MDC). Amended and extended with Decision 216/25.02.2010. Amended with decision 494/08.08.2011;
- Permit N 13710063/27.07.2011 for intake of sewage waters of Ledenika recreation rest house.

Kozloduy NPP generates the following sewage water flows:

- From the water used for drinking and residential needs;
- Provisionally clean waters from the waters for production needs, which are used mostly for cooling;
- occasional rainfall waters

Waters from the sewage system, draining the residential waters from the administration, production and household rooms, which are not in the controlled area as well as the rainfall waters fallen down on the territory of the production site of Kozloduy NPP, usually do not contain any radionuclides above the background levels. In EP-1 the control is made only by sampling of the waters drained into the drainage channels. Residential and sanitary sewage waters from the controlled area in EP-1 are treated in the same way as the production waters from these zones.

Provisionally clean sewage production water- the flows of the cooling water after the condensers (circulation water) and after the consumers of the service water are drained into HC 1 by a system of low head channels.

As a result of Units 1 to 4 shut down, the cooling water consumption is interrupted, its temperature downstream the condensers rises by appr.10 ^{0}C. Its flow rate is about 45 000 m^3/h per turbine, i.e. about 360 000 m^3/h, if Units 1-4 were in operation.

Besides the circulation and service water downstream the consumers in low head channels (and for Units 1 and 4 and directly in HC 1) also the waters similar to production sewage waters are taken into it as follows:

- Disbalanced waters – they are a result of the treated radioactive production sewage waters and heating steam condenser after the systems for special treatment system:
- SWT-3 – designed for treatment of sump waters from the Controlled Area; sources of such waters are controlled and uncontrolled leakages from the primary circuit, containing boric acid, potassium base, ammonia and other reagents, which are entered into the coolant in order to maintain certain water mode, decontamination of equipment and systems, washing out and regeneration of filters, SWT-3 itself- if the treated waters do not comply with the norms of the chemical water treatment mode in Kozloduy NPP or of the ones for disbalanced waters etc.;
- SWT-5 – designed for the treatment of the water generated from the blow down – permanent and periodical, of the steam generators;
- SWT-6 – designed for treatment of waters containing boron from I circuit aiming to obtain treated concentrated dissolution of boric acid for re-use in the technological cycle; This system is installed only in Units 3 and 4.
- Waters from drainage tanks II circuit and wash out water from the system for main condensate;
- Waters from the overspill compensators of HP deaerators;
- Wash out waters from circulating water filters;
- Sewage waters from the generation of the chemical demineralized water.

Waters from SWT 1, 2 and 3 are of better qualities than the ones of the water in the water receiver. Disbalanced waters are supplied to the intermediate containers (tanks) from where they are discharged to the receiver after an analysis and with radioactivity below the norm.

The treatment technology for radioactive waters by evaporation guarantees that when complying with the radioactivity norms in the discharged waters the content of the harmful and hazardous substances does not exceed the emission norms permitted for Kozloduy NPP.

Quantities of the disbalanced and sewage waters discharged into the environment within the period 1990 – 1999 with normal operation of the power plant (according to data from EIA of Kozloduy NPP, 1999[82]) are comparatively permanent and quite high – average 207000 m^3/y with dispersion within the range ±13.3%. According to Kozloduy NPP data the share of EP-1 in the total quantity of the disbalanced waters within the period 1994 - 1999 is 55-62% of their total capacity for Kozloduy NPP. Laundries/bathrooms in both EP form about 10-12% of the quantity of the disbalanced and sewage waters;

Bigger quantities of disbalanced waters discharged in different years are related to certain bigger scope of the maintenance works.

Sewage waters from the production of chemically demineralized water (DW), by which the water losses will be restored in the circulation water supply system, are neutralized before their discharging into HC 1 (for EP-1)

Sewage waters from the production of chemically demineralized water contain different acids, bases and their compounds. They are collected in one of the two chambers, so called "neutralization pits", where joint mineralization is conducted and after pH control they are discharged. If they do not comply with the norm, they will be held until reaching the needed neutralization extent. If needed, additional treatment for pH correction will be made. Until the neutralized quantities will be discharged from one chamber the sewage waters are collected into the other one for neutralization purposes.

Total quantity of the produced DW in Kozloduy NPP within the period 2002 – 2008 is reduced by 1607000m^3 (59.4 %) and this is mostly on the account of the reduction of WDF for the needs of EP-1, namely of 1306000 of 114000m^3, i.e. with 91.3 % . However, considering that for the same time also the production of DW for the needs of EP-2 is reduced by 29.7 %, it could be assumed that the reduction of DW caused by the shutdown of Units 1-4, is by about 60 %.

As a result of this, the same is the reduction rate of the consumption of sulphuric, hydrochloric and nitric acids, sodium hydroxide, used for regeneration of the ion exchange filters, used for the demineralization (desalination) of the water as well as of the calcium carbonate and ferric chloride used for coagulation of the hydrochloric extracted during the regeneration of hydrochloric from the sewage waters from the production of DW.

Origin and quantities of the sewage waters generated in 2006, 2007 2008, 2009, 2010 and 2011 sewage waters compared with the permitted ones are as follows:

Table 3.3.1.3-4 Origin and quantities of the sewage waters generated in 2006 – 2011

Channel /Discharge N	Water origin	Permitted quantity [tsnd. m^3]	Generated quantity [tsnd. m^3]					
			2006.	2007.	2008.	2009.	2010.	2011
Flow N1 (TCC – MDC)	Production, residential and rainfall waters EP-1	3 900	≈3 598	1 781	498	≈610	620	580
Flow №2 (DN300 – MDC)	Residential waters after water treatment complex /EP-2	450	487	573	527	194	65	16
Flow №3 (DN1000 – MDC)	Treated production waters from TH, DGS and etc.	6,600	≈6 638	6 639	7 360	≈4,564	1980	1 895
Flow №4 (Switchyard – MDC)	Residential sewage waters from Switchyard	1095	≈1072	Not measured	Not measured	Not measured	1000	1000
Flow HC1, HC2 – Danube River	Cooling and Production sewage waters from EP-1 and EP-2	3 280 000	3 178 688	2 250 449	2 536 387	2 383 715	2 416 456	2 621 935*

*In 2011 the quantity of the sewage waters from Ledenika recreation Rest House is 9000 m^3.

Cooling and production waters from EP-1, including cooling waters, disbalanced waters and waters from WDF in EP etc., sewage waters from WDF in EP-1 and secondary condensate from SWT-3 and peak boiler and Service Water from Nitrogen-Oxygen Station and Compressor Station in EP-1.
In 2006, about 97 % of the permitted quantities were discharged into the Danube River by HC 1 and MDC N1. In 2007 82% of the permitted quantities are intaken into the Main Drainage Channel and in the Danube River by HC 1 and HC 2 - approximately 69% oof the permitted quantity. In 2008 the quantity of the sewage waters intake into the Danube River by HC 1 and HC 2 is approximately 77 % of the permitted quantity and in 2011 this quantity was approximately 80%.
Sewage water quantities from DN300 and DN1000, intaken into the Main Drainage channel exceed the permitted quantities (exceeding of the permitted quantities is also monitored in 2006 and 2008 and after that in the period of 2009-2011 no exceeds are monitored).
In 2008 after Units 3 and 4 Shutdown (2006) there is decreasing by 23.4 % of the total quantity of sewage waters discharged into the Danube River, which trend is also kept in the following monitoring period 2009-2011. When evaluating the permitted quantities of the sewage waters and quantities generated from CTS workshop and Auxiliary Building during 2009, 2010 and 2011, the following could be stated:

- In 2009, 2010 and 2011 the quantities of the sewage water intaken into the Main Drainage Channel are considerably lower than the permitted ones;
- the quantity of the sewage waters intake through HC-1 into the Danube River in 2010 and 2011 exceeds the maximal permitted one, but the total quantity of waters intaken through HC-1 and HC-2 does not exceed the maximal one for both channels, which is 3 280 mio m^3;
- The sewage waters generated by the module treatment facility are within the framework of the permitted quantity.

Executing the elaborated by Kozloduy NPP Program for non-radiation in house monitoring (PIHNRM) of the emissions in the air and waters from Kozloduy ID N UK.UOS.PM.013 [127] the qualities of the sewage waters discharged in the Danube River by HC-1 and HC-2 and into the main drainage channel (MDC) are monitored.
Sampling and testing according to the program are made once per quarter by the Regional laboratory in the town of Vratsa of EEA. Since 2007 quarter samplings and tests of the sewage waters are made. Results presented in Appendix 11.4.1.4 are compared with the individual emission restrictions stipulated by both permits for discharge of the sewage waters. According to Permit N 13750001/20.04.2007 a control is required once per three months. According to Permit N 13750001/20.04.2007 a control is required once per month. According to the Program for In House Monitoring of the Water Emissions from Kozloduy NPP [127] the indicator COD dichromate is controlled monthly in order to determine the actual category of the discharge waters (under Ordinance N 7 from 8 August 1986 [112]). According to the Permit for use of water site for intaking of the sewage waters in the surface water sites N 03120003/15.12.2007 the control periodicity is once per quarter. Indicators „suspended substances" and „COD" (together with the indicator "BOD_5", not included in the individual emission restrictions, are controlled monthly aiming to determine the category (according to Ordinance N 7 from 1986) of the discharge waters and unit amount of the fee (according to item 5 of the table in Para.9 of the

Tariff for Fees for the Right of Water Use and/or Permitted Use of the Water Facility with Decree of the Council of Ministers N 154 from 28 July 2000, promulgated in SG, issue 65/2000). In 2009, 2010 and 2011 the samples from the sewage waters are analyzed by accredited laboratory - Vratsa and by the laboratories of Kozloduy NPP..
The results compared with the individual emission limits are as follows:

Intake into TCC

All registered values are under the individual emission limits determined for this flow in the permit, except the "Boron" indicator, under which the restriction is "not allowed" (table 3.3.1.3-5) and „non-solved substances" in 2011.

Table 3.3.1.3-5 Exceeds of the individual emission limits are observed for the Boron indicator

Indicator	Number of analyzed samples	Number of exceeds	IEL, mg/l	Average value, mg/l	Maximal value, mg/l
Boron	4* 4** 6***	3* 4** 6***	Not allowed	0.07* 0.04** 0.04***	0.09* 0.115** 0.04***
non-dissolved substances	9***	1***	50***	-	56***

*2009; ** 2010 ***2011

Intake into F1000

Exceeds of the individual emission limits are observed for the Boron indicator (table 3.3.1.3-6) for the all three years, total Nitrogen for 2009, BOD_5 for 2009 and total phosphate 2009 and 2011.

In 2010 no exceeds of the individual emission limits are observed under indicators total Nitrogen, total phosphor and BOD determined for this flow by the permit for intake of sewage waters.

Table 3.3.1.3-6 Exceeds the individual emission limits of the observed indicators

Indicator	Number of analyzed samples	Number of exceeds	IEL, mg/l	Average value, mg/l	Maximal value, mg/l
Boron	2* 4** 15***	1* 4** 13***	Not allowed	0.095* 0.06** 0.05***	0.19* 0.1427** 0.09***
BOD5 (only 2009)	2	1	15	15.6	24.8
Total Nitrogen (only 2009)	2	1	15	12.3	15.9
Total phosphor (2009 and 2011.)	2* 12***	2* 1***	2* 2***	2.46* -	2.75* 2.045***

Intake into Switchyard

In 2009 in the switchyard during control inspection a violation of the issued punitive decree is detected. After determination of the reasons some measures are undertaken for avoidance of future violations.

In 2010 all registered values are below the individual emission limits determined for this flow in the permit for intake of sewage waters.

In 2011 all registered values are below the individual emission limits determined for this flow in the permit for intake of sewage waters, except 1 analyzed sample under "Boron" indicator, for which the restriction is "not allowed (table 3.3.1.3-7) and "unsolved substance".

Table 3.3.1.3-7 Exceeds of the individual emission limits are observed for the Boron indicator

Indicator	Number of analyzed samples	Number of exceeds	IEL, mg/l	Average value, mg/l	Maximal value, mg/l
Boron	3	1	Not allowed	0.11	0.11
non-dissolved substances	9	1	50	-	56

HC-1

Single exceed of the individual emission restrictions in 2009 is monitored only for the indicator "residual chlorine" in the second quarter (table 3.3.1.3-8). Such exceed was not typical in 2008, but it was also observed in 2007.

In 2010 and 2011 all registered values are under the individual emission limits determined for this flow in the permit for intake of sewage waters.

Table 3.3.1.3-8 Exceeds the individual emission limits of chlorine indicator (2009)

Indicator	Number of analyzed samples	Number of exceeds	IEL, mg/l	Average value, mg/l	Maximal value, mg/l
Residual chlorine	4	2	0.1	0.12	0.18

HC-2

In 2009 single exceed of IEL is observed for the indicators „residual chlorine" – 0.16 mg/l.

In 2010 and 2011 there are no exceeds of the individual emission limits for this flow determined in the permit for intake of sewage waters.

Conclusions:

Considering the results from the analyses it could be summarized that in 2010 and 2011 only in the sewage waters of the MDC some minor values of "boron" indicators are recorded, but they are within the frameworks of the values reported for the drinking water of the town of Kozloduy and the water of the Danube River as well as single minimal exceed of the IEL for "unsolved substances" in 2011.

Monitoring of sewage waters from the conventional disposal facility

On the territory of the storage facility two types of sewage water flows are generated, for which separate collection pits are constructed:

- for infiltrate – Reactor shaft – 4;
- for residential and surface waters – Reactor shaft-7.

After execution of radiation control the waters from both pits are transported by a cistern to the neutralization pit in EP-2 and from there by low-head channels it is supplied to HC 1 End water intake of the waters is the Danube River.

Quantity of the sewage waters from the Repository (around 1278 m^3/year in 2011) is less than 0.3 % of the quantity of the sewage waters from the neutralization pit in EP-2 (341 870 m^3/year).

In the infiltrate from the Repository and in the sewage waters from the site of RCMIW more sensitive indicators are unsolved substances and oil products.

From the attached tables 3.3.1.3-9, 3.3.1.3-10 и 3.3.1.3-11 with summarized indicators of physical and chemical tests of the infiltrate (Reactor shaft-4), for the unsolved substances a trend for their reduction is monitored in 2010 in comparison

with 2009 as well as slight increase in 2011, but anyway the values are lower than the values in 2009. The opposite is valid for the quantity of the oil products.
Regarding the sewage waters (surface and residential) from the Repository, some increasing is monitored of the quantity of the unsolved substances in 2010, when the quantity of the oil products in both years is more or less the same.

Table 3.3.1.3-9 Summarized indicators from tests of the sewage waters from the Repository (infiltrate and residential surface waters) for 2009

Point	Tested indicator						
	pH	unsolved substances, mg/l	oil products, mg/l	iron, mg/l	copper, mg/l	chromium, mg/l	zinc, mg/l
РШ-4	7.6-8.18	24-100	0.1-1.2	0.380-2.37	0,0024-0,008	0.01	0.021-0.052
РШ-7	7.84-8.43	9-36	0.2-1.9	0.06-0.52	0,0013-0,0095	0.01	0,014-0,034

Table 3.3.1.3-10 Summarized indicators from tests of the sewage waters from the Repository for 2010

Point	Tested indicator						
	pH	unsolved substances, mg/l	oil products, mg/l	iron, mg/l	copper, mg/l	chromium, mg/l	zinc, mg/l
РШ-4	7,72-8,08	17-37	0,1-0,4	0,136-0,467	0,0057-0,0094	0,0051-0,01	0,003-0,006
РШ-7	7,31-7,8	16-176	0,2-1,6	0,024-0,602	0,0027-0,0085	0,013-0,01	0,003-0,016

Table 3.3.1.3-11 Summarized indicators from tests of the sewage waters from the Repository for 2011

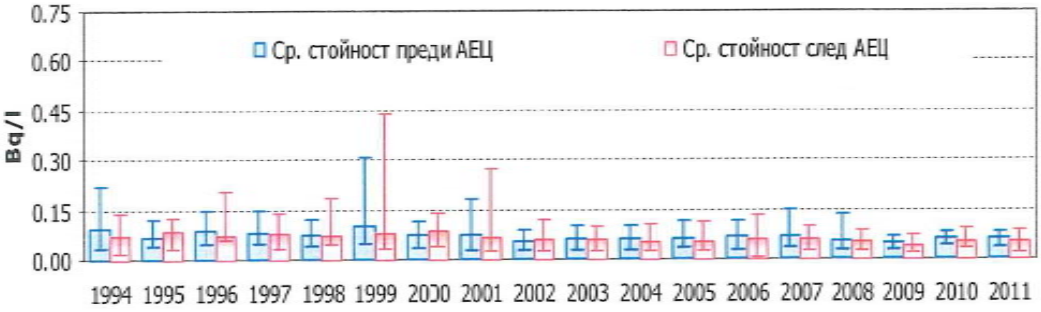
Point	Tested indicator						
	pH	unsolved substances, mg/l	oil products, mg/l	iron, mg/l	copper, mg/l	chromium, mg/l	zinc, mg/l
РШ-4	7.78-8.6	2.08-70	0.4-2.05	0,1087-0,2487	0.0049-0.0230	0,0017-0,0051	0,0034-0,0107
РШ-7	7.43-7.85	4.8-74	0.3-3.87	0,0092-0,0881	0,0006-0,0154	0,0004-0,0193	0,0007-0,0174

It can be concluded that there is no stable trend for change of the controlled indicators of the sewage waters from the repository.

3.3.1.4 Radiological condition of the surface waters

During the last 10-15 years there is no considerable dynamic in the radiation condition of the waters of the Danube River. The data about much lower total β-activity as well as the multiple results from the previous tests show that the radiation condition of the surface waters is not impacted by the operation of Kozloduy NPP for long-term period. The radiological monitoring of the rivers, lakes and dams in the country is made by the network of points and is mainly performed as control of the indicators according to Ordinance No 7/08.08.86 on the indicators and norms for determination of the running surface waters quality [112] - total beta activity (750 mBq/l), content of total Uranium (0.6 mg/l), 226 Radium (150 mBq/l). Low background activity is typical for the region of Kozloduy NPP, i.e. content of Uranium, Thorium and products of their radiation decomposition are below the

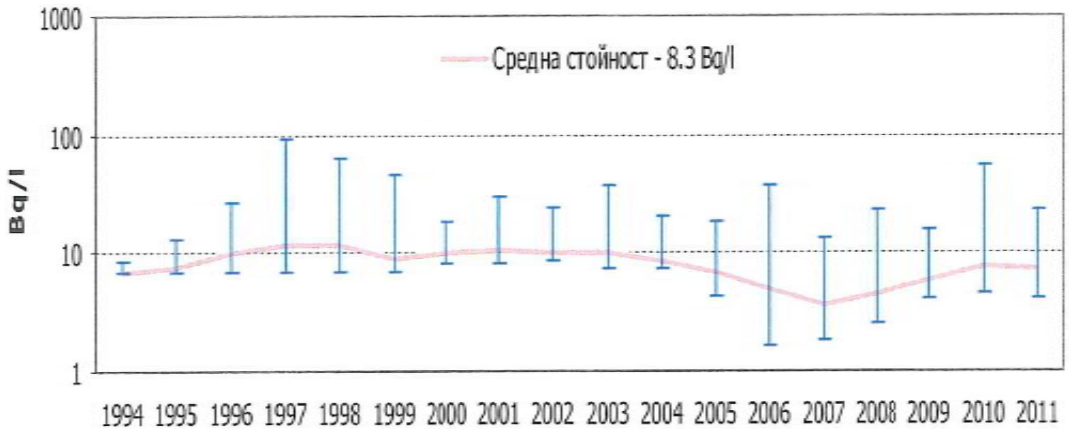
average values for the country. It is a result of the prevailing sedimetogene origin of the geological formations where the investigated region is located.
Average Uranium concentrations for the waters of Danube River are within the range of (2.0±0.2)x10^{-6} g/l (25 mBq/l). Due to the considerably low solubility of the compounds of Thorium the river waters are characterized with several times lower concentrations for which the waters of the Danube do not exceed 0.1mBq/l. From the products of Uranium decay the most significant for the Danube River is the availability of the Radii (^{226}Ra) -2.7±0.9x10^{-13} g/l (9.7±3.4 mBq/l). In the sediments of the Danube River and its tributaries the natural existing radionuclide are detected and the concentration levels of ^{226}Ra and ^{228}Ra comply with the normal geochemical activity. The regional spreading of the contamination with ^{137}Cs is a result mainly of the Chernobyl accident in April 1986. Within the period between 1988 and 2007 it is proven that there is a clearly expressed total reduction of the concentration activity of ^{137}Cs in the sediment of the Danube River. Due to the reduction of the anthropogenic radioactivity of the river it is not associated with a health risk. There is no anthropogenic impact by industrial sources determined.
The radiological monitoring of Kozloduy NPP is a part of the system for provision of safety of the power plant and the radiation protection of the population as well as environmental protection of the region and it has to be regulated by the long-term program of Kozloduy NPP for radiation monitoring of the environment and it is in compliance with the requirements to the normative regulations in the area. For localization and assessment of eventual impact of Kozloduy NPP on the environment there are three control areas with different radii detached around the power plant: radiation protection area (3km), controlled area (12km) and monitored area – up to 100 km. There are 7 points for the water ecosystem placed in the monitored area. Summarized results of the total water activity of the Summarized results of the total water activity of the Danube River in the region of Kozloduy NPP for the period 1994 to 2011 are shown on fig. 3.3.1.4-1. Comparability of the results in different points of the river flow before and after NPP shows that the disbalanced waters, discharged by the generation, do not impact the total beta activity. [118]



Legend: *Ср. стойност преди АЕЦ – average value before KNPP*
Ср. стойност след АЕЦ – average value after KNPP

Fig. 3.3.1.4-1 Summarized results of the total beta water activity of the Danube River within the period 1994 – 2011.
Source: Radiological monitoring of Kozloduy NPP for 2011, Annual report of Kozloduy NPP 2012 [190].

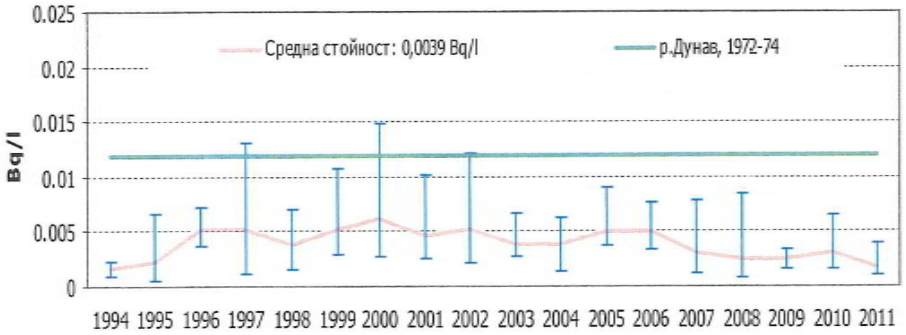
The long-term investigations of Tritium in the waters of the Danube River after NPP show lower activity than the tritium norm for drinking waters – 100 Bq/l (Ordinance № 9/2001)



Legend: Средна стойност – average value

Fig. 3.3.1.4-2 Summarized results for Tritium in waters of the Danube River after Kozloduy NPP within the period 1994 – 2011.

Source: Radiological monitoring of Kozloduy NPP for 2011, Annual report of Kozloduy NPP 2012 [85в].



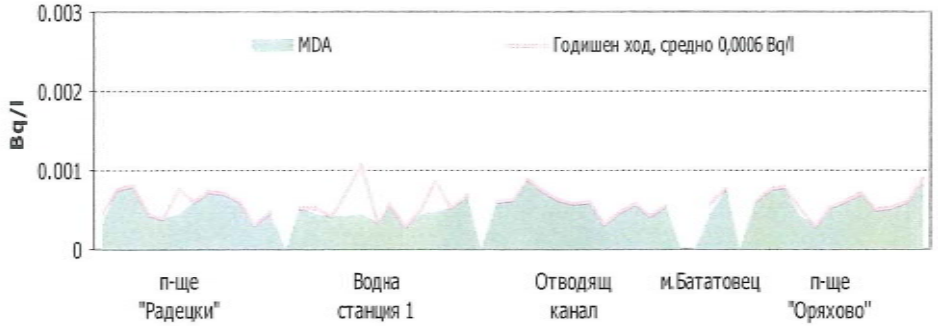
Legend: Средна стойност – average value
р. Дунав – Danube River

Fig. 3.3.1.4-3 Summarized results for 90Sr (Bq/l) in waters of the Danube River after Kozloduy NPP within the period 1994 – 2011.

Source: Radiological monitoring of Kozloduy NPP for 2011, Annual report of Kozloduy NPP 2012 [85в].

The figure shows comparison of the data during the examined period and the activity in the last years is lower than the one before the commissioning of the NPP in 1972-1974. The anthropogenic activity of ^{90}Sr is a result of the global pollution with levels typical for the natural water sources. The data vary and change depending on the full-flowing and respectively on the suspended organic and non-organic substances containing radioactivity. Before the commissioning of Kozloduy NPP according to the data of NCRBRP- for 1972-74, the anthropogenic activity was appr. 12.00 mBq/l of ^{90}Sr and appr. 4.0 mBq/l of ^{137}Cs.

Gamma-spectrometric analyses show that in 2011 some traces of over-background ^{137}Cs are registered only in sa few samples from the water station 1, Radetski port, Oryahovo port and Batanovets area (fig. 3.3.1.4-4). These activities are lower than the onesfrom pre-commissioning period. According to EU recommendation 2004/2/Euratom ^{137}Cs is the key radioniclude for the control of the emissions into the environment. Data from 2011 and from the previous years show that there is no considerable impact registered from the debalanced water discharged from the Kozloduy NPP on the anthropogenic activity of the Danube basin in the region.



Legend: *Годишен ход, средно – Annual rateq average*
П-ще „Радецки"- Port "Radetzky"
Водна станция 1 – Water station 1
Отводящ канал – Discharge channel
М. Бататовец – area Batatovets
П-ще „Оряхово" - Port "Oryahovo"

Fig. 3.3.1.4-4 Activity of ^{137}Cs (Bq/l) in the waters from the Danube River, 2011.
Source: Radiological monitoring of Kozloduy NPP for 2011, Annual report of Kozloduy NPP 2012 [190].

Table 3.3.1.4-1 below shows the average data about the controlled parameters of the total beta activity, ^{90}Sr, ^{137}Cs and tritium in the natural and drinking waters, in the waters from the drainage channel and bottom sediments for the period 1993 – 2011.

Table 3.3.1.4-1 Radioecological monitoring of Kozloduy NPP during the period 1993-2011

Subject to control	Controlled parameter	Controlled parameter Bq/l Bq/l	Controlled parameter Bq/l Natural waters	Controlled parameter Bq/l 2009.	Controlled parameter Bq/l 2010	Controlled parameter Bq/l 2011.
Natural waters	Total beta activity	<0.026 ÷ 0.44	0.027 ÷0.13	0.018÷0.14	0.025 ÷0.15	0.012 ÷0.15
	Tritium	<1.8 ÷ 94	<2.5 ÷ 7.4	4.1 ÷15.7	5.3-13.5	5.4-18.8
	^{90}Sr	<0.0006 ÷ 0.015	< 0.0008 ÷ 0.0084	0.0015÷0.0034	0.0016÷0.0064	0.0009 – 0.0039
	^{137}Cs	<0.0004 ÷ 0.015	<0.0006 ÷ <0.0013	0.0003÷0.002	0.0003÷0.001	0.0003÷0.0011
Water from drainage NPP channel	Total beta activity	<0.022 ÷ 0.36	< 0.028 ÷ 0.084	0.018÷0.062	0.097	0.087
	Tritium	Max 62	<2.6 ÷ 23.1	15.7	53.8	22.3
	^{90}Sr	0.0006 ÷ 0.0134	<0.0013 ÷ 0.0029	0.0003÷0.002	0.0064	0.0009– 0.0039
	^{137}Cs	<0.0005 ÷ 0.204	<0.0006 ÷ < 0.0014	0.00036÷0.0014	0.001,	0.0011
Bottom sediments*	^{137}Cs	0.18 ÷ 98	<0.38 ÷ 20.7	0.87÷16.3	11.2-19	3.7-16.1
	^{90}Sr	<0.082 ÷ 4.00	<0.22 ÷ 0.70	0.19 ÷0.97	0.19 ÷1.63	0.19-1.41
Drinking water	Total beta activity	<0.030 ÷ 0.69	<0.018 ÷ 0.13	0.029÷0.075	0.023÷0.087	0.024-0.088
	^{90}Sr	<0.0006 ÷ 0.014	<0.0007 ÷ 0.0016	0.0008÷0.0023	0.0009÷0.0025	0.0008÷0.0023

* Activity is measured in Bq/kg ** '<' indicates that the value is below the LOD for the sample

Source: Radiological monitoring of Kozloduy NPP for 2008, 2009 and 2010,2011. Annual report of Kozloduy NPP EAD 2009 [85], Annual report of Kozloduy NPP EAD, 2010 [190]. Annual report of Kozloduy NPP EAD, 2011 [190], Annual report of Kozloduy NPP 2012 (190)

The results of the total beta activity of the drinking waters in 2008 are within the range of 0.019 - 0.13 Bq/l (average 0.0490 Bq/l). In all analyzed samples the activity of the tritium is below MDA (LLA) (<2.5 - 7.4 Bq/l). Values are much lower than the permissible norms for the drinking water – 2 Bq/l for total beta activity and 100 Bq/l for tritium pursuant to OrdinanceN. 9/16.03.2001г. Specified results are analogical and commensurable with the ones from the previous years. In 2008 the activity of ^{137}Cs in all analyzed samples is below MDA (LLA) (<0.7 - <1.6m Bq/l). Activity of ^{90}Sr in the drinking waters in 2008 varies within the range of <0.9 - <1.2m Bq/l). The results are similar to the ones of the previous years and are about 1000 times lower than the legal limits (BNRP-2004 [16]).Results are similar to the ones of the previous years and are about 1000 times lower than the legal norms (MRPN-2004 [16]).

Results of the total beta activity of the drinking waters in 2009 are within the limits of 0.029÷0.075 Bq/l (average 0.0480 Bq/l). In all analyzed samples the activity of the tritium is below MDA (LLA) (<4.3÷7.2 Bq/l). Values are much lower than the permissible norms for the drinking water – 2 Bq/l for total beta activity and 100 Bq/l for tritium pursuant to Ordinance N. 9/16.03.2001г. Specified results are analogical to and commensurable with the ones from the previous years. In 2009 the activity of ^{137}Cs in all analyzed samples is below MDA (LLA) (<0.9÷<1.4mBq/l). The activity of ^{90}Sr in the drinking waters in 2009 varies within the range of <0.8÷<2.3mBq/l.

Results of the total beta activity of the drinking waters in 2009 are within the range of 0.023÷0.087Bq/l. In all analyzed samples the activity of the tritium is below MDA (LLA) (<4.4÷7.0 Bq/l). Values are much lower than the permissible norms for the drinking water – 2 Bq/l for total beta activity and 100Bq/l for tritium pursuant to Ordinance N. 9/16.03.2001. Specified results are analogical and commensurable with the ones from the previous years. In 2010 the activity of ^{137}Cs in all analyzed samples is below MDA (LLA) (<0.5÷<1.3 m Bq/l). The activity of ^{90}Sr in the drinking waters in 2010 varies within the range of <0.9÷<2.5 mBq/l.

The results of the total beta activity of the drinking waters in 2011 are within the limits of 0.024÷0.088 Bq/l (average0.051 Bq/l). In all analyzed samples the activity of the tritium is below MDA (LLA) 3.9÷8.3 Bq/l.. Values are much lower than the permissible norms for the drinking water – 2 Bq/l for total beta activity and 100 Bq/l for tritium pursuant to Ordinance N. 9/16.03.2001. Specified results are analogical toand commensurable with the ones from the previous years. In 2011 the activity of ^{137}Cs in all analyzed samples is below MDA (LLA) (<0.9÷<1.4mBq/l). The activity of 90Sr in the drinking waters in 2011 varies within the range of <0.8÷<2.3mBq/l.

It could be concluded that the radiation status of the drinking water sources for the towns of Kozloduy, Hurlets, Kozloduy NPP and the town of Oryahovo completely complies with the sanitary standards.

Tests of the natural waters include mainly the radioactivity of the Danube River alongside the river valley and the internal rivers and water sources next to the power plant - Ogosta River, Tsibritsa and Kozloduy dam. The analysis and the interpretation of the data from the investigations allow summarizing that the results are comparable with the ones from the previous years. Amountsof the total beta activity, activity of ^{90}Sr, ^{137}Cs are within the normal limits for the natural resources. In justification of the above and for comparison purposes table 3.3.1.4-2 show data about the radiological status of the natural waters, waters from the Danube River and bottom sediments before the operation of Kozloduy NPP.

Table 3.3.1.4-2 Radioactivity of sites from NPP environment in pre-operation period 1972-1974.

Investigated object	Content of:		
	^{137}Cs	^{90}Sr	Total β activity
Natural waters, mBq/l	10. 0 - 6.0	7.0 - 6.0	420 - 170
Waters of the Danube River, mBq/l	4.0 - 1.2	12.0 - 2.0	248 - 70
Bottom sediments of the Danube River. Bq/kg	3.6 - 1.4	2.6 - 0.6	889 - 74

Source: Annual report of Kozloduy NPP EAD Results from radiological monitoring. 2009 [190].

Comparison shows that apart from the ^{137}Cs concentration in the bottom sediments, which is increased in comparison with the pre-operation period, under all other indicators the activity of the waters during the last year is lower than during the pre-operation period.

Tritium activity is recorded sometimes only in the waters of the drainage channel of Kozloduy NPP and this shows the minimal impact of the power plant on the disbalanced waters.

Conclusions:

Minimal activities of tritium are sometimes measured in the waters of the drainage channel - Kozloduy NPP and Water station - 1. The recorded traces of the anthropogenic activity are even lower than the drinking water norms and show the negligible impact of the power plant on the waters of the Danube River caused by the disbalanced waters, discharged from the channel.

The operation of Kozloduy NPP has not assessable impact on the Danube waters and on the waters of the other water resources in the region. The results are within the normal ranges for the natural water resources and are much below the established limits.

The radiation condition of the drinking water sources in the region is not impacted by the NPP activity and complies with the sanitary standards.

We would like to underline, that the Ministry of Environment and Water performs independent radiological monitoring beyond the area of preventive protection measures of Kozloduy NPP. Except continuous measurements of the radiation gamma background, control of the radiological indicators of the atmosphere air, radiation monitoring of soils, also monthly radiation monitoring is made of the Danube River and sewage waters of Kozloduy NPP as well as radiation monitoring of the bottom sediments.. In 2009 a system monitoring is made of the radiation condition of the Danube River at 10 points (from Novo selo to Silistra) and at other 92 points alongside the river valley of the biggest rivers and other water facilities in the country (fig. 3.3.1.4-3).

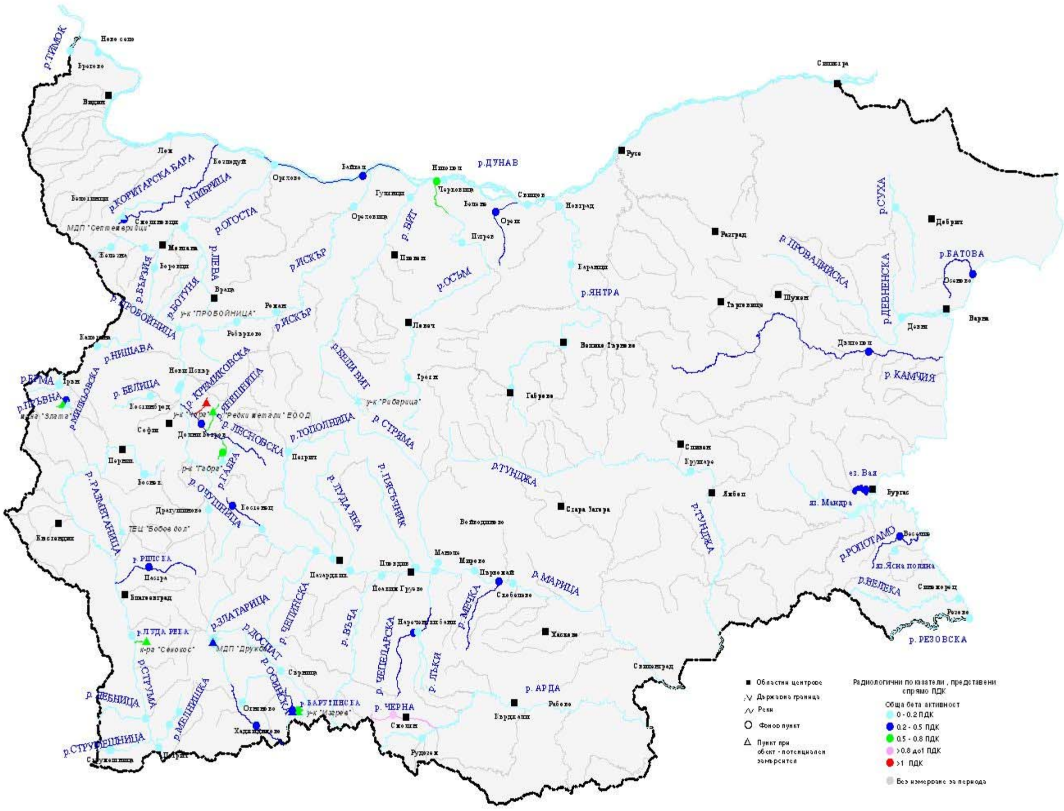
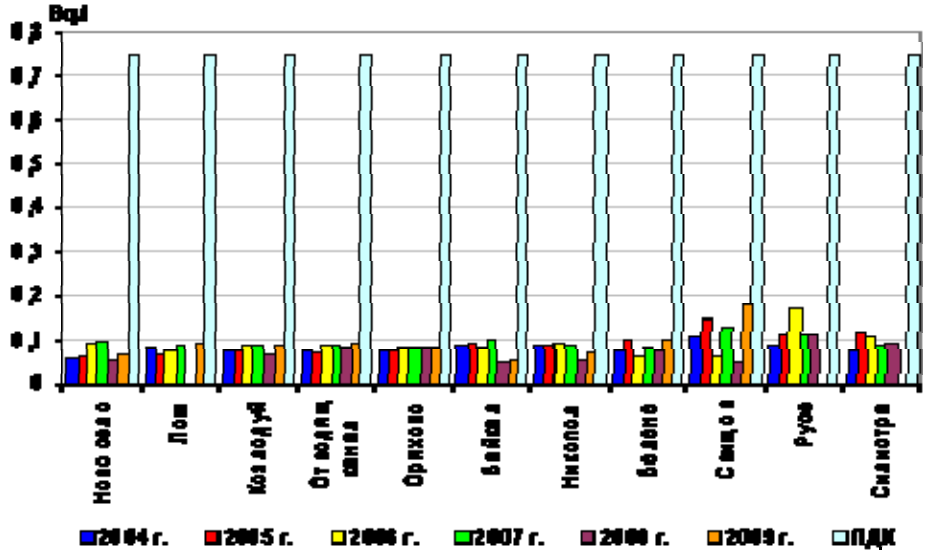


Fig. 3.3.1.4-3 Monitoring of the radiation condition of the Danube River
Source, Annual report on the environment condition in 2009., EEA, 2010.

The analysis of the results of the total beta activity of the waters of the Danube River and other main rivers, lakes and dams shows limits far below the PLC.
On these grounds a conclusion could be made that during the year the Danube River and the rest water sources in the country were in very good radiation condition.

Radiological monitor of surface waters from 100km area of Kozloduy NPP and disbalanced waters from the power plant

Radiological parameters are monitored in the waters from the rivers: Danube, Ogosta, Iskur, Osum, Tsibritsa and Timok, flowing in 100 km area of the nuclear power plant. The analysis of the data of the total beta activity of the waters of the Danube River (from Novo selo to Silistra), compared with the waters from the discharge channel of Kozloduy NPP during the period 2004-2009 (fig. 3.3.1.4-4), shows values far below the limit permissible values as determined by the standards for the quality of the surface waters (0.750 Bq/l). This conclusion is also valid for the rest tests of the rivers in the region.



Legend:
Ново село - Novo selo
Лом - Lom
Козлодуй - Kozloduy
Отводнителен канал - Drainage Channel
Оряхово - Oryahovo
Байкал - Baikal
Никопол - Nikopol
Белене - Belene
Свищов - Svishtov
Русе - Ruse
Силистра - Silistra

Fig. 3.3.1.4-4 Total background beta-activity of the Danube River 2004-2009, Bq/l

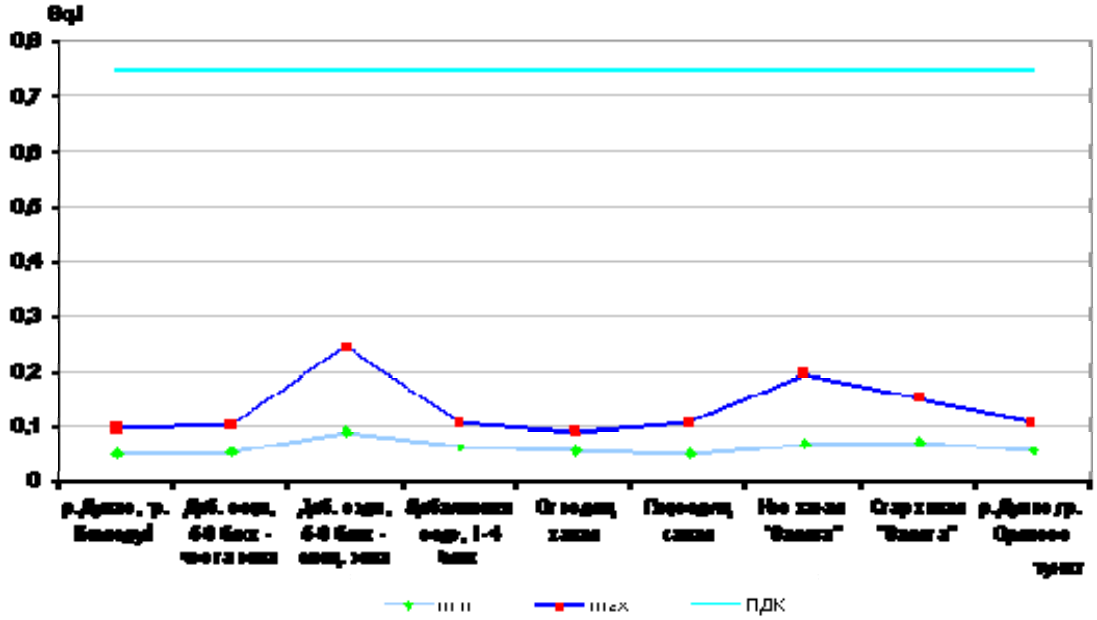
Source: Executive Environmental Agency

Monthly radiological control of the sewage waters of the power plant includes the following points:

- Danube River with Kozloduy – port;
- Disbalanced waters, Units 5-6 – decontaminated area;
- Disbalanced waters, Units 5-6 – special area;
- Disbalanced waters, Units 1-4;
- Drainage channel (HC);
- Feeding channel;
- New channel Valyata;
- Old channel Valyata;
- Danube River with Oryahovo – port.

The Executive Environmental Agency receives monthly references about the volume and activity of the disbalanced waters as a result of the executed institutional radiological monitoring of the power plant.

Received values of the radiation parameters are far below the permissible norms (fig. 3.3.1.4-5).



Legend:
р. Дунав, гр. Козлодуй - Danube River, Kozloduy
Деб. Води, 5-6 блок – чиста зона - Disbalanced water, Units 5&6 – clean zone
Деб. Води, 5-6 блок – спец. зона - Disbalanced water, Units 5&6 – special treatment
Дебалансни води 1-4 блок - Disbalanced water, Units 1 to 4
Отводящ канал - Drainage Channel
Подводяща канал - Feeding Chanel
Нов канал „Валията" - New Chanel Valiata
Стар канал „Валията" - Old Channel Valiata
р. Дунав, гр.Оряхово - Danube River, Oryahovo
пункт - Monitoring Station

Fig. 3.3.1.4-5 Total beta activity [Bq/l] in the disbalanced waters of Kozloduy NPP, Bq/l, *Source: Executive Environmental Agency*

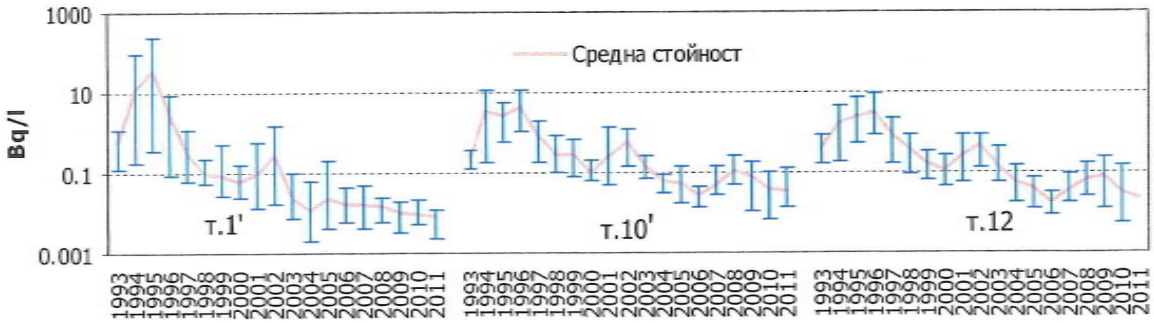
The results of the analyses are comparable with the ones recorded from the previous years and they do not show change of the radiological characteristics of the Danube River on Bulgarian territory as a result of the activity of Kozloduy NPP.

Radiation control of sewage and residential and faecial waters (RFW)

During the test of the ***waters from the sprinkler ponds*** of Units I – VI monthly the tritium content and the seasonal total beta activity are determined. The tritium activity in the last year is 4.1 to 20.5 is of average value 6.7 Bq/l. Most of the results are below PDA (4.1-7.7Bq/l). Total beta activity varies from 0.028 to 0.33Bq/l, with average activity 0.15 Bq/l.

It could be concluded that the radiation status of the most samples from the sprinkler ponds is with normal levels of the natural water resources.

The waters from the RFW are tested monthly regarding a content of tritium and gama-spectometric tests are carried out regarding the radionuclide content (mainly ^{134}Cs, ^{137}Cs) and once per year regarding ^{90}Sr.



Legend: Средна стойност – average value

Fig. 3.3.1.4-6 Activity of ^{137}Cs in the waters from RFW for the period 1993 – 2011 from Kozloduy NPP, Bq/l

Based on figure 3.3.1.4-6 the following conclusions could be drawn:

1. Comparing with the results from 1993 the specific activities of ^{137}Cs in the waters from RFW in 2011 are the lowest for the period. This is a sign that the radiation situation in the region is improved as a result of the strict radiation control of the waters discharged from Kozloduy NPP. The measured anthropogenic levels are not hazardous for the ecological situation in the region of Blatoto.
2. General radiological status of the environment in 30km zone of Kozloduy NPP is presented on fig. 3.3.1.4-7 Results are shown from the sample analyses of non-agricultural soils, bottom sediments and waters from the river network in the region.
3. As a result of the radiological monitoring made within the system of MoEW within 30km area of Kozloduy NPP the entire radiation status of the environment in the region could be monitored [118].

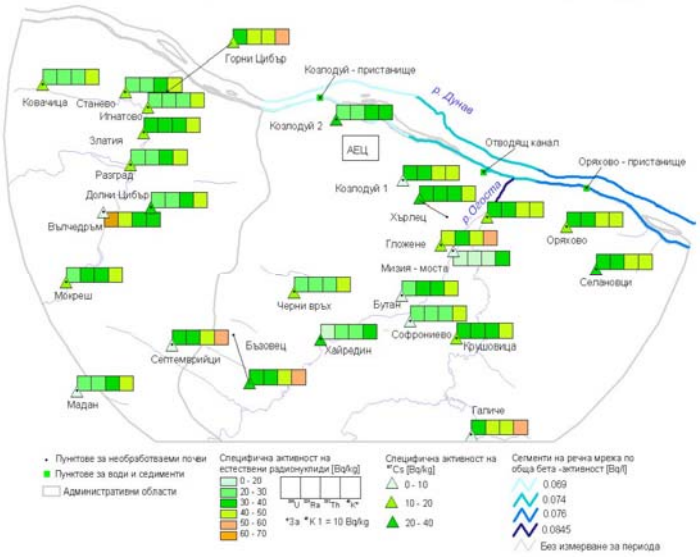


Fig. 3.3.1.4-7 Radiation condition of the environment in 30km area of Kozloduy NPP, 2010 **Source: Executive Environmental Agency**

In the data received in 2010 about the radiation condition of the environment compared with the results from the previous years, nodeviations are detected of the measured specific activity of the natural radionuclide in non-agricultural soils and bottom sediments as well as total beta activity of surface waters compared with the

values typical for the region As a result of the operation of the nuclear power plant, no unfavourable trends are expected to impact the environmental components.

3.3.2 Groundwaters

3.3.2.1 Location and geomorphologic structure

Kozloduy NPP is located between the village of Hurlets and the town of Kozloduy. From the geomorphological point of view the power plant is located on the not overflowed terrace of the Danube River and the hydro-technical facilities (cold, hot channel and BPS) are located on the overflowed terrace. Both terraces form the Kozloduy low land.

Landscape of the non-overflowed terrace is a plain of average 35 – 40 m altitude. A rise could be seen in the South-West part, where the non-overflowed terrace goes into the slope and there is a steep slope batter between the flood plain and the non-overflowed terrace. Also, there is a rise occurred in the North-West part and this rise is related to the process of formation of the loess deposits in the border of non-overflowed terrace.

The overflowed terrace, where the hydro-technological facilities are constructed, is also of plain landscape. Average elevations are between 26.00 and 30.00 m. The border between both terraces is marked with a terrace slope of 5-6 m height.

In the overflowed terrace there are protection facilities (protection dikes), which protect the Kozloduy low land against overflowing in case of high waters of the Danube River. Besides, in the low land there are a lot of hydromeliorative facilities constructed, including drainage and irrigation channels.

3.3.2.2 Geological and hydrogeological prerequisites

From the hydrogeological point of view the Neogene lithostratigraphic units are the most important for the Kozloduy low land - Archarska and Brusarska formations as well as the Quaternary alluvial and loess sediments.

To the West from the Ogosta River the upper parts of the Neogene are constructed by sediment rocks of the Brusarska formation coming with quick lithological transition and overlapping with a washing out only of Quaternary alluvial. Brusarska formation is determined mainly by drill works in depth - in the lands of Dolni Tsibur, the town of Kozloduy and to the East up to the Ogosta River. In the cross section the formation consists of grey-green sandy loams interbedded with sand lenses. There are non-economically viable deposits of coal in the lower parts. Detailed information and analysis about the condition of geological and hydrogeological conditions in the region of Kozloduy NPP are presented in Kozloduy NPP EIA Report, 1999 [82].

Within the range of the site of Kozloduy NPP (according to the data from the drill works) in the lower parts of the section there are sands of up to 16m thickness coming above the coal (0.5 m). Thickness of the sediment rocks of the Brusarska formation varies from several meters to 40 – 50 m, and sometimes it is up to 70 m, but their age is Dacian-Romanian.

On the grounds of the performed investigations it was defined that the Brusarska formation, which is an underlying of the Quaternary alluvial strata, has uneven surface. In the Northern and South-West parts the sands could be also discovered at higher elevations (22.0 m) and gradually to the North and Northeast direction they drop down to 12.0 m elevation.

Section of the Quaternary is constructed by several lithological types of sediment rocks. In the region of Kozloduy NPP and next to it within the range of the Quaternary three sections are recorded.
Gravels origin from Eo-Pleistocene and they are kept on the ridge parts at a relative height of 90-100 m from the contemporary river levels. From the lithofacial point of view the Pleistocene section is constructed of several genetic types of sediment rocks - proluvial, (plain), alluvial, proluvial-alluvial, eolithic and eolithic-proluvial-alluvial.
In the section of Pleistocene spatially two parts could be split: lower - clayey-gravel and upper - loess and loess formations.
Gravels in which there always are some interlayers and lens of sends the lower part of the Pleistocene are of alluvial origin.
The site of Kozloduy NPP and communication to it in the restricted area are situated on (at a depth under the loess) gravels and sands of ancient paleobeds of one of the paleobranches of the Danube that are the biggest and most important natural water-saturated lithofacial area. Thickness of these alluvial sandy-gravel materials varies within wide range - from the first several meters up to 10 –12 m.
Upper part of the Pleistocene section is made of loess and loess-type formations that are widely spread into the region. These materials are undoubtedly of eolithic origin. As loess varieties in the region and next to it the sandy and typical loess are determined. In this case the sandy loess is available only alongside the Danube River between Kozloduy and Oryahovo.
The youngest Quaternary sediment rocks are the Holocene ones, which come with a wash out and they are cut into the Pleistocene on the temporary rivers, but also in the Neogene/Pliocene. Within the range of the contemporary rivers these alluvial are represented mostly by gravels and sands and above then sandy loams and clays are available.

3.3.2.3 Hydrogeological conditions

Both terraces of the Kozloduy low land in the region of Kozloduy NPP are respectively the non-overflowed terrace - of Pleistocene age and the overflowed terrace - of Holocene age. Both terraces form common Quaternary aquifer distributed in the Quaternary alluvial deposits and especially in the gravel-sandy sediment rocks, which as per their nature are paleobeds of the Danube River.
For the interlayer (aquitard) of this aquifer the gray and gray-green clays of the Brusarska formation (Pliocene) are used, but at some places under the gravels there are fine-grained sands of the same formation available that could discovered as lens and thin interbeds and then the aquitard is imperfect. In these sections the supply of the Quaternary aquifer is made by the aquifers located under it. It is determined that the interbed is of unequal surface.
The top rock of the Quaternary aquifer in the non-overflowed terrace is made of loess materials (sandy loess, clayey loess and loess clay), and at the overflowed terrace these are the powder-sandy loams.
Main facilities of Kozloduy NPP are located on the non-overflowed terrace of the Danube River. Average elevation of the ground surface for Units 1 - 4 is 35.00m, and for Units 5– 6 it is 36.50 m. From the lithostratigraphic point of view the non-overflowed terrace has two layers from up to the bottom:

- first (upper) layer is constructed of loess materials (sandy loess, clayey loess and loess clay). It is of lower water impermeability. In it the Western and

Southern part the sandy loess prevails and in the central parts the loess is developed with its three lithologic varieties. Its thickness is changed from 14-15 m to 11-13m and respectively elevations from 25-23 to 24-22 m;

- the second (lower) layer consists of gravel- aggregates-sandy alluvial depositions, where the Quaternary aquifer is available. Its thickness changes from 1-2 m to 10-11 m, average 6-7m and respectively elevations 17-10 m.

During the investigation works in 1967-1970 and 1978-1980 in connection with the construction of EP-1 and EP-2, no groundwater was detected in the loess materials. Drillings have been made made in dry condition by manual drills and in this way it was determined that the occurrence and level of the groundwater of the Quaternary aquifer is changed from 9.60 to 10.50 m, respectively at elevations 26.0 m to 27.0 m and between 10.60 – 12.50 m, equal to elevations 24.50-22.50 m.

This shows that the water level of the groundwater occurs slightly above the water saturated gravels and sands in the loess materials so as per their hydraulic nature the aquifer is one semi-pressured aquifer. With this difference between the depths where the water saturated rocks are distributed and the water level occurs indirectly the value of the capillary increase of the loess materials is determined, which fluctuates between 1.20 – 1.60 m.

For determination of the filtration parameters of the Quaternary aquifer during the specified stages of investigation some filtration works were executed on the test sections by water pumping drainage and monitoring drills. Results of these tests are as follows:

- For the region of Units 1 – 4 the filtration ratio does not change from 45 m/d to 100 m/d, average K = 70m/d and respectively the conductivity ratio is T = 500 m^2/d;
- For the region of Units 5-6 the filtration ratio changes from 45 m/d to 135 m/d, average K = 100 m/d and respectively T = 700 m^2/d.

Increasing of the values of the filtration parameters from east to west is a result of the change of the size of gravel-sandy alluvial, their better wash-out, feed up with groundwater from west from the overflowed terrace in case of high water levels of the Danube River and from the sandy loess, which in the western part is a top rock of the aquifer. Water discharge ratio /μ/ for the Quaternary aquifer is 0.004 up to 0.007 and the gravity water discharge ratio is 0.15 up to 0.2. Average values of the filtration ratio of the different lithologic varieties are shown in Table 3.3.2.3-1.

Table 3.3.2.3 -1 Filtration ratios.

Lythologic varieties	Filtration ratio, m/d		
	From	Average	To
Gravel-sandy alluvial	45	90	170
Sands of different grain size	5	10	20
Fine grainy sands	2	5	10
Loess-like sand	3	4	5
Sandy loess	1.0	1.5.	2.5
Clay-like loess	0.20	0.3	0.4
Loess-like clay	0.1	0.15	0.2
Pliocene sands	0.5	1.50	2.0

Main factors influenced the mode of the groundwater from the Quaternary aquifer of the Kozloduy low land are Danube River and hydrotechnical and hydromeliorative equipment constructed there. Next to the river (up to 500m) the impact is negligible. Change of the water level of the groundwater follows the change of the river level. The recede from it (up to 2 km) gradually reduces its impact.

Investigations made in 1968-1970 and 1978-1980 prove that concerning Kozloduy NPP site the Danube River influence is negligible [111]. As per data by Energoproekt from 1991 a relationship between the fluctuation of the river level and the groundwater table in the alluvial aquifer is proven. Course of the head changing in the bed follows the one of the river level, but it is with very smaller amplitude and is more gradual.

According to the Plan for Management of the river basin of the Basin Directorate Danube River (BDDR) the following underground water sources are identified in the region of Kozloduy NPP:

- Porous waters in Quaternary – Kozloduy low land - groundwater source BG1G0000Qal005;
- Porous waters in Quaternary – between the rivers Lom and Iskur - groundwater source BG1G0000QPl023;
- Porous waters in Neogen – Lom-Pleven low land - groundwater source BG1G00000N2034;
- Groundwater source BG1G0000Qal005 has an area of 39km^2.

The exploitation resource is 2130 l/s, and the module of the exploitation resource is 426 l/s/km^2. The pumping of the water source is 426 l/s., and the free water quantities is 579 l/s. for drinking water needs 3150847m^3 are used and for industrial needs 1603100m^3. As related to the point sources of pollution a good and poor conditions are identified regarding the diffusive pollution sources.

The chemical condition of this UWB is good, but its quantitative condition is poor. UWB is in risk regarding the chemical condition.

The ecological objective of the underground water source, code BG1G0000Qal005 is „Maintenance of the good condition of the water body". The underground water source is determined as an area for protection of the drinking waters pursuant to Article 119a, Para.1, item.1 of the Water Act (WA) code BG1DGW0000QaL005. The condition of the area is poor.

Underground source code BG1G0000Qpl023. The chemical and quantitative conditions of the underground source are **good**. The ecological objective of the underground water source code BG1G0000QPl023 is „Maintenance of the good

condition of the water body". The underground water source is determined as an area for protection of the drinking waters pursuant to Article 119a, Para.1, item.1 of the Water Act (WA) code BG1DGW0000Qpl023. The condition of the area is **good.**
Underground source code BG1G00000N2034 has an area 3065 km^2. The exploitation resource amounts to 1040 l/s, and the module of the underground outflow is 0.34 l/s/km^2. The pumping of the water source is 86 l/s., and the free water quantities are 426 l/s. for drinking water needs 2646316 m^3 and together with the waters used for industrial and irrigation needs it amounts to 2701007 m^3. The chemical condition of the water source is **poor** deviating under nitrates indicator as a result of the diffusive pollution sources**.** The quantitative condition of the underground source is **good**. The ecological objective of the underground water source code BG1G00000N2034 is „Maintenance of the good condition of the water body". The underground water source is determined as an area for protection of the drinking waters pursuant to Article 119a, Para.1, item.1 of the Water Act (WA) code BG1DGW00000N2034. The condition of the area is **good.**
For the areas of protection of the drinking waters the specific environmental goal is "Reduction of the need of water treatment before their use and provision of the designed quantity of the water intake facilities until 2015.
The site of Kozloduy NPP is not involved in the water protection area pursuant to Article 119a, Para. 1, item 5 of the Water Act.

Fig. 3.3.2.3-1 Underground water sources in Neogene-Quaternary

Pursuant to the requirements of the Framework Water Directive, the assessments of the quality of the groundwaters are made under underground water bodies (UWB). The results of the performed analyses are compared with quality standards (QS) of the

groundwaters pursuant to Ordinance N 1 from 10 October 2007 amended SG, issue 2 from 8 January 2010 for investigation, use and protection of the groundwaters.

3.3.2.4 Quality of the groundwaters

Non-radiation monitoring

For the quality analysis of the groundwaters in the region of Kozloduy NPP in view of their physical and chemical indicators the following data are used:

- EEA/MoEW Report Concerning the Groundwater Status in the Danube River Basin, 2010[120];
- Summarized results of the physical and chemical tests of the groundwater mined for the purposes of NPP in 2008-2011 [119, 119a, 119 b, 119 v].
- Non-radiation in house monitoring (IHNRM) of the groundwater in Kozloduy NPP in 2011 [191].
- Non-radiation in house monitoring (IHNRM) of the groundwater from the RCMIW [191].

In the Danube basin region the monitoring of the groundwaters in 2010 is made in 98 monitoring points allocated in 50 underground water bodies - thirty of them and four UWB are joint with the Quaternary deposits in the North-Bulgarian hydrogeological region and there are three UWB in the Neogene deposits at the second level of the ground surface. Also, there are thirteen karst and karst-fractions UWB and one fraction UWB.

The results of these studies are summarized in annual report on the environmental condition 2010. (Executive Environmental Agency). Statistic processing is made of the monitoring data for 15 years (period 1995 – 2010). Medians are determined (50 percentiles) under underground water bodies for the respective parameters for the data from the monitoring points, which are averaged in advance for each year. The underground water bodies, where exceeds of the medians are detected during the years, are specified as hazardous.

During the period 1996 – 2010 gradual improvement of the quality of the groundwaters is monitored for the bigger part of the indicators.

For the period 2000-2010 seven of all nine indicators for groundwaters (ammonium, nitrate ions, permanganate oxidization, sulphates and chlorides, total iron and manganese) show reduction.

The percentages of the points where the average annual concentrates of nitrates exceed the quality standard for nitrates in the period 1996-2010 show negligible changes comparing with 1996 with slight increasing in 2008 and stagnation during the last three years.

Trends for change of the nitrate content in the groundwaters for two three-year period 2005 – 2007 and 2008 – 2010 show prevalence of the percentage of high increasing of the nitrate content in the uncovered groundwaters; for the waters from the karst sources strong reduction or lack of any trend is observed.

The removal of the pesticides from the groundwaters is considered as a positive change and in 2010 the results of the analyses show values below the quality standards. The analyzed specific organic pollutants also show values below the limits for determination of the laboratory analysis methods.

Main pollutants of the groundwaters in 2010 are the nitrates. The results of the statistic processing show that a big part of the UWB for the basin during the last 15 years have at least one median value exceeding the quality standards under at least

one of the following eight indicators. The highest share is the one of the manganese, total iron and nitrate ions. For the manganese and nitrates several underground water bodies could be specified where longer exceeds are monitored during the period 1995-2010. Such more considerable exceeds of the quality standards of the manganese are detected in the porous waters of the Quaternary deposits of the Kozloduy, Ostrovska, Belene-Svishtov low land and in the Vardim-Novograd low land; in the Quaternary deposits of the terraces of the rivers Ogosta, Skut, Vit, Rositsa..

After an analysis of the rest mandatory indicators under Ordinance N 1/10.10.2007 (ammonium and nitrite ions, phosphates, chlorides, sulphates, iron and manganese, permanganate oxidization, electric conductivity, calcium and magnesium), at some monitoring points also some exceeds of the pollution limits are detected. During the period 1993 – 2007 availability of high risk pollutants is detected in view of nitrates, ammonium and nitrite ions, phosphates, sulphate, iron, manganese and magnesium.

In most cases these deviations are not related to the operation of Kozloduy NPP, but they show the total worsen condition of the groundwater as a result of the anthropogenic activities. Concentration of ammonium nitrogen (NH_4 – N) and biogenic elements (nitrate nitrogen and phosphates) are usually increased as a result of the organic pollution by discharged sewage waters of the town, industrial enterprises, agriculture and stock-breeding. Reasons for the high content of manganese and iron are probably the oxidizing-reduction processes when the metals are converted into a soluble form. There are some single breaches of the quality standard of the indicators of lead and common chromium monitored for the analyzed heavy metals.

Non-radiation In House Monitoring (IHNRM) in Kozloduy NPP was developed from the end of 2001 and is in compliance with the requirements of:

- Ordinance N 1 from 10 October 2007 for the exploration, use and protection of the groundwater [121];
- Ordinance N5 from 23 April 2007 for the monitoring of the waters (New Ordinance N 1/11.04.2011) [115];
- Ordinance No 8 for 24 August 2004 on the conditions and requirements for construction and operation of landfills and other facilities and installations for waste disposal and waste recovery [122].

Summarized results of the physical and chemical analyses of the **mined groundwater** from 6 shaft wells (SW), as well as wells Ranei and Valiata for Kozloduy NPP in 2006 until 2011, are presented in Appendix 11.3.1.

The results of the total chemical analysis of the mined groundwater from 6 shaft wells (SW), as well as wells Ranei and Valiata for Kozloduy NPP in 2006, 2007 and 2008 show exceeding of the quality standard for nitrites, iron and manganese for the water from SW Ranei as well as for iron and lead respectively for SWC4 and SWC6.

All recorded values for 2009, except the result of nitrates for SWC-1, comply with the quality standard specified in Appendix 1 of Ordinance N 1 from 10 October 2007, for investigation, use and protection of the groundwaters.

All values recorded for 2010 are below the individual emission limits specified for these water sources in the permits.

Table 3.3.2.4-1 SUMMARIZED RESULTS OF THE CHEMICAL ANALYSIS OF THE PRODUCED GROUNDWATERS MINED in 2009.

N	Indicator	Measuring unit	Quality standard*	SW Valiata	SW Ranei5	SWC1	SWC2	SWC3	SWC4	SWC5	SWC6
	Active reaction	pH units	≥ 6.5 and ≤ 9.5	8.45	7.71	8.30	8.3	8.21	8.27	8.36	8.66
	No hydrochloric acid bubbling is observed.	µs cm^{-1}	2000	774	523	770	488	492	593	506	477
	Dissolved oxygen	mgO_2/l	-	5.42	5.10	4.62	4.71	4.63	4.09	3.99	4.12
	Ammonium ion	mg/l	0.5	0.406	0.412	0.008	< 0.007	0.124	0.022	< 0.007	< 0.007
	Nitrates	mg/l	50	3.88	3.55	54.5	13.2	6.33	5.03	4.8	6.58
	Chlorides	mg/l	250	129	24.1	55.3	21.3	19.8	24.1	21.3	19.8
	Sulphates	mg/l	250	66.8	39.8	86.2	49.9	51.3	88.1	57.5	52.4

* * According to Appendix N 1 of Ordinance N1 from 10 October 2007 for exploration and protection of the groundwaters (promulgated SG, issue. 87 from 30 October 2007, amendment and supplement. 2 from 8 January 2010.).

Table 3.3.2.4-2 SUMMARIZED RESULTS OF THE CHEMICAL ANALYSIS OF THE GROUND WATERSMINED IN 2010.

N	Indicator	Measuring unit	Quality standard*	SW Valiata	SW Ranei5	SWC1	SWC2	SWC3	SWC4	SWC5	SWC6
	Active reaction	pH units	≥ 6.5 and ≤ 9.5	7.69	7.3	7.69	7.73	7.49	7.43	7.86	7.6
	No hydrochloric acid bubbling is observed.	µs cm^{-1}	2000	562	562	703	445	563	641	402	441
	Dissolved oxygen	mgO_2/l	-	2.79	2.79	3.91	3.52	3.11	3.41	3.6	2.83
	Ammonium ion	mg/l	0.5	0.281	0.280	0.019	<0.009	<0.009	0.02	0.012	0.031
	Nitrates	mg/l	50	0.169	0.169	40.4	4.54	1.23	2.4	6.29	0.296
	Chlorides	mg/l	250	18.4	18.4	43.9	20.6	20.6	30.5	15.6	21.3
	Sulphates	mg/l	250	56.4	30.7	73.1	41.5	40.3	73.6	46.2	39.8

* * According to Appendix N 1 of Ordinance N1 from 10 October 2007 for exploration and protection of the groundwaters (promulgated SG, issue. 87 from 30 October 2007, amendment and supplement. 2 from 8 January 2010).

Table 3.3.2.4-3 SUMMARIZED RESULTS OF THE CHEMICAL ANALYSIS OF THE GROUNDWATERS MINED IN 2011.

N	Indicator / flow	Size	Quality standard*	SWC 1	SWC 2	SWC 3	SWC 4	SWC 5	SWC 6	Valiata	Ranei
	Active reaction	*pH*	6.5 – 9.5	7.50	7.30	7.12	7.11	7.36	7.42	7.20	7.05
	Iron	*µg/l*	200	22.30	31.85	21.94	20.32	19.96	20.07	95.49	258.60
	Cadmium	*mg/l*	5.0	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	0.53	<0.14
	Manganese	*µg/l*	50	142.62	171.92	148.73	7.81	17.92	58.05	2.26	663.36
	Copper	*mg/l*	0.2	0.01556	0.01836	0.02126	0.01890	0.02461	0.02093	0.02119	0.01503
	Nickel	*µg/l*	20	<0.84	<0.84	<0.84	<0.84	<0.84	<0.84	<0.84	<0.84
	Lead	*µg/l*	10	<2.07	<2.07	<2.07	<2.07	<2.07	<2.07	<2.07	<2.07
	Zinc.	*mg/l*	1.0	0.00370	0.00253	0.00307	0.00265	0.00213	0.00189	0.02052	0.01339
	Crom	*µg/l*	50	0.71	<0.41	<0.41	<0.41	<0.41	<0.41	45.55	<0.41
	Aluminum	*µg/l*	200	39.17	58.07	44.92	45.50	59.07	36.84	11.91	44.17
	Mercury	*µg/l*	1.0	<2.65	<2.65	<2.65	<2.65	<2.65	<2.65	<2.65	<2.65
	Sb	*µg/l*	5.0	<2.47	<2.47	<2.47	<2.47	<2.47	<2.47	<2.47	<2.47
	Arsenic	*µg/l*	10	<2.97	<2.97	<2.97	<2.97	<2.97	<2.97	<2.97	<2.97
	Calcium	*mg/l*	150	84.9	78.4	71.1	143.1	89.3	79.5	84.5	146.9
	Magnesium	*mg/l*	80	44.4	27.3	39.7	37.7	35.9	25.9	50.5	27.0
	Sodium	*mg/l*	200	424.7	275.9	238.2	212.1	146.8	352.6	360.9	315.5
	Selenium	*µg/l*	10	18.04	<2.41	3.34	4.70	13.42	15.35	4.10	<2.41
	Boron	*mg/l*	1.0	0.04196	0.03292	0.14228	0.06998	0.03165	0.03833	0.08044	0.04332
	Dissolved oxygen	*mgO_2/l*	-	6.31	5.63	5.05	6.57	5.82	6.89	5.28	2.09
	Electrical conductivity	*µS/cm*	2000	902	591	681	892	695	587	1128	684

	Chlorides	*mg/l*	250	38.2	19.8	21.2	31.2	19.9	21.2	129	20.8
	Sulphates	*mg/l*	250	62.8	38.5	37.1	86.5	47.4	33.5	45.8	37.7
	Amonium ions	*mg/l*	0.5	<0.013	<0.013	<0.013	<0.013	<0.013	<0.013	<0.013	0.430
	Nitrites	*mg/l*	0.5	<0.013	<0.013	<0.013	<0.013	<0.013	<0.013	<0.013	<0.013
	Nitrates	*mg/l*	50	14.9	3.72	1.09	1.07	0.933	1.84	13.5	0.633
	Phosphates	*mg/l*	0.5	0.061	0.066	0.036	0.047	0.057	0.074	0.085	0.099
	Permanganate Oxidation	*mgO_2/l*	5	0.536	0.496	0.408	0.440	<0.37	0.600	0.560	0.376
	Cyanide	*µg/l*	50	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
	Fluorides	*mg/l*	1.5.	0.257	0.274	0.303	0.251	0.240	0.225	0.243	0.201
	Content of: natural uranium	*mg/l*	0.06	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Oranic chlorine pesticides											
	α-HCH	*µg/l*	-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	β-HCH	*µg/l*	-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	γ-HCH /Lindane	*µg/l*	-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	δ-HCH	*µg/l*	-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	ε-HCH	*µg/l*	-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	HCB	*µg/l*	-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Heptachlor	*µg/l*	0.03	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Adrin	*µg/l*	0.03	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Dieldrin	*µg/l*	-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Endrin	*µg/l*	-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

	Metoxilor	*µg/l*	-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	o,p DDE	*µg/l*	-	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
	p,p DDE	*µg/l*	-	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
	o,p DDD	*µg/l*	-	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
	p,p DDD	*µg/l*	-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	p,p DDT	*µg/l*	-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nitrogen and phosphor containing pesticides											
	Atrazine	*µg/l*	-	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
	Propazine	*µg/l*	-	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
	Simazine	*µg/l*	-	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025	<0.025
Polycyclic aromatic hydrocarbon											
	Benzo/в+к/ fluorethane	*µg/l*	-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Benzo/a/pirene	*µg/l*	0.01	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Benzo/ghi/perilene	*µg/l*	-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Indeno/1,2,3-c,d/ pirene	*µg/l*	-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Volatile Organic Compouns											
	Benzene	*µg/l*	1.0	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	1,2-Dichlorethane	*µg/l*	3.0	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Thrichloroethilene	*µg/l*	10	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Tetrachloroethylene	*µg/l*	10	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

* * According to Appendix N 1 of Ordinance N 1 from 10 October 2007 for investigation, use and protection of the groundwaters (promulgated SG issue. 87 from 30 October 2007; amendment and supplement, issue 2 of 2 January 2010).

All values recorded for 2011 are below the individual emission limits specified for these water sources in the permits, except the results for the iron for well type Ranei and manganese next to SWC-1, 2, 3 and 6 and well type Ranei and they comply with the quality standard specified in Appendix 1 of Ordinance N 1 from 10 October 2007 for investigation, use and protection of the groundwaters.

Monitoring of the groundwaters

For the purposes of ***In house Non-Radiation Monitoring*** (IHNRM) of the groundwater in the region of nuclear power plant there are 14 drill wells selected in the protected area of Kozloduy NPP and 3 wells beyond the protected territory. Their location is as presented in table3.3.2.4-4.

Table 3.3.2.4-4 Location of the drill wells for own non-radiation monitoring.

N of the drill well	Location
CK 114	Turbine hall Units 1-2
CK 121	Sanitary building in EP -1
CK 127	Nitrogen - Oxygen plant in EP - 1
CK 135	Reactor room Units 1 – 2 and water treatment plants in EP-1
CK 213	Turbine hall Units 3-4
CK 237	Reactor room Units 3 – 4
CK 334	AB– 1
CK 422	AB– 2
CK 512	Reactor room Unit 5
CK 614	Reactor room Unit 6
CK 735	Water treatment plan in EP-2
CK 944	RAW disposal facility
CK w-4	RAW treatment plant
AB p-3	RAW storage
AB P-1	Beyond the protected territory – Northern from the Switchyard
AB P-2	Beyond the protected area – in the yard of the fire protection service
AB P-3	Beyond the protected area - Southern from the information centre

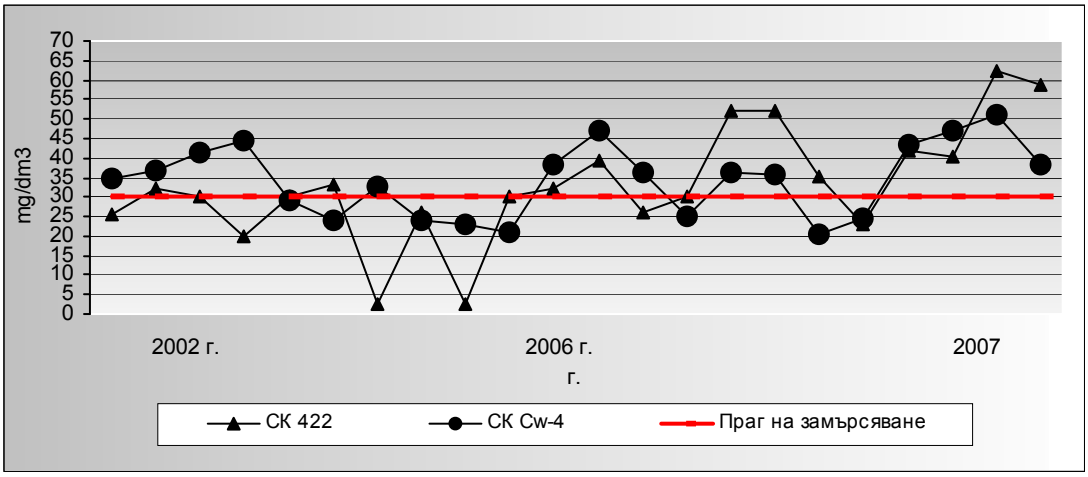
Sampling and tests are made by the Regional laboratory - Vratsa with the EEA-Sofia.

Measured water levels

Measured prevailing level of the groundwater in the region of Kozloduy NPP during the last three years is from 2m to 10.0m.

Summarized results of the physical and chemical tests of the groundwaters

Systematic increase is observed of the iron and manganese content in the groundwaters and in some places there are increased lead values for the period before 2008. [126]. About 35% of the samples from the drill wells in 2008 show that there are some exceeds of the standard norms under the indicators of nitrates, nitrites, ammonia and in drill well AB-135 next to the reactor room of Units 1 – 2 and water treatment plant in EP-1 an increased content of nitrates is recorded during the entire 2008. Some increased concentrations of sulphates and chlorides are detected in the groundwater of the site in EP-1 and EP-2 of the power plant.



Legend:
Special Building - СК
Праг на замърсяване - limit of pollution
Фиг. 3.3.2.4-2 Groundwaters (NPP) – monitored indicator "Nitrates" in 2002. – 2007.
Source: Report on the results of ONRM by Kozloduy NPP for 2008 .[90].

In 2009 totally 68 samples of groundwaters are selected and analyzed. The quality standard from 2009 is completely satisfied by the waters of AB N 114, N 121, N 127, N 213,N 735, N 944, N C^{p-3}, N C^{w-4} and N P-3. Single exceeds of the quality Standard Norms for some indicators are registered in the waters of CK N237 (nitrates), N 334 (permanganate oxidization), N 422 (nitrates and iron), N 512 (active reaction and sulphates), N 614 (manganese) and N P-1 (manganese).

In the waters of two of the wells during approximately the entire monitoring period some exceeds of the respective values of the quality standard are monitored. Analogical results are made in 2008 when these wells are included in the Monitoring program. Wells are as follows:

AB N 135:

Exceeds are recorded of the respective standard values for quality under indicator "nitrates" during the whole monitoring period (59.1 mg/l, 116 mg/l, 123 mg/l and 91.8 mg/l) under standard 50 mg/l.

AB N P-2:

Exceeds are registered for exceed of the respective values of the quality standard under:
content of "*nitrates"* during the entire monitoring period (58.2 mg/l, 81.9 mg/l, 88.7 mg/l and 77.6 mg/l) under standard of 50 mg/l.
content of "*sulphates"* in I-st, II-nd and IV-th quarter (486 mg/l, 392 mg/l and 253 mg/l) with standard 250 mg/l.

Considering the results from 2008 it could be summarized that:

1. For the waters of well 135, located next to the Reactor Hall of Units 1-2 a permanent exceed of the quality standard under "nitrates" content is monitored.
2. The waters of well N512, located next to the Reactor Hall of Unit 5 are with active reaction appr.9 and some values exceed the standard quality norm (≤9.5).
3. With the waters of well P-2, located beyond the NPP site in the yard of Fire protection service a permanent exceed of the quality standard under "nitrates" and "sulphates"content is monitored.

In 2010 totally 63 samples of groundwaters are selected and analyzed.

The quality standard from 2010 is completely satisfied by the waters of AB N 114, N 121, N 127, N 135,N 213, N 237, N 334, N 735, N 944N C^{p-3}, N C^{w-4} and N P-3.
Some exceeds of the quality standard norms is certain indicators are registered in the waters from N 422, N 512, N 614, N P-1, N P-2 are registered.
In the waters of two of the wells permanent exceed is monitored of the respective quality standard values under different indicators. Wells are as follows:
AB N 512:
Exceeds are recorded of the respective standard values for quality under indicator *„pH"* in II quarter (9.81, under standard ≥ 6.5 and ≤ 9.5).
AB N P-2
Exceeds are registered for exceed of the respective values of the quality standard under:

- content of "*nitrates"* in I-st, II-nd and IV-th quarter (68 mg/l, 50,9 mg/l and 65.2 mg/l) with standard 50 mg/l.
- content of *„sulphates"* in I quarter (267 mg/l, with standard 250 mg/l).

The exceeds of the rest wells are related to the indicators "nitrates" and manganese

- under indicator "*nitrates*"
- AB N 422 – 55.6 mg/l *in* II quarter under standard 50 mg/l;
- 57.5 mg/l in III quarter with standard 50 mg/l;
- 54.3 mg/l in IV quarter under standard 50 mg/l.
- under indicator *„manganese"*
- AB N 614 – 81.34 μg/l in III quarter under standard 50 μg/l;
- AB N P-1- 570.54 μg/l in III quarter under standard 50 μg/l;

Considering the results from 2010 it could be summarized that:

- The waters of well N512, located next to the Reactor Hall of Unit 5 are with active alkaline reaction (above 9) and periodically registered values exceed the standard quality norm (≤9.5).
- Waters from well N P-2, located in the yard of the Firefighting service do not comply with the requirements of the quality standard under content of "nitrates" and"sulphates".
- permanent exceed is monitored of the indicator „manganese" for AB N 614 and AB N P-1(62 μg/l for AB N 614 and 93 μg/l for AB № P-1 for 2009).
- In 2011 the sampling and tests of the groundwaters are made in March, August and November. 51 samples of groundwaters are selected and analyzed.
- In 2011 the quality standard is completely met by the waters of drill wells: N 114, N 127, N 213, N 334, N 422, N 614, N 735, N 944,N Cp-3, N P-1 and N P-3.
- Some exceeds of the quality standard norms is certain indicators are registered in the waters from N 121, N 135, N 237, N512 , N Cw-4 and N P-2 are registered.

AB N 512:
Exceeds are recorded of the respective standard values for quality under indicator *„pH"* in III quarter (9.80, under standard ≥ 6.5 and ≤ 9.5).
AB N P-2:
Exceeds are registered for exceed of the respective values of the quality standard under:

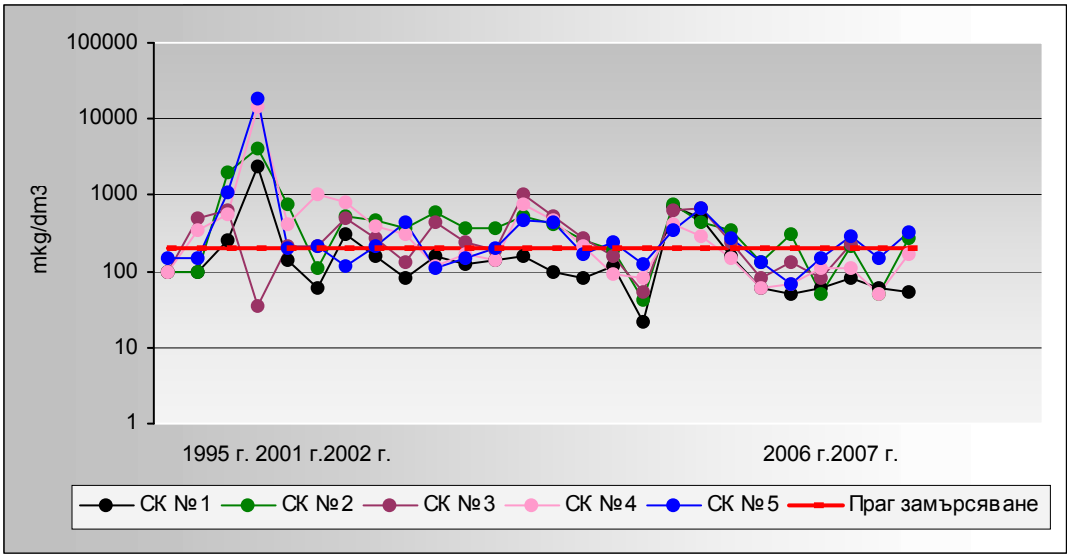
- content of *„nitrates"* in III quarter (70,04 mg/l under standard 50 mg/l);
- content of *„sulphates"* in III quarter (362.62 mg/l, with standard 250 mg/l).

The exceeds of the rest wells are related to the indicators "*nitrates*" and *"fluorides"*

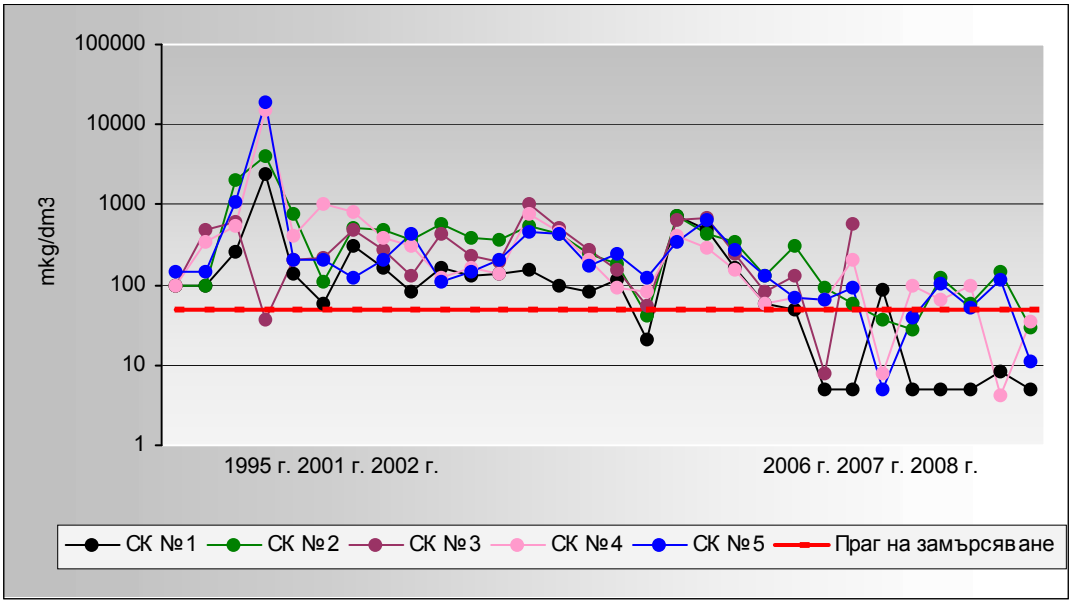
- under indicator "*nitrates*"
- AB N 135 – 109,23 mg/l in III quarter with standard 50 mg/l;
- AB N 237 – 60,19 mg/l in III quarter with standard 50 mg/l;
- under indicator "*fluorides*"
- AB N 121 – 2,46 mg/l in III quarter with standard 1.5 mg/l;
- AB N 135 – 2.9 mg/l in III quarter with standard 1.5 mg/l;
- AB N C^{w-4} – 2,01 mg/l in III quarter with standard 1.5 mg/l;

Considering the results it could be summarized that:
The waters of well N512, located next to the Reactor Hall of Unit 5 are with active alkaline reaction (above 9) and periodically registered values exceed the standard quality norm (≤9.5).
Waters from well N P-2, located in the yard of the Firefighting service do not comply with the requirements of the quality standard under content of "nitrates" and sulphates".
In 2011 for the first time an exceed is monitored of the quality standard values under indicator "fluoride "AB N 121 (located next to Chemical workshop EP-1), AB N 135 (located next to the Reactor Hall Units 1 and 2 and chemical water treatment in EP-1) and AB N Cw-4 (located next to naphta – oil facility in EP-2 and RAW treatment workshop). In house non-radiation monitoring (INRM) of the groundwaters in the region of the facility for Repository of conventional; municipal and industrial wastes (RCMIW)
For the purposes of IHNRM of the groundwater in the region of the Repository for Conventional Municipal and Industrial Waste (RCMIW) 5 wells are drilled alongside its entire length. As a reference AB No 944 is included that is situated next to the limestone facility (before the Repository following the course of the groundwater). AB N3 is removed from the monitoring program in III quarter of 2007.
After making of radiation control the sewage waters discharged on the territory of the Disposal facility are transported by a cistern to the neutralization pit in EP-2 and from there by low-head channels the waters are supplied to HC 1. End water intake of the waters is the Danube River. Sometimes, in the infiltrate from the Repository low concentrations of AOX are observed, which are below the individual emission limits, but anyway they should be controlled. Periodically, some increase of the content of undiluted substances and iron in the infiltrate is monitored also in the waters from the site of RCMIW. No pollution of the infiltrate with oil products has been detected (Appendix 11.3.1). Quantity of the sewage waters from the Disposal facility (around 1278 m^3/year) is less than 0.3 % o the quantity of the sewage waters from the neutralization pit in EP-2 (341 870 m^3/year).
During the monitoring period from 2001 unil 2011, including also in 1995, when the first analyses were made after the construction of the drill wells in the region of the Repository very often an exceeding of the respective limit for iron and manganese indicators is detected.(Appendix 11.3.1 and 3.3.2.4-1 and fig. 3.3.2.4-2). In 2010 no exceeds are

monitored of the quality standards in neither well (Appendix 11.3.1). In 2011 exceed of manganese is also monitored in AB2 and AB5 (Appendix 11.3.1).



Legend:
Special Building - СК
Праг на замърсяване - limit of pollution
Fig. 3.3.2.4-1– Concentration of "Iron /total/" in the groundwaters (RCMIW) in 1995 – 2007.
Source: Report on the results of ONRM by Kozloduy NPP for 2008 [90].



Legend:
Special Building - СК
Праг на замърсяване - limit of pollution
Fig. 3.3.2.4-2 Concentration of "Manganese' in the groundwaters (RCMIW) during 1995-2008.
Source: Report on the results of IHRM of Kozloduy NPP for 2008 [90].

In view of the groundwaters in the region of the Repository it could be summarized that during the whole monitoring period, including pre-commissioning period, annual values are recorded, which exceed the effective standards regarding the indicators iron and manganese.

However, based on the expressed trend for reduction of the limit of iron and Manganese pollution after 2006 and because of the negligible contribution of the wastewater from the Repository in the neutralization pit volume (0.3%) it can be considered that the impact of the Repository on the groundwater following these two indicators is negligible.

3.3.2.5 Natural and anthropogenic radioactivity of the groundwater

For the analysis purposes of the natural and anthropogenic radioactivity of the groundwater in the region of Kozloduy NPP in the current report data of the EIA Report by Kozloduy NPP, 1999 [82] are used as well as the results of the institutional radiation monitoring of the groundwater of Kozloduy NPP formed in annual reports for the period 2006 – 2011, [189].

There are not many investigations made in the region of Kozloduy NPP and beyond it in order to establish the natural radioactivity of the groundwater and especially for the Quaternary aquifer and Dacian-Levant aquatic complex.

Mechanism and assessment of the radionuclides in the hydrosphere in the region of Kozloduy NPP are examined in 1992 in the Report on the Classification of the Disperse Characteristics of the Soil and Water Environment in the Region of Kozloduy NPP site, aiming to analyze the possible paths for migration of radionuclides in the soil and hydrosphere". Very important for this transfer are the filtration characteristics of the covering clays and loess materials in view of the vertical transmission through the aeration area as well as the gravels, through which the eventual horizontal transfer of the radionuclides will be carried out.

As a result of these studies it is determined that the variations of a horizontal transport of radionuclides in the alluvial aquifer are high - 100-2 000 m^2/d. In the central and Southern parts of the aquifer of the low land the conductivity is mostly 100-500m^2/d. To the North and North-East it increases and in some parts reaches 1 500-2 000 m^2/d.

Very small penetration velocities (within a range of mm per year) show that the time for achievement of the radionuclides up to the level of the groundwaters is very long. For the high terrace the time for overcoming of the aeration zone exceeds 250-300 year for Sr, respectively 750-800 years for Cs, while for the loess plateau during this time is even higher –above 500years for Sr and 1500 years for Cs. Even for the thin aeration zone of the low alluvial terrace the time for reaching the water level is about 100 years (with the tickness of the aeration zone from 0.5 m), respectively 200 years (with thickness of the aeration zone of 1.0 m).

Based on the above information it could be concluded that the geological structures are effective natural barrier against the distribution of radioactive pollutions in the groundwaters.

In compliance with the Basic Norms for Radiation Protection (BNRP [16]) on the grounds of the limit of the effective annual dose 1 mSv of total outside and/or inside internal radiation for B category (population of the country as a whole), as secondary limits are determined the average annual permissible concentrations (AAPC) for the separate radionuclide and the basic of them are used as criteria for assessment of radioactivity of the groundwater [16], namely:

Table 3.3.2.5-1 Average annual; permissible concentrations of separate radiounuclides in the groundwater

Radionuclide	AAPC Bq/l
Tritium - ^{3}H	70000
Manganese - ^{54}Mn	1000
Cobalt - ^{60}Co	100
Strontium - ^{90}Sr	20

Radionuclide	AAPC Bq/l
Iodine - ^{131}J	20
Caesium - ^{137}Cs	80
βtotal*	0.75
Ra*	0.15
Ra **	0.1/0.5

Source: EIA_R of Kozloduy NPP 1999 [82] (Pursuant to the Regulation on the basic Norms for Radiation protection [16]).

Institutional environmental radiation monitoring is regulated by the long-term program of Kozloduy NPP for environmental radiation monitoring [150]. Program is based on the requirements of the regulations in this field - Article 130 of the Regulation on ensuring the safety of nuclear power plants, promulgated SG, issue issue 66 from 30 July 2004 [11], Article 118 of the Regulation on radiation protection during activities with sources of ionizing radiation, promulgated in SG, issue 74 from 24 August 2004 [17], Article 14, Para 1, item 3 of the Regulation for the conditions and procedure for establishing of special-statutory areas around nuclear facilities and facilities with sources of ionizing radiation, promulgated in SG SG, issue issue 69 from 6 August 2004 [29] as well as based on the good international practice and the operation experience of RM Department.

Program is agreed with the Ministry of Environment and Waters /MoEW/, Ministry of Health/MH and Nuclear Regulatory Agency/NRA/ as well as with the recommendations of the international organizations in the matter. In order an independent control to be provided also some parallel radiation monitoring programs are implemented by the control authorities – Environmental Executive Agency (EEA)/MoEW and National Centre for Radiobiology and Radiation Protection NCRBRP/MH.

Monitoring of the radiation parameters of the groundwater of the control bodies is based on the execution of the Program for radiological monitoring approved by the Minister of Environment and Waters with Order No RD-227/06.04.2007 and are a part of the National System of Radiological Environmental Monitoring.

Radiation condition of the surface, underground and sewage waters in the monitored area of Kozloduy NPP is made by the means of radiometric measurements in sampling collection conditions and followed laboratory and analytics activities by the laboratory for radiation measurements in Vratsa. Every quarter the reports and protocols containing the information of the laboratory analyses are sent to EEA Sofia. Data are collected, processed and stored in the national data base and for this purposes special software is used. Total alpha and beta activities are measured as well as a content of natural uranium, radium-226 and tritium in surface, underground and sewage waters.

Institutional radiation monitoring is made of groundwater from about 181 drill wells 76 of which are located at the territory of EP 1, 52 – on the territory of EP -2 and 53 in the regions of Spent Nuclear Fuel Storage Facility (SNFSF), RAW Disposal Facility (RAWDF) and limestone facility. The diagram of the radiation monitoring points is shown in (Appendix11.3.1). Frequencies of sampling, the type of measurements of the type of radionuclide are in compliance with the Program of radioactive control of the environments during the operation of Kozloduy NPP.

As a result of the measurement of the activity of the waters from 115 wells in 2008, 116 in 2009, 115 in 2010 and 2011 as well as from the measurements from previous years it is established that the activities in NPP have a local impact on certain site sections. Water with total beta activity higher than 1.5 Bq/l in 2008 is measured in one drill well located on the

territories of EP-1, EP-2 and RAWDF Kozloduy as well as on the territory of RAW repository - in two wells. The highest total activity is 2.43Bq/l, measured on the territory of RAWS. In 110 wells the total beta activity has been never higher than 0.75Bq/l, which is the permissible value of surface running waters (Ordinance N7 for indicators and norms for determination of the quality of the running surface waters [112]. Groundwater generally has higher salt content than surface water and therefore has a higher natural radioactivity.
Out of 115 total drill wells investigated for Tritium in 2008 in 48 of them the tritium activity has never exceeded the annual MPA (up to 7.6 Bq/l). Water in 40 drills has contained tritium at least once per year within the limits of MPA -100 Bq/l and the water in 27 of the drills at least once per year has exceeded 100 Bq/l
In 2008 the highest tritium content in the water of the drill wells is measured in 2008 as follows

- On the territory of EP-1, drill 142 (3 341 Bq/l);
- On the territory of EP-2, drill 725 (17 452 Bq/l).

Out of 11 wells with Tritium activity increased above 10000 Bq/l, 7 are located in the region of AB-3, Units 5 and 6 and 3 boreholes are next to the SE RAW_treatment plant Kozloduy. Maximal tritium concentrations are measured in the Eastern part of the sanitary building
As a result of the measurement of the activity of the waters from 116 wells in 2009 in 110 pcs it has never exceeded 0.75 Bq/l, which is actually the permissible value for the surface-running waters, when the groundwaters as a rule has higher natural radioactivity. The water in 4 drill wells at least once was with total beta activity of 0.75 Bq/l – to 1.5 Bq/l, and in another two cases at least once it was higher than 1.5 Bq/l.
Out of 116 total drill wells investigated for Tritium in 2009 in 57 of them the tritium activity has never exceeded the annual MPA (up to 7.6 Bq/l). Water in 32 drills has contained tritium at least once per year within the limits of MPA-100 Bq/l and the water in 27 of the drills at least once per year has exceeded 100 Bq/l
In 2009 the highest tritium content in the water of the drill wells is measured as follows

- On the territory of EP-1, drill 142 (2959 Bq/l);
- On the territory of EP-1, drill 714 (14,228 Bq/l);

Out of 11 wells with Tritium activity increased above 10000 Bq/l, 7 are located in the region of AB-3, 3 boreholes are next to the RAW treatment plant Kozloduy and one well of EP-1 (Units I and II) Maximal tritium concentrations are measured in the Eastern part of the sanitary building (AB-3)
As a result of the measurement of the activity of the waters from 115 wells in 2010 and in 110 pcs it has never exceeded 0.75 Bq/l. The water in 3 drill wells (N 013,N131,N937) at least once was with total beta activity of 0.75 Bq/l – to 1.5 Bq/l, and in another two wells (N 948, N 951) at least once it was higher than 1.5 Bq/l.

Out of 115 total drill wells investigated for Tritium in 2010 in 58 of them the tritium activity has never exceeded the annual MPA (up to 7.6 Bq/l). Water in 30 drills has contained tritium at least once per year within the limits of MPA - 100 Bq/l and the water in 27 of the drills at least once per year exceeded 100 Bq/l
In 2010 the highest tritium content in the water of the drill wells is measured as follows

- On the territory of EP-1, drill 145 (314 Bq/l);
- On the territory of EP-2, drill 729 (10 567 Bq/l);

Out of 11 wells with Tritium activity increased above 10000 Bq/l, 6 are located in the region of AB-3, Units 5 and 6 and 3 boreholes are next to the RAW Kozloduy treatment plant.

Maximal tritium concentrations are measured in the Eastern part of the sanitary building.
As a result of the measurement of the activity of the waters from 115 wells in 2011 and in 110 pcs it has never exceeded 0.75 Bq/l. The water in 4 drill wells at least once was with total beta activity of 0.75 Bq/l – to 1.5 Bq/l, and in 1 well at least once it was higher than 1.5 Bq/l.
Out of 115 total drill wells investigated for Tritium in 2011 in 54 of them the tritium activity has never exceeded the annual MPA (up to 7.6 Bq/l). Water in 38 drills has contained tritium at least once per year within the limits of MPA -100 Bq/l and the water in 23 of the drills at least once per year has exceeded 100 Bq/l
In 2011 the highest tritium content in the water of the drill wells is measured in as follows

- On the territory of EP-1, drill 341 (422 Bq/l);
- On the territory of EP-2, drill 711 (12,861 Bq/l);

Out of 9 wells with Tritium activity increased above 10000 Bq/l, 5 are located in the region of AB-3, Units 5 and 6 and 3 boreholes are next to the RAW Kozloduy treatment plant and one RAW storage. Maximal tritium concentrations are measured in the Eastern part of the sanitary building.
Change of the route made in 1994 leading to the disbalanced waters from AB-3 provides grounds to expect a reduction of the tritium content in the groundwater. However, in spite of the pumping out of the water from these wells there is no permanent trend for reduction of their pollution with tritium.
According to the Program for radiation control and environmental monitoring the water of the drill wells with total beta activity is higher than 1,5 Bq/l is tested for radionuclide content. Based on the executed tests it was determined that the anthropogenic activity is registered in single wells. As in the precedent years in 2011 activity of ^{60}Co is measured only in two drills. No traces of activation products (^{54}Mn) are discovered. Minor activity of ^{137}Cs is discovered in one drill.
Increased radioactivity of tritium in the piezometers around the RAW treatment plant (RAWTP) N010, 012 and 013 (RAWTP) and 022 (RAWS) is a result of old pollutions and penetration of waters from the part of AB-3.
As a whole, except well N951, all measured values of total beta activity are lower the norm for groundwaters (2 Bq/l, Ordinance 1 from 15 November 1999 for radiation protection and safety norms in liquidation of the results of Uranium industry in the Republic of Bulgaria).
In the EIA report (1999) [82] a study of Akvater is mentioned with a team leader prof. M. Gulubov [125] for forecasting of the migration of radionuclides in the aeration area on the site of Kozloduy NPP. In case of surface leakages on the site of the power plant the thickness of the aeration zone and its migration ability are very important, because it is a media of accumulation of these pollutions. Velocity of the vertical transmission (V_z) is determined in cm/a for the different lithological sediment rocks of it. The results are shown in table 3.3.2.5-2.

Table 3.3.2.5-2 Parameters of the water migration from Kozloduy NPP

Lithologic varieties	Filtration ratio, m/d	Velocity of the vertical transfer **Vz / cm/a**	
		^{90}Sr	^{137}Cs
Loess sandy	2.0	1.8	0.6
Loess clayey	0.2	0.6	0.2
Loess-like clay	0.1	0.3	0.1
Alluvial clay	0.3	0.5	0.2

On the ground of these data the times for crossing of the aeration area are determined - for ^{90}Sr they are 200-300 years and for ^{137}Cs - 700-800 years within the borders of the non-overflowed terrace. In the region of the overflowed terrace with the aeration area thickness of 0.5 m, the time for reaching the water level is 100 years.

This longer period of penetration of the radionuclide through the aeration area of the groundwater is confirmed also by the values of ^{90}Sr in the water samples taken from the site of Kozloduy NPP for the EIA purposes in 1999 [82]. They are changed from 0.031 to 0.071 Bq/l, with a permissible norm of 3.7 Bq/l. In case of direct underground discharges of radioactive waters on the site of the power plant, which have occurred in different sections during the different years of its operation, such local contents have been detected, but however, they are several times lower than the norm. Weak migration of the radionuclides in the loess deposits is confirmed by the localization of these "pollutions" at different places without their extension.

In execution of the Program for radiation and environmental monitoring of the Repository for conventional municipal and industrial waste of Kozloduy NPP НУБ.МОС.ПМ.004/01 [159], from the site commissioning in 2001, monitoring of the radiation indicators of the region of the RCMIW site is held. Controlled facilities are 5 drill wells (piesometers) for groundwater, sewage waters, collection tanks and rainfall water

In 2008 the results under total beta activity of the groundwaters around the RCMIW site vary within the range from <0.052 to 0.25 Bq/l, with average activity 0.085 Bq/l. The results are considered in normal range for groundwaters (2 Bq/l, Ordinance 1 from 15 November 1999 for Radiation Protection and Safety in Liquidation of the Consequences Caused by the Uranium Industry in the Republic of Bulgaria).

Constant tritium activity is measured only in the water of well P-1. The analysis shows activities within the range from 89.1 to 159.0 Bq/l, with average content 137.5 Bq/l. Availability of tritium in well P-1, considering the fact that it is not available in the wells next to RCMIW and close to Kozloduy NPP site, could not be logically explained. Once in 2008 the minimal activity 17.9Bq/l is determined in well П-4. All other results are below PDA (3.9÷7.6Bq/l). Recorded tritium activities in the groundwater around RCMIW are very low.

In the gamma spectrometric analyses of the sewage and rainfall waters from the RCMIW no anthropogenic activity is registered. All results for ^{54}Mn, ^{60}Co, ^{134}Cs and ^{137}Cs are lower than the respective MPA (0.096÷0.95 Bq/l).

In 2009 the results of total beta activity of the groundwaters around the RCMIW site varies within the range from <0.052 to 0.33 Bq/l, with average activity of 0.10 Bq/l. These results are within the normal range for groundwaters and are lower than the norm for groundwaters (2 Bq/l, Ordinance N 1 from 15 November 1999 for the radiation protection and safety norms in liquidation of the results of the uranium industry in the Republic of Bulgaria).

The analyses of tritium in the groundwaters in 2009 show activity within the range from 4.2 to 143.0 Bq/l, with average content 23.9 Bq/l. All results are below PDA (3.9÷7.6 Bq/l), except the ones of piesometer P1. It has to be considered that the registered tritium activities in the groundwaters around RCMIW in 2009 are very low.

In the gamma spectrometric analyses of the sewage and rainfall waters from the RCMIW no anthropogenic activity is registered. All results for ^{54}Mn. ^{60}Co. ^{134}Cs and ^{137}Cs are lower than the respective PDA (0.12÷0.44 Bq/l).

In 2010 the results for total beta activity of the groundwaters around the RCMIW site vary within the range from <0.051 to 0.39 Bq/l, with average value of 0.096 Bq/l. These results are within the normal range for groundwaters and are lower than the norm for groundwaters

(2 Bq/l, Ordinance N 1 from 15 November 1999 for the radiation protection and safety norms in liquidation of the results of the uranium industry in the Republic of Bulgaria).
The analyses of tritium in the groundwaters in 2010 show activity within the range from 4.5 to 70,9 Bq/l. It has to be considered that the registered tritium activities in the groundwaters around RCMIW in 2010 are very low.
In the gamma spectrometric analyses of the sewage and rainfall waters from the RCMIW no anthropogenic activity is registered. All results for ^{54}Mn, ^{60}Co, ^{134}Cs и ^{137}Cs are lower than the respective PDA (0.11÷0.39 Bq/l).
In 2011 the results of total beta activity of the groundwaters around the RCMIW site vary within the range from <0.055 to 0.39 Bq/l, with average value of 0.11 Bq/l. These results are within the normal range for groundwaters and are lower than the norm for groundwaters (2 Bq/l, Ordinance N 1 from 15 November 1999 for the radiation protection and safety norms in liquidation of the results of the uranium industry in the Republic of Bulgaria).
The analyses of tritium in the groundwaters in 2011 show activity within the range from 4.2 to 60.3 Bq/l, with average content 13.3Bq/l. All results are below PDA (3.9÷7.6 Bq/l), except the piesometer P1. It has to be considered that the recorded tritium activities in the groundwaters around RCMIW in 2011 are very low, even below the norm for drinking water (100Bq/l, Ordinance N 9 from 16 March 2001 for the water quality designed for drinking and residential needs).
In the gamma spectrometric analyses of the sewage and rainfall waters from the RCMIW no anthropogenic activity is registered. All results for ^{54}Mn, ^{60}Co, ^{134}Cs and ^{137}Cs are lower than the respective PDA (0.11÷0.34 Bq/l).
As a ***conclusion*** it is determined that the activities in Kozloduy NPP have a local impact on the groundwaters in certain sections of the site of the power plant.

3.3.3 Surface and groundwater in the 30 km area from the Romanian territory

The Romanian territory within the 30 km area around the nuclear power plant of Kozloduy occupies 133,035 ha. It is situated in the South of the county of Dolj, between the Danube River, Romanatilor and Bailesti plains. Detailed description of the geographical environment and larger water bodies is given in Chapter 3.10.1 of the EIA report.

3.3.3.1 Surface water

3.3.3.1.1 **Non-radioactive monitoring of water quality**

Detailed information about the results of non-radiation monitoring conducted in 2008 and 2009 is presented in [178]. Information provided by the Romanian is for the purposes of present evaluation. Measurements were carried out at 214 points located in 19 surface water bodies within a 100 km zone. Their class is defined in accordance to Order 161/2006 "Normativului privind clasificarea calitatii apelor de suprafata in vederea stabilirii starii ecologice a corpurilor de apa". Classification of the rivers is presented in Table 3.3.5.1.1-1.

Table 3.3.3.1.1-1 categorization of the rivers in 100 km area in 2008 and 2009

Categories	Number of water bodies	
Year	2008	2009
II	158	147
III	51	61
IV	0	1
V	5	5

Source: Input data provided in support the evaluation of the impact of decommissioning activities on Romanian territory (Hydrological data)

The monitoring results show an increase in water pollution and due to this reason in 2009 a re-categorization was made of 10 rivers from category II to III and one - from III to IV category. The main reason for the re-categorization is the pollution with CCOCr and in one case the increased concentration of N-NO3, . N-NH3, P-PO4

3.3.3.1.2 Radioactive monitoring of surface water quality

The National Environmental Radioactivity Surveillance Network (NERSN) of Romania, monitors the radioactivity in the area influenced by NPP Kozloduy – Bulgaria, through 4 laboratories, called Surveillance Stations for Radioactivity Monitoring (SSRM) - in Bechet, Craiova, Drobeta Turnu Severin and Zimnicea, and also 13 automatic air gamma dose rate monitoring stations Eleven of these stations are located in Dolj county, one in Mehedinti county and one station is located in Teleorman county.

Total beta activity of the surface water in the period 2000 – 2009 is shown in Table 3.3.3.1.2-1.

Table 3.3.3.1.2-1 Surface water - total beta activity [Bq/m^3]

Year	Drobeta Turnu Severin*	Bechet*	Craiova**	Zimnicea*
2000	240.921	176.131	243.578	276.729
2001	224.569	168.735	193.961	225.378
2002	246.275	195.533	200.357	230.686
2003	261.531	212.964	246.532	208.469
2004	242.467	274.320	267.675	204.182
2005	261.724	226.906	279.738	198.780
2006	188.239	202.366	243.755	213.853
2007	278.017	353.093	447.980	177.020
2008	145.444	439.823	366.282	179.000
2009	241.217	685.755	157.585	201.897

Note: * samplig point – Danube River
** т** samplig point – Jiu river

During the whole period 2000 – 2009 no exceed of the total beta activity was determined in the points downstream the Danube after Kozloduy NPP.

The surface water samples that have been taken under the Special Program and analyzed by gamma spectrometry have not indicated presence of artificial radionuclides in the investigated samples

3.3.3.2 Groundwater

The Danube and Jiu meadows are covered by sandy soil, with high level of the ground water and a presence of wet silty areas.

3.3.3.2.1 Non-radioactive monitoring of ground water quality

Evaluation of the chemical status of the groundwater bodies in 30 km controlled area of the Romanian territory was carried out according to the requirements of Water Frame Directive 2000/60/CE and 2006/118/CE Directive on the protection of groundwater against pollution; in Romanian legislation 2006/118/CE Directive is transposed by HG 53/2009 and OM 137/2009, which establish the target values for the groundwater bodies.

In 2009, 20 wells are monitored by the national hydrogeological network, 11 pollution control wells, 8 domestic wells from Gorj County and 18 domestic wells from Dolj County. In 2010

for this underground water body are monitored 6 wells from the national hydro-geological network and 7 wells for pollution control.
The following groundwater bodies are located in the investigated area:

- The groundwater body ROJI05" Lunca si terasele Jiului şi afluenţilor săi"
- The groundwater body ROJI06 "Lunca si terasele Dunarii"
- The groundwater body ROOT08 "Lunca si terasele Oltului inferior"
- The groundwater body ROOT09 "Lunca Dunarii – sectorul Bechet-Turnu Magurele"
- The groundwater body ROAG09 "Luncile râurilor Vedea, Teleorman şi Călmăţui"
- The groundwater body ROAG10 "Lunca Dunării (Turnu Magurele-Zimnicea)"

When applying the evaluation principles for the above mentioned water bodies for the years 2009 and 2010 the bodies were divided into two categories:
1. Good chemical status:

- The groundwater body ROOT09 "Lunca Dunarii – sectorul Bechet-Turnu Magurele" (2009). The chemical parameters determing the chemical status for this groundwater body are: nitrates, ammonium ion, chlorides, sulphates, nitrites, phosphates, lead and cadmium;
- The groundwater body ROAG09 "Luncile râurilor Vedea, Teleorman şi Călmăţui" The chemical parameters determining the chemical status for this groundwater body are: nitrates, ammonium ion, chlorides, sulphates, nitrites, phosphates, lead, cadmium and arsenic;

2. The following underground water bodies are in poor chemical status:
The groundwater body ROJI05" Lunca si terasele Jiului şi afluenţilor săi" The chemical parameters determing the chemical status for this groundwater body are: nitrates, ammonium ion, chlorides, sulphates and nitrites. In 2009 and 2010 norms are exceeded by nitrates, ammonium ions and nitrites. This groundwater body has considered at risk for nitrates.
The groundwater body ROJI06 "Lunca si terasele Dunarii" The chemical parameters determing the chemical status for this groundwater body are: nitrates, ammonium ion, chlorides, sulphates and nitrites. The norms are exceeded: in 2009 by nitrates, ammonium ions and nitrites. In 2010 – by nitrates, nitrites and chlorides for selected observation wells;
The groundwater body ROAG10 "Lunca Dunării (Turnu Magurele-Zimnicea)" The chemical parameters determing the chemical status for this groundwater body are: nitrates, ammonium ion, chlorides, sulphates,, nitrites, phosphates, lead and cadmium;
The groundwater body ROOT08 "Lunca si terasele Oltului inferior" The chemical parameters determing the chemical status for this groundwater body are: nitrates, ammonium ion, chlorides, sulphates, nitrites, phosphates, lead and cadmium;
Detailed information for the pollution, responsible for the status of the controlled groundwater bodies, was provided by the Romanian side and is presented in reference [178]

3.3.3.2.2 Radiation monitoring of ground water quality

Results from Radiation Monitoring in Romania within the 30 km area of Kozloduy NPP in a period of three years (2008-2010) are shown in Table 3.3.3.2.2-1.

Table 3.3.3.2.2-1 Total Beta activity in the wells in the 30 km area

No.	Sample	Date of collection	District	Location	Measuring unit	Total beta
1.	Open well	2008	Dj	Gighera	Bq/l	0.57±0.23

2.	Covered well	2008	Dj	Ghighera	Bq/l	0.42±0.17
3.	Open well	2009	Dj	Ghighera	Bq/l	0.51±0.2
4.	Covered well	2009	Dj	Ghighera	Bq/l	0.5±0.2
5.	Open well	2010	Dj	Ghighera	Bq/l	0.67±0.25
6.	Covered well	2010	Dj	Ghighera	Bq/l	0.4±0.17

The total beta activity is lower than the limit value for surface water. Groundwater generally has higher salt content than surface water and therefore has a higher natural radioactivity. The higher beta activity in open wells shows that an increase is possible due to precipitation and atmospheric aerosols.

It can be concluded that many anthropogenic activities, related to industrial production and agriculture in the region, are the most likely sources of contamination found by the monitoring of pollution. Data from monitoring of surface and groundwater in the area of 30 km in Romania around NPP "Kozloduy" showed no abnormalities that may relate to the operation of NPP.

3.4 Lands and soils

Soils on the territory of Kozloduy NPP and 30km area around it situated on the territories of the municipalities of Kozloduy, Oryahovo, Hayredin and Misia are black-earths, alluvial, deluvial and gray forest soils. Data about their more important characteristics are presented in table 3.4.1 of Appendix 11.3.3.

Black-earths are the most distributed soils within 30 km area around Kozloduy NPP. Most frequently the black-earth carbonate sandy-clayey, eroded black-earth carbonate and black-earth typical leached heavy sandy clayey are distributed.

Structure of the soil profile depends on the soil difference. More thicker are the meadow black-earths, medium leached heavy sandy-clayey black-earths (Sofronievo), leached black earths in the region of Krushovitsa etc..Eroded black-earths and carbonates where no transient horizon is constructed are of smaller thickness. Mostly, the erosion has affected the black-earth on the inclined slope and mainly the ones next to Tsibritsa River on the western slopes of the table land. Part of this territory in the past was stepped leveled. In spite of that now we could see some traces of active area erosion. Humus-accumulative horizons are entirely or partially eroded and are of 20-40cm thickness. With medium eroded black-earths the humus horizon is eroded and the transition horizon or its part is a subject to cultivation. In the sections where some erosion processes are well developed also the transition horizon is washed-out and on the surface there are some parts of paedogenesis rock, i.e. the profile is much shortened.

Humus content in the black-earths varies, but it is not very high as a whole. In some sections with meadow or leached black-earths there are higher values such as 2.9% (Sofronievo) 3.17% (Mihailovo), 4.72% (Selanovtsi), etc. Quantities about 2% prevails that means that the black-earths in the region are poor and of medium humus content. Humus content is directly related to the pollution resistance of the soils, including the radioactive contamination. It is known that there is a strong accumulation of ^{90}Sr and ^{137}Cs in the surface horizons, which are rich of organic substance. Thus the migration of the radioactive elements to other media is reduced.

Active soil acidity fluctuates within the low alkaline spectrum 7.4-8.4. Rarely, some lower values exist - in the region of Krushovitsa, (pH=6.0), Manastirishte (pH=5.5) etc..Weak alkaline spectrum is extremely favourable in view of the reduction of the effect of soil pollution. Lack of any forms of acidity in the soil determines the specific behaviour of the

elements in it both regarding ^{90}Sr and ^{137}Cs, as well as a number of other pollutants reduces their utilization by the biological systems. Soil resistance is also increased due to the carbonates available in them. In spite of the ongoing leaching processes related to the reduction of the carbonate content in the surface soil layers, the soils contain in depth considerable carbonate quantities, which are migration barrier and protect the groundwaters against different pollutants. On the grounds of the presented data (Appendix 11.3.3), the soils in the regions poor of carbonates are Krushovitsa, Sofronievo, Manastirishte etc.

Cushion capability of the black-earths is high. Their physical and chemical characteristics show that the cushion capability is mainly the dissolution of calcium carbonate and cushion capacity of such soils is high.

Mechanical composition of the black-earths varies from slight sandy-clayey to heavy sandy-clayey. The only exclusion are the black-earths in the region of Misia, which are mostly clayey-sandy ones. Soil differences of lighter mechanical composition are located in the lands of Kozloduy, G. Vadin, Manastirishte etc. and the ones of heavier composition are located in the lands of Hurlets, Mihailovo, Sofronievo, Rogozen etc. Availability of higher clay content in the soils is a sign of high adsorption capacity. High sorption is established for the Bulgarian soils in view of ^{90}Sr and even more higher regarding the ^{137}Cs (Raikov, 1984). Clay is an effective adsorbent, which is naturally contained in the soils and their adsorption capacity is increased by mud fraction (size of the particles <0.001 mm). In the black-earths of the above lands the quantity of the mud fraction is about one quarter up to one third of all mechanical fractions and shows high soil resistance against the chemical impacts. Reduced mud quantity in some regions - Kozloduy, G. Vadin, village of Razgrad etc. is a result of the elimination of the pulverized surface layer as a result of the deflation processes that are typical for the region.

Black-earths are one of the most generous soils in the country. Nitrogen content in the plough up area is from 0.20% to 0.24 % and follows the humus allocation. C/N ratio is within 10-12 and shows conditions favourable for the mineralization of the organic substance.

Black-earths are of high percentage content of absorbable potassium, which explains their favourable potassium properties. Except for the soil fertility this element is also important for the pollution with radioactive substances. It is known that the cesium assimilability is inversely proportional to the quantity of the exchanged potassium in the soil.

Sorption capacity of the carbonate black-earths in the surface horizons is 20-35 mequ/100g soil, and in the eroded soils very often it does not exceed 15 mequ/100g.

Eroded black-earths have some differences from the other soil varieties. They have more light mechanical content, because the more deep horizons are available on the surface. There are considerable differences in the content of the nutrition substances only in the medium or severe eroded soils. Humus quantity there is reduced very much.

A region of very strong wind erosion - first class is the Zlatiata table land shape. Regarding the indicators of texture class and humus content that determine the erosion pliability of the soil, the carbonate black-earths there are evaluated with total mark of 6, and i.e. they are of high pliability to the wind erosion.

Covering of the soil with vegetation and vegetation remains considerably impacts the wind erosion in the region. Bigger part of the growing cultures wheat, barley, sunflower and partially beetroot. They have very poor wind erosion protection during the early spring dry periods, when the most severe dust storms are recorded in the region.

Total assessment of the risk of occurrence of the wind erosion of the soil within the Zlatia protected area depends mostly on the grown cultures and on the application of erosion protection measures aimed at restriction of the erosion risk.

Resistance of the black-earths from 30 km area around the Kozloduy NPP against the anthropogenic impacts depends on the type of the conducted activities. Regarding the mechanical impact by the construction, excavation and embankment works etc. their resistance is extremely high. Pressure impact is related with the deterioration of the soil structure, which especially in the carbonate black-earths is developed very poor. Structure deterioration leads to some negative changes of the physical properties, water and air regime of the soils and worsen their harvest.
In view of the chemical impacts such as pollution with nonorganic and organic pollutants the soils are very sustainable. Their cushion property depends on the favourable reaction of the soil solution and high carbonates heavy mechanical composition. Favourable potassium mode is very important for the resistance against radioactive contamination.
Distribution of the alluvial soils in the above 30km area around Kozloduy NPP is related to the alluvial river alluviums on which these soils are formed. Bigger areas are located on the overflowed Danube terrace and islands in it. Their profile fluctuates very much depending of the thickness– from 44 cm in the land of Selanovtsi up to 207cm in the land of Krushovitsa (Appendix 11.3.3). Mechanical composition of the surface soil beds is too various. Mechanical composition of the surface soil beds is too various. for example, in the land of Mihaylovo the alluvial soils are sandy-clayey with only 4.8% mud, when in the regions of Hurlets, Krushovitsa, Mizia etc. they are light clayey with a mud content reaching 50% (Krushovitsa region).
Fluctuation of the characteristics of the alluvial soils does not allow summarizing the assessments of their resistance against the anthropogenic impacts. As more resistant against the chemical impact are the ones with high pH, high content of clayey and carbonates from the regions of Krushovitsa, Selanovtsi, Mizia etc..
Alluvial-deluvial soils are available in the lands of Rogozen and Selanovtsi. They are of 115-160 cm thickness, having weak alkaline reaction and medium sandy-clayey mechanical composition (Appendix 11.3.3). In some accumulative forms of the landscape also deluvial soils are formed. They are available in the lands of Hurlets, Kozloduy and Selanovtsi. These ones from the Kozloduy region are of bigger thickness (140-160cm). Depending on the fluctuation of their characteristics they are like the alluvial soils. Also, the soil formation process of the deluvial soils is related to the deposition of layers but in this case it is made in the outskirts of the hilly slopes. Deluvial soils are weak alkaline, containing carbonates. Their mechanical composition is light (clayey-sandy) for the profile from Hurlets land and it is heavy (heavy sandy-clayey) for the profile of Selanovtsi (Appendix 11.3.3).
In the Rogosen land there are also dark ***gray forest*** soils (Appendix 11.3.3). They are of medium thickness, deep leached - the carbonates are at 130cm depth in the soil formatting materials. Reaction of the soil solution is medium acidity. Soil had differentiated texture. Clay content reaches 53.4% in the mud horizons. Surface horizon is of high clay content and the soil in it is heavy sandy-clayey. Gray forest soils could be considered soils resistant against the chemical impact in the region.

Antropogenic soils. They are distributed on the territory of Kozloduy NPP as well as within the 30-km area. On the Kozloduy NPP site they occurred due to the construction activities related to the power plant construction. Soils are mechanically deteriorated by the mechanical and excavation and backfill works causing also deterioration of the soil profile structure. In the Blatoto area and on both parts of the drainage channel and collection channels some earth quantities are stored that are a result of the construction and cleaning of the channels. Thickness of the covering layer is 90-100 cm, which consists of different horizons and layers

of carbonate black earth and alluvial-deluvial soils. A big part of NPP area is occupied by "sealed" soils - that are soils, which are insulated due to the construction of buildings, facilities, channels, roads, parking areas etc. Their properties and characteristics are destroyed and the circular motion of the substances, water and energy in them is changed. Within 30km zone there are also some sealed soils available. They are located on the territories of populated areas, roads, construction enterprises, asphalt facilities, agricultural buildings, gas field next to Butan etc. Availability of compacted coverings such as concrete, bricks, asphalt etc.insulates the soil surface and that stops the soil generation process, changes the water and heat regimes as well as the soil properties

As per the data provided by EIA-R of Kozloduy NPP (1999), to the North from the power plant in Blatoto area also over-***wet and boggy soils*** are available. The reasons for these degradation processes are natural and antropogenous. Depths of the groundwaters, which are directly connected with the level of the Danube River provide conditions for swamping. The lowest part of the Blatoto area is occupied by alluvial-deluvial alluviums of light mechanical composition (15-30% physical clay). In the soils profile there are signs of hydro morphism. Thickness of the humus-accumulative horizon is 30-35cm, humus content – 1.0%, and the base saturation – 100%, due to the high carbonate content of the materials deposited by the Danube River and slope lands. Anthropogenic factor that impacted the area extension of overwet soils around the Blatoto area has influenced by leakage of waters by the discharged system, discharge of sewage waters by the household sewage system of the NPP and the Kozloduy town, water from the the pig-breeding farm, construction sites etc. in the condition of high level of the waters at the lowest part of the overflown terrace of the Danube River.

Radioactive contamination of the soils

According to the data of EIA-R by Kozloduy NPP, the first investigations of the soil pollution starts in **1978**, when some samples of the territory next to the power plant were tested as well as towards the wind flame.

Investigations are extended for the period ***1982-1985***. Contents of number of radionuclides are tested (tables N 3.4.1 and 3.4.-2) is determined that after expiration of the Chernobile contamination with short-lived radionuclides as main pollutants, Cs-^{137} and Sr-^{90} have been determined.

Table 3.4-3 shows data of the studies of NIPa N. Pushkarov, NRRPC and MEW from 30-km area around NPP (1994-1998).

Table 3.4-1 Radioactive contamination with anthropogenic radionuclides - average for the period 1980-1985.

N	Site	Depth (cm)	^{90}Sr (Bq/kg)	^{137}Cs (Bq/kg)
1.	Leskovets	0 – 5	2.2	21 - 2%
2.	Botev alley	0 – 5	5.0	23 - 2%
3.	Buzovets	0 – 5	2.7	14 - 3%
4.	Kozloduy, veterinary health station	0 – 5	1.7	3 - 10 %
5.	Gozhene	0 – 5	3.7	5 - 7%
6.	Butan	0 – 5	3.7	9 - 5%
7.	Sofronievo	0 – 5	2.8	12 - 3%

Table 3.4-2 Content of anthropogenic radionuclides in the surface water layer for sites from NPP Kozloduy region in Bq/kg.

N	Site	1988					1989				
		^{90}Sr	^{137}Cs	^{134}Cs	^{106}Ru	^{125}Sb	^{90}Sr	^{137}Cs	^{134}Cs	^{106}Ru	^{125}Sb
1.	Byala slatina	8.1	78- 3%	9 - 3%	5 - 25%	3 - 30%	12.4	89- 4%	17- 8%	<1.1	<0.5
2.	Leskovets	8.8	120 -1%	20- 6%	13- 30%	1 - 30%	3.6	53- 4%	5 - 6%	<1.3	<0.7
3.	Kozloduy-Botev alley	12.8	48 - 2%	12- 7%	7 - 22%	2 - 30%	5.5	78 - 2%	6 - 9%	<0.9	<0.6
4.	Sofronievo	3.2	38- 2%	6- 6%	<1.2	<0.4	4.1	52- 3%	5- 13%	<0.9	<0.4
5.	Buzovets	4.9	46 - 2%	2 - 27%	<1.9	<0.7	10.4	50- 2%	4 - 7%	<1.2	<0.7
6.	Dolni Tsibur	3.5	63 - 2%	7- 10%	<0.9	<0.6	5.8	82- 2%	13- 11%	<0.8	<0.5
7.	Oryahovo, poplar forest	-	56- 2%	6- 10%	<1.0	<0.7	5.5	39- 2%	4- 11%	<0.9	<0.6
8.	Kozloduy, acacia forest	-	26- 2%	3- 26%	<0.8	<0.7	4.8	51- 2%	4 - 10%	<0.8	<0.4
9.	Kozloduy., veterinary service	-	66- 1%	9 - 10%	<1.0	<0.5	3.6	34 - 5%	4 - 25%	<1.0	<0.6
10.	Gozhene	-	-	-	-	-	7.1	32- 2%	4- 12%	<0.8	<0.4
11.	Hayredin	-	-	-	-	-	6.3	60- 4%	6- 14%	<0.7	<0.7
Average for the region		6.6-3.7	60-26				5.7- 2.4	56-18			
Average for North Bulgaria		5.5-3.7	51-32				5.0- 3.0	46-28			

Table № 3.4-3 Content of anthropogenic radionuclides in the surface layer 0-5cm, for sites from the region of Kozloduy NPP Bq/kg.

N Site	Laboratory	1994		1995		1996		1997		1998	
		^{137}Cs	^{90}Sr	^{137}Cs	^{90}Sr	^{137}Cs	^{90}Sr	^{137}Cs	^{90}Sr	^{137}Cs	^{90}Sr
1	2	3	4	5	6	7	8	9	10	11	12
1. Byala slatina	NIPA NRRPC MEW	17-2%	6.3	15-4%	3.5	24-5%	3.0	7-7%	1.0		
2. Leskovets	NIPA NRRPC MEW	114-2%	11.6	101-3%	7.7	51-4% 23-5%	5.1 1.0	- 18-6%	- 1.5.		
3. Botev alley	NIPA NRRPC MEW	46-2%	4.8	5-10%	2.1	63-4%	2.4	26-3%	4,2		
4. Sofronievo	NIPA NRRPC MEW	29-4%	3.7	22-5% - 15	4.6	11-7% - 13	1.2 - -	20-4% - 19	2.4 - -	- - 20	- - -
5. Buzovets	NIPA NRRPC MEW	45-2%	6.9	10-10% - 13	5.5	27-4% - -	4.1 - -	49-2% - 13	4.7 - -	- - 19	- - -
6. Dolni Tsibur	NIPA NRRPC MEW	34-2%	4.5	48-2% - 38	5.0	27-5% - -	2.4 - -	28-3% - 44	2.3 - -	- - 29	- - -
7. Oryahovo, poplar forest	NIPA NRRPC MEW	35-2%	9.2	27-4%	2.8	50-5% - 24	6.4 - -	11-5% - 18	1,3 - -	- - 18	- - -
8. Kozloduy, acacia forest	NIPA NRRPC MEW	27-3%	3.9	22-5%	6.4	35-6%	6.8	26-3%	4.8		

N Site	Laboratory	1994		1995		1996		1997		1998	
		^{137}Cs	^{90}Sr	^{137}Cs	^{90}Sr	^{137}Cs	^{90}Sr	^{137}Cs	^{90}Sr	^{137}Cs	^{90}Sr
9. Kozloduy, veterinary serv.	NIPA NRRPC MEW	40-4%	4.0	45-2%	4,2	45-4%	8.3	2-22%	1.0		
10. Gozhene	NIPA NRRPC MEW	55-2%	4.0	62-4% - 40	5.3	79-2% 26-4% 16	1.8 0.2 -	33-5% 27-4% 23	3.7 0.7 -	- - 26	- - -
11. Hayredin	NIPA NRRPC MEW	41-3%	13.9	20-6% - 26	2.0	19-6% - 17	2.8 - -	26-3% - 29	1.4 - -	- - 23	- - -
12. Kozloduy, port	NIPA NRRPC MEW	18-2%	4.,1	12-8% -	2.	16-6% 47-5% 12	2.5 0.5 -	13-5% 65-4% 11	2.3 0.9	- - 14	- - -
13. Septemvriitsi	NIPA NRRPC MEW	32-4% -	3.7	36-4% - 13	7.,0	13-8%	1.0	16-5% - 16	3.8 - -	- - 26	- - -
14. Butan	NIPA NRRPC MEW	22-4%	3.8	22-7%	4.0	16-5% 38-3% -	3.3 1.4	12-6% 15-8%	3.3 0.7	- - -	- - -
15. Krushovitsa	NIPA NRRPC MEW	-	-	- - 12	-	- 26-5% 12	- 1.5. -	- 24-6% 15	- 0.9 -	- - 15	- - -
16. Vulchedrum	NIPA NRRPC MEW	-	-	- - 12	-	- 23-4% -	- 1.4 -	- 14-7% 13	- 1.4 -	- - 24	- - -

Investigations within this period show increasing of from 3 to 6 times of the concentrations of Cs-^{137} and 2 times of Sr -^{90}. Also, there are some quantities of ^{106}Ru, ^{125}Sb and ^{134}Cs recorded which before the Chernobyl accident and after 1990 are not found in soil samples. Important conclusion made on the grounds of the conducted investigations is that the values of different radionuclide fluctuate too much, which is valid both for the Kozloduy NPP territory and for the country territory, therefore the assessment of increasing of the content of certain radionuclide in the soils is quite relative.
Indicative is the content of Cs-^{137} and Sr-^{90} in 8 soil samples taken next to Kozloduy NPP, taken from square area (side 20 m), at 10 m distance from one to another (table 3.4-4).

Table 3.4-4 content of Cs-^{137} and Sr -^{90} in soils next to Kozloduy NPP.

Isotope	1	2	3	4	5	6	7	8
^{137}Cs	77	60	32	73	19	26	38	73
^{90}Sr	7.1	8.6	-	3.3	-	4.8	4.9	6.5

In depth of the soil profile the allocation of radionuclides is the same, regardless the pollution of the soil surface showing the lack of migration processes as well as some additional deposits (table 3.4-5).

Table 3.4-5 penetration of ^{137}C with soils (according to EIA-R of Kozloduy NPP, 1999 [82])

Depth. (cm)	pH (H_2O)	$T_{8.2}$ meq/100g	Volume Ca in % $T_{8.2}$	Saturation with bases in % $T_{8,2}$	^{137}Cs in % of total activity of the layer 0 –15 cm		
					total	old*	new*
Kozloduy, acacia forest – carbonate black-earth							
0 –2,5	7.9	20.0	97.5	100	44	37	51
2.5 – 5	8.0	20.0	94.5	100	32	32	32
5 – 10	8.1	18.3	94.7	100	16	19	13
10 -15	8.1	16.3	89.6	100	8	12	4
Byala Slatina – leached black-earth							
0 -2.5	7.5	40.8	83.6	94.	56	51	64
2.5 – 5	7.6	34.9	85.4	95.4	22	22	23
5 – 10	7.7	32.6	87.7	97.2	14	19	8
10 -15	7.7	31.7	87.1	96.8	7	9	4
Smolyan, Kriva reka – brown forest							
0 –2.5	5.0	43.6	48.2	63.3	83	76	86
2.5 – 5	4.8	38.9	44.7	57.8	14	22	11
5 – 10	4.9	35.0	43.1	56.6	2	1	2
10 -15	4.9	24.6	47.2	56.9	0.6	0.6	0.6

Note: old* - until 1986; new* - after May 1986
In the annual reports of Kozloduy NPP the concentrations of ^{90}Sr were as follows:

- Year 1995 from 0.39 Bq/kg up to 3.08 Bq/kg,
- Year 1996 from 0.76 to 3.72 Bq/kg,
- Year 1998 from 0.19 Bq/kg to 3.46 Bq/kg.

Average content of ^{90}Sr was 5.0±0.4 Bq/kg within the period 1972-1974, and in 1998 it is 1.58 Bq/kg.
Extreme values for Sr-^{90} are determined in Berkovitsa – in 1995 – 9.2 Bq/kg and in 1996 – 4.08 Bq/kg. Annual value of the monitored 36 points is 1.58 Bq/kg.
Regarding ^{137}Cs the concentrations were as follows:

- Year 1996 – from 3.1 Bq/kg to 84.6 Bq/kg,
- Year 1997 - from 3.3 Bq/kg to 84.6 Bq/kg,
- Year 1998 - from 2.28 Bq/kg to103 Bq/kg.

Average content of Cs-^{137} for 1998 is 26.7 Bq/kg. In some points the content of Cs-^{137} was lower than the average one for the territory of NPP and the reason of that is the elimination of the surface soil layer during the construction and excavation to the surface of lower laying beds.
Content of ^{134}Cs is several times lower than the one of ^{137}Cs.
With the radiation control on the territory of NPP content of Co-^{60} in the soils is determined in some of the monitored points (Table 3.4-6), as well as in the slime of the NPP channels.

Table 3.4-6 Content of Co-^{60} in the soils from the industrial site and in radius of 500 m around NPP (Bq/kg a.d.w.)

Point N	1995	1996	1997	1998
1	< 0.4 - 1.11	< 0.20	0.66 - 1.01	< 0.20
2	0.65 - 0.83	< 0.20 - 0.81	< 0.20 - 0.57	< 0.20
3	4.55 - 5.50	4.28 - 4.29	2.48 - 2.89	< 0.20 - 1.51
4	< 0.40	< 0.20	< 0.20 - 1.34	< 0.20
31	2.10 - 2.11	1.32 - 2.01	1.29 - 1.43	< 0.20 - 1.34
32	5.89 - 9.55	7.10 -18.3	7.56 - 8.66	8.18 - 10.1
33	0.89 - 0.95	1.33 - 3.09	2.75 - 9.62	0.80 - 3.32
34	< 0.40 - 0.95	1.00 - 5.88	0.65 - 0.74	< 0.20
36	< 0.40 - 1.13	< 0.20	< 0.20	< 0.20 - 0.74

According to data by REWI Vratsa in the same period the contents of 238U, ^{226}Ra, ^{232}Th, ^{40}K and ^{137}Cs were within the ranges of the expected background contents.
In ***1999***, during the development in 1999 EIAR of the KNPP units in operation [189] samples were analyzed showing that the average content ^{137}Cs is 31±18Bq/kg, which proves the absence of additional sediments or transboundary transfer.
Also, there are quantities of ^{60}Co detected. Contents of the natural radionuclide ^{238}U, ^{226}Ra and ^{232}Th comply with the background levels. In the bottom deposits from the dry channel, which in spite of the conducted re-cultivation are potential source of the soil pollution high values of content of ^{137}Cs is detected– in some samples up to 15563 Bq/kg and 9954 Bq/kg, as well as considerable content of ^{60}Co. Average values increase is estimated for ^{134}Cs and ^{241}Am.

The analysis of the soil pollution in the region of KNPP until 1999 shows that it is not possible to prove the contribution of the power plant into the value of ^{137}Cs and ^{90}Sr content in soils. Until 1986 it is considered that their concentrations are impacted by the experiments with nuclear weapons during many years. After 1986 the radioactive pollution is increased as a result of the Chernobyl accident and within the period 1986-1990 new higher level was determined in 0-5cm layer as well as penetration of ^{137}Cs and ^{90}Sr in the soil profile. As a whole the functioning of the power plant did not impact the soils' properties. Some local pollution has been determined and the respective measures have been undertaken. Above conclusions are confirmed by the studies made during the period 2006-2011. The received results show concentrations express the background concentrations and are a result of the nuclear experiments and the accident in Chernobyl NPP. Slight trend of self-purification of the surface soil layer is detected considering the average content in 1972-1974 -5±0.4Bq/kg. Monitoring of the soil pollution shows that the most important pollutants ^{90}Sr and ^{137}Cs are in concentrations lower than the other country regions. (Annual reports of Kozloduy NPP 2006, 207, 2008[190]) On the site of Kozloduy NPP and next to it ^{60}Co is detected.

In table 3.4-7 are presented results from the gamma-spectrometric analyses of the soils samples from the region of the Repository of non-radioactive household and production wastes (RNHIW) in 2006, 2007 and 2008.

Table 3.4-7 Gamma-spectrometric analyses of the soil samples from the region of RNHIW in Bq/kg.

Date	^{54}Mn	^{60}Co	^{134}Cs	^{137}Cs
30.05.2006	<0.46	<0.4	<0.83	2.75±0.12
24.10.2006	<0.36	<0.62	<0.7	2.96±0.12
24.04.2007	<0.49	<0.65	<0.80	3.14±0.13
6.11.2007	<0.35	<0.57	<0.75	2.55±0.26
05.2008	<0.26	<0.53	<0.42	2.29±0.12
10.2008	<0.1	<0.7	<0.93	1.53±0.12

Results in the table 3.6-7 show that the values and activities of the radionuclides are below the minimal provable activity. Only the values of ^{137}Csare an exception, but they are lower than the average content in 100 km area of NPP – 25 Bq/kg. Explanation of the low concentrations is the re-cultivation of the surface soil layer.

On the grounds of the monitoring of the soils pollution conducted in 2006, 2007 and 2008 a conclusion is made that the radioecological status of the soils in the region is not influenced by the Kozloduy NPP.

The anthropogenic activity of the samples analyzed in the last 3 years is also below PDA, except of ^{137}Cs. In **Table** (table 3.4-8) are shown the data received in **2009**. (Annual report of Kozloduy NPP, 2009) [190].

Table 3.4-8 Gamma-spectrometric analyses of the soil samples from the region of RNHIW in Bq/kg.

Date	^{54}Mn	^{60}Co	^{134}Cs	^{137}Cs
04.2009	<0.28	<0.52	<0.66	2.04±0.10
14.2009	<0.38	<0.55	<0.68	2.76±0.13

The values measured in samples from 36 control points in 100km area around the power plant complies with the background for this geographic region and are caused

by the global warming. Like in the previous years there is a slight trend for self-purification.

In Annual report of Kozloduy NPP (**2010**) [190] it is stated that the content of ^{90}Sr, in 100km area varies from 0.22 to 1.92Bq/kg, and the average values for all 36 points is 1.09Bq/kg. The values are close to the ones measured during the previous years and reflect the global deposits on the earth surface from the nuclear experiments in the atmosphere and the accident in Chernobyl NPP. In the soils of Bulgaria as well as in the most European countries the content of ^{90}Sr is within the range of 2-6Bq/kg. Slight trend of self-purification of the surface soil layer is confirmed comparing with1972-1974, when the average 90Sr in the country was 5±0.4 Bq/kg. Regarding the content of ^{137}Cs, the results for 2010 show that it varies from 1.78 to 54.4 Bq/kg, and the average value is 13.9 Bq/kg. In the previous years the concentrations vary within considerably wider range reaching 114 Bq/kg at point 27, next to Oriahovo, in 1996

In 2010 as well as in the previous years ^{134}Cs is detected, which has shorter semi-decay period. The activities of radiocesium measured during the last years (^{134}Cs, ^{137}Cs) and their ratios prove its transboundary effect in 100km area around the power plant. The source is the accident in Chernobile NPP in 1986.

As a whole the content of both main soil pollutants in 100 km area around Kozloduy NPP" - ^{137}Cs and ^{90}Sr is lower than in the other country regions, e.g. in the Rodopi mountain an activity of 500Bq/kg is recorded. Main reason for weaker pollution of the soils in North-West Bulgaria compared with the Southern part is the negligible quantity of the rainfalls fallen in May 1986.

During the period 2004-2010 a content of 60Co in the soils of Kozloduy NPP is detected. The pollution is low and local. In table 3.4-9 there are results presented from the gamma-spectrometric analyses of the soils samples in 2011. [190].

Table 3.4-9 Gamma-spectrometric analyses of the soil samples from the region of RNHIW in Bq/kg.

Date	^{54}Mn	^{60}Co	^{134}Cs	^{137}Cs
04.2011	<0.40	<0.63	<0.81	2.36±0.13
10.2011	<0.42	<0.64	<0.88	2.60±0.35

The results do not differ considerably from the previous years - anthropogenic activity of the samples is below PDA.

Summarized analysis results of the most important pollutants for the plant region ^{137}Cs and ^{90}Sr are presented in table 3.4-10 (Annual reports of Kozloduy NPP) [190].

Table 3.4-10 content of ^{137}Cs and ^{90}Sr in soils (Bq/kg)

Year	Content of ^{137}Cs		Content of ^{90}Sr	
	Average	Interval	Average	Interval
2006	16.9	1.96-62.03	2.55	1.40-6.51
2007	14.8	1.94-55.8	1.97	0.34-6.12
2008	15.5	1.53-48.5	1.12	0.37–3.51
2009		2.04-2.76		
2010	13.9	1.78-54.4	1.09	0.22-1.92
2011		2.36-2.60		
1972-1974			5.0±0.4	
Background for Europe				2-6

Year	Content of ^{137}Cs		Content of ^{90}Sr	
	Average	Interval	Average	Interval
100 km area of Kozloduy NPP	25			

Pollutants of the soils with nonorganic and organic pollutants

Pollution sources for the soils from the territory of Kozloduy Municipality are concrete factory, construction enterprise, asphalt facilities, motor transport and ceramic factory. Also, there are gas field and industrial enterprises located of the town of Mizia, which due to the wind direction could not impact the soil condition ("Ecological model of Kozloduy NPP"). Investigation in view of the above elaboration shows that the pollution with lead is available around the villages of Glozhene, Hurlets, Butan (agricultural yard and gas field) on the territory of the town of Kozloduy, river bed of Ogosta and Southern border of Kozloduy NPP. High values of lead, copper and zinc are established in the soils next to Glozhene MTS caused by the motor vehicles. Content of manganese in the investigated soil samples is within the limits of the natural concentrations of the national concentrations for the country. Higher values are measured next to Glozhene and Sofronievo from the river bed of Ogosta and next to motor vehicle facility of Kozloduy NPP. Content of the oil products in the soil is investigated from the organic pollutants. Their existence is detected in the soils of 8 points.

Increased contents of oils and oil products are determined mostly in the regions of the dumping-grounds, pump stations and agricultural yards. Recorded pollutions are not related to the operation of Kozloduy NPP.

Investigation of the soil pollution with heavy metals are also made in connection with "Mapping of general and movable forms of heavy metals and metalloids in the region of Vratsa" of the MAFI – Headquarters "Earth and land property" and of the MoEW – Department "Soil resources, quality and evaluation". In the regions of industrial activity there are some common and movable forms of copper, zinc, lead, cadmium and arsenic available.

Agricultural lands polluted by the industrial enterprises are located at a big distance from Kozloduy NPP. On the territory of the ex-district of Vratsa in 30km area of Kozloduy NPP the polluted agricultural lands located in the massive of perennial plants are available only in the land of the town of Oryahovo. More than 1480 dca have been investigated and about 84% of them are practically not polluted and the rest ones are slightly polluted.

For the purposes of EIA-R of Kozloduy NPP in 1999 the contents of series of heavy metals, nitrates, salt concentration, residual concentrations of organic chlorine pesticides and oil products in the soils have been analyzed. Places of sampling are shown in table N 3.4-11, and the respective results are shown in table 3.4-12.

Table 3.4-11 sampling of soil points of EIA - R Kozloduy NPP 1999.

Sample	Depth,	Date of	Location	Condition of
1	0-20	28.07.99	NPP greenhouse – (indoor area)	agricultural, with
2	0-10	28.07.99	EP-2 – before engineering-laboratory building	non-agricultural, grassed
3	0-10	28.07.99	EP-1 – black oil and oil facility	not agricultural

Sample	Depth,	Date of	Location	Condition of
4	0-10	28.07.99	EP-1 – to the fence of Station-32	non-agricultural,
5	0-10	28.07.99	EP-1 before SB-1	non-agricultural,
6	0-10	28.07.99	Next to the Botev alley - about 25 m from the highway	non-agricultural, with wood types
7	0-10	28.07.99	EP-1 – in the fenced area of point-32 of the institutional monitoring system	non-agricultural, grassed
8	0-10	29.07.99	Acacia forest over the highway Southern from Kozloduy NPP	non-agricultural, with grass and wood plants
9	0-10	29.07.99	v. Glojene – next to the stadium	non-agricultural, grassed
10	0-10	29.07.99	v. Butan – at the beginning of the 3rd farmyard near to the access check point	non-agricultural, grassed
11	0-10	29.07.99	v. Bazovets – above the dam lake	non-agricultural, grassed
12	0-10	29.07.99	v. Krushovits – before the snow machines garage	non-agricultural, grassed
13	0-10	29.07.99	village of Leskovets - after the villgae to the right from the road towards the town of Nikopol	non-agricultural, grassed
14	0-10	29.07.99	town of Kozloduy-port between the restaurant and of the Danube River	non-agricultural, with grasses and srubby and wood plants
15	0-20	11.08.99	NPP greenhouse – (outdoor area)	agricultural, with pepper
14'	0-20	16.09.99	NPP greenhouse – (indoor area)	agricultural, with tomatoes
15'	0-20	16.09.99	NPP greenhouse – (outdoor area)	agricultural, with cabbage
16	0-20	16.09.99	NPP greenhouse – (outdoor area)	agricultural, with strawberry
17	0-20	16.09.99	NPP greenhouse – (outdoor area)	agricultural, with pepper

Exceeds of PCL are assessed according to the effective in that time Ordinance N3 for "Norms regarding the permissible content of harmful substances in the soils" (Prom.

SG, issue 36 from 8 May 1979, amended. SG, issue 5 from 16 January 1996, amended. SG, issue 54 from 8 July 1997, amended. SG, issue 21 from 17 March 2000г., amended. SG, issue 39 from 16 April 2002.). There are no exceeds regarding PCL detected. According to the updated Ordinance N 3 for „Norms for permissible content of hazardous substances in the soils" from 12 August 2008, results are assessed in the same manner.

Table 3.4-13 presents data of the investigation of the soil pollutions in the land of Kozloduy Municipality which are also sassed pursuant to the old Ordinance.

According to the updated Ordinance N 3 for „Norms for permissible content of hazardous substances in the soils" from 12 August 2008, the same results are assessed in a different manner. In view of the maximal permissible concentrations (MPC) for the agricultural lands and carbonate black-earth lead content is 2.0-3.3 times above MPC in the meadow black-earth the copper is within the limit with MPC and in the alluvial and alluvial-meadow soils the copper content exceeds 1.15 times MPC, lead content is 1.08 to 2.29 times above MPC and zinc – 1.9 times. Obtained values are below the interference concentrations for heavy metals, i.e. below the level causing destruction of the soil functions and endangering the environment and human health. During the investigation no single leakages are detected.

According to the data of the agency for soil resources (2010) the copper and zinc content in the network for soil monitoring is below the maximal permissible concentrations (Ordinance N 3, 2008). Points for soil monitoring are shown on figure 3.4-1 and the data about the content of the heavy metals in the soils - in table 3.4-14. Zinc content in the investigated points is even lower than the background concentration. Regarding the copper, the received values are higher. They are higher than the preventive ones and in 2 points (N 29 and 30) they are close to the maximal permissible concentration. The later expresses the possibility that in certain conditions a risk for environment and people could occur. Concrete conditions show favorable media for blocking of mobility of the Copper and minimization of the environmental risk - the reaction of the soil dissolution is within the weak alkaline spectrum that means domination of the soil mechanisms, which precipitate the Copper in the insoluble complex compounds.

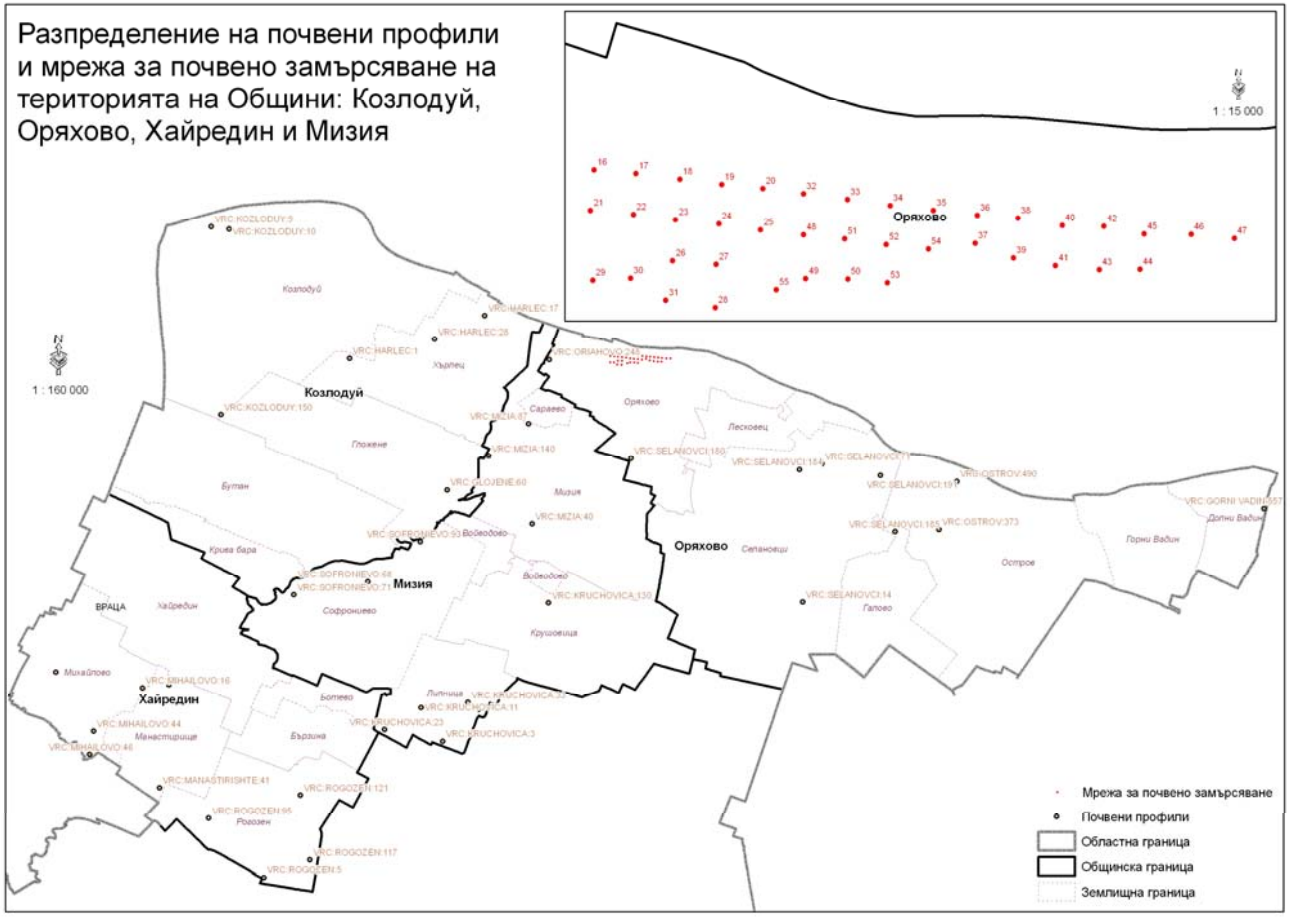
Table 3.4.-12 content of heavy metals and metalloids in the soil samples (mg/kg) (EIA-R Kozloduy NPP 1999.)

No	pH	Cu		Pb		Zn		Ni		Hg		As		Cd		Cr		Mn	Co	Fe	B
		result	PLC	result	PLC	Result	PLC	result	PLC	result	PLC	result	PLC	result	PLC	result	PLC				
1	6.9	28.950	<260	20.408	<80	60.513	<340	27.765	70	-	-	-	-	traces		-	-	320.123	7.831	745.610	-
2*	7.2	21.244	<270	18.070	<80	32.695	<360	28.814	70	-	-	-	-	traces		-	-	293.270	6.837	760.402	-
4*	7.0	18.929	<260	23.481	<80	44.566	<340	32.107	70	-	-	-	-	traces		-	-	298.304	7.188	751.390	-
5*	7.0	20.747	<260	21.850	<80	37.080	<340	26.927	70	0.232	1	8.6	29-	traces		-	-	278.317	7.504	689.503	-
6	7.0	17.705	<260	18.548	<80	30.773	<340	24.871	70	-	-	5.98	25	traces		23.3	200	265.366	6.323	660.990	36.7
7*	7.0	18.031	<260	21.930	<80	41.910	<340	26.072	70	-	-	-	-	traces		-	-	280.458	7.066	1561.89	35.6
8	7.0	18.689	<260	20.678	<80	32.607	<340	25.052	70	-	-	0.2	25	traces		-	-	259.066	7.158	624.304	-
9	6.8	35.413	<260	47.217	<80	57.515	<340	26.874	70	-	-	-	-	traces		-	-	322.986	8.037	787.121	39.5
10	7.3	20.583	<270	19.142	<80	36.226	<360	31.286	70	0.412	1	10.3	25	traces		-	-	279.722	8.645	645.892	-
11	7.5	22.533	<270	21.347	<80	39.611	<360	30.123	70	-	-	-	-	traces		34.0	200	312.381	8.776	744.307	52.0
12	7.3	17.735	<270	32.711	<80	53.992	<360	23.252	70	-	-	-	-	0.197		-	-	262.868	5.518	609.285	-
13	7.0	22.001	<260	22.719	<80	38.741	<340	28.219	70	-	-	-	-	traces		-	-	306.103	8.370	749.474	-
14	7.0	16.858	<260	21.639	<80	36.987	<340	22.142	70	-	-	-	-	traces		-	-	256.894	5.787	772.192	-
15	8.0	17.200	<280	10.500	<80	43.700	360	21.000	70	1.350	1	4.4	25	0.440		23.6	200	335.000	2.800	-	37.1
14’	-	-	-	-	-	-	-	-	-	1.040	1	-	-	-	-	-	-	-	-	-	-
15’	-	-	-	-	-	-	-	-	-	0.810	1	-	-	-	-	-	-	-	-	-	-
16	-	-	-	-	-	-	-	-	-	0.602	1	-	-	-	-	-	-	-	-	-	-
17	-	-	-	-	-	-	-	-	-	<0.050	1	-	-	-	-	-	-	-	-	-	-

Table3.4-13 Soil pollution of the land of Kozloduy Municipality (with pH 7.5 - 8.5).

Element	Number of samples	Average [mg/kg]	Sample N	Quantity mg/kg	PCL, mg/kg	Content exceeds several times PCL	Approximate location of the taken soil sample
Carbonate black-earths, sandy-clay							
Pb	123	51.77	41 61 62 63 69	114.0 398.3 91.5 251.8 390.0	above 80 “ “ “ “	1.43 4.98 1.14 3.15 4.88	Butan village – close to sheep-breeding farm after the petrol station Butan – next to the farmyard Butan village – next to the MTS, after the gas field Butan village - down the gas field after the lborder with the village of Kriva bara c
Oils and oil pipeline	29	180	62	51	300 with 1% humus	below PCL	Butan village – next to the MTS, after the gas field
Oil products	“	131	“	37	300 with 1% humus	below PCL	Butan village – next to the MTS, after the gas field
Meadow black-earth medium and thick sandy-clay.							
Pb	17	35.16	40	109.0	below 80	1.36	Kozloduy stock breeding farm
Cu	17	81.06	41	317.0	270-280	1.17-1.13	Butan village – close to sheep-breeding farm after the petrol station
Oils and oil pipeline	3		2	140.0	300 with 1% humus	below PCL	next to the floating pump station
Oil products	“		2 40	80.0 680.0	“ “	below PCL 2.27	next to the floating pump Kozloduy stock breeding farm
Alluvial and alluvial-meadow soils, sandy and sandy-clay							
Pb	29	64.57	18 24	275.0 182.5	below 80 “	3.44 2.28	Glozhene village – next tgo MTS Ogosta River – down the bridge

Element	Number of samples	Average [mg/kg]	Sample N	Quantity mg/kg	PCL, mg/kg	Content exceeds several times PCL	Approximate location of the taken soil sample
Cu	29	57.26	18	347.5	270-280	1.29-1.24	Glozhene village – next to MTS
Zn	23	137.5	18	775.0	360-370	2.15-2.09	"
Mn	23	889.6	24 57 106	3450.0 1012.0 3875.0	850 " "	4.06 1.19 4.56	Ogosta River – down the bridge Glozhene village - next to the dumping-ground Village of Butan – next to the gas field
As	5	197.0	24	-	25	7.88	Ogosta River – down the bridge
Oils and oil pipeline	8	-	72	2060	300 with 1% humus	6.87	Kriva bara village – next to the dumping-ground
Oil pipeline.	"	-	"	880	"	2.93	"



Legend: Repartition of soil profiles and soil contamination monitoring network on the territory of the municipalities Kolzoduy, Oryahovo, Hayredin and Mizia

Fig. 3.4-1 Soil pollution network (Agency for soil resources, 2010)

Table 3.4-14 Content of Copper and Zinc in soils of 30km area around Kozloduy NPP (Agency for soil resources, 2010.)

Check point N	Profile	pH		Cu (mg/kg)		Zn (mg/kg)	
16	501	pH	60.8	Cu	295.0	Zn	53.0
17	502	pH	7.7	Cu	248.3	Zn	44.5
18	503	pH	7.7	Cu	186.5	Zn	70.0
19	514	pH	7.8	Cu	155.0	Zn	58.3
20	515	pH	7.8	Cu	183.5	Zn	69.0
21	504	pH	7.5	Cu	188.5	Zn	51.5
22	505	pH	7.9	Cu	113.0	Zn	58.0
23	506	pH	7.8	Cu	124.8	Zn	65.0
24	513	pH	7.8	Cu	289.8	Zn	68.0
25	516	pH	7.9	Cu	290.0	Zn	68.3
26	510	pH	7.9	Cu	297.5	Zn	62.5
27	512	pH	7.8	Cu	283.5	Zn	59.5
28	511	pH	7.7	Cu	256.3	Zn	60.5
29	507	pH	7.9	Cu	302.3	Zn	61.5
30	508	pH	7.8	Cu	307.5	Zn	62.8
31	509	pH	7.6	Cu	289.0	Zn	60.5
32	517	pH	7.9	Cu	193.5	Zn	72.5
33	522	pH	8.0	Cu	194.0	Zn	73.0
34	523	pH	8.0	Cu	234.0	Zn	64.0
35	527	pH	8.0	Cu	229.8	Zn	87.0
36	528	pH	7.9	Cu	238.0	Zn	62.5
37	529	pH	7.7	Cu	237.3	Zn	61.5
38	530	pH	7.7	Cu	124.8	Zn	67.5
39	531	pH	7.8	Cu	198.5	Zn	75.0
40	533	pH	7.9	Cu	76.8	Zn	52.5
41	532	pH	7.7	Cu	207.8	Zn	56.8
42	534	pH	7.7	Cu	148.5	Zn	70.3
43	535	pH	8.0	Cu	228.0	Zn	86.0
44	536	pH	7.9	Cu	238.3	Zn	76.0
45	537	pH	8.0	Cu	167.5	Zn	63.5
46	538	pH	7.8	Cu	124.8	Zn	59.0
47	539	pH	7.9	Cu	85.8	Zn	81.3
48	518	pH	7.8	Cu	278.5	Zn	58.5
49	519	pH	7.9	Cu	225.0	Zn	61.5
50	520	pH	7.9	Cu	210.5	Zn	57.5
51	521	pH	7.9	Cu	245.0	Zn	60.3
52	524	pH	8.0	Cu	238.8	Zn	59.0
53	525	pH	7.9	Cu	217.8	Zn	59.5
54	526	pH	7.9	Cu	220.0	Zn	83.3

Data about the designation of the lands within 30 km area around Kozloduy NPP, land ownership and categories are shown in tables 3.4-15 and 3.4-17.
Lands in 30 km area around NPP are mostly agricultural ones. Totally in the lands of all populated areas they are of 64 472 ha. In table 3.4-15 a balance of the lands as per their designation is shown. At the second place are the populated areas of 4435 ha. Lands used for forests are not too much - 2552 ha. Water flows and areas are 2651 ha. In the agricultural lands the fields are prevailed – 53 150 ha. Table 3.4-16, which is the balance of the lands as per the manner of permanent utilization shows that the land categories are mostly IV and III. Area of the lands of IV category is 30 682 ha, and of the ones of III – 20 739 ha. Small areas - 5281 ha are occupied by the lands of V category.
In 30 km area around Kozloduy NPP the private lands prevail – 46 745 ha. Next lands depending on the area are the ones of the legal entities - 7293 ha, state private land - 5359 ha, municipal public land 4615 ha etc.(table 3.4-17).

Table 3.4-15 Balance of the agricultural lands as per their designation

Settlement	Type of territories depending on their designation							
	agriculture		forest		populated areas		water flows and areas	
	(ha)	(%)	(ha)	(%)	(ha)	(%)	(ha)	(%)
v. Dolni vadin	1432,65	77,88	100,81	5,48	63,44	3,45	237,9	12,93
v. Voivodovo	686,32	89,82	0	0	68,39	8,95	3,19	0,42
v. Glozhene	4714,85	90,34	96,87	1,86	302,64	5,8	93,36	1,79
v. Hurlets	3701,17	78,32	88,75	1,88	640,61	13,56	281,91	5,95
v. Butan	5882,4	92,87	4,62	0,08	378,04	5,97	63,55	1
v. Kriva bara	1442,9	92,71	0	0	86,65	5,57	25,21	1,61
v. Kozloduy	7840,29	73,57	815,29	7,65	656,18	6,16	1309,06	12,28
v. Leskovets	1196,24	67,29	214,9	12,09	92,47	5,2	266,02	14,96
Mizia town	5533,74	86,21	326,05	5,08	364,09	5,67	5,23	0,08
v. Saraevo	322,23	83,88	14,34	3,73	30,19	7,86	10,34	2,69
v. Sofronievo	5115,12	90,11	171,19	3,02	287,79	5,07	85,41	1,5
v. Galovo	2479,84	94,65	24,56	0,94	105,17	4,01	2,96	0,11
v. Krushovitsa	4585,66	90,18	179,11	3,52	217,97	5,35	36,07	0,71
v. Lipnitsa	2334,8	89,76	80,04	3,08	138,66	5,33	31,51	1,21
v. Botevo	825,4	90,76	35,47	3,9	37,42	4,12	3,53	0,39
v. Hayredin	5333,89	91,39	195,18	3,34	262,71	4,5	32,48	0,56
v. Burzina	1496,12	90,04	42,98	2,59	80,45	4,84	34,31	2,06
v. Rogozen	3776,97	90,29	97,66	2,33	242,81	5,8	56,9	1,36
v. Mihailovo	3298,17	92,16	0	0	232,35	6,49	34,35	0,96
v. Manastirishte	2473,71	90,5	65,17	2,38	147,84	5,41	38,36	1,4
Total	**64472,47**		**2552,99**		**4435,87**		**2651,65**	

Table 3.4-16 Balance of the lands depending on the manner of permanent use

Settlement	Manner of permanent use				Land categories					
	Fields		Pastures		III		IV		V	
	(ha)	(%)	(ha)	(%)	(ha)	(%)	(ha)	(%)	(ha)	(%)
v.D. Vadin	1173,9	63,8	145,19	7,89	0	0	454,26	24,7	442,25	24
v. Voivodovo	563,59	73,8	38,6	5,05	212,01	27,8	376,04	49,2	48,55	6,35
v. Glozhene	3790,5	72,6	130,02	2,49	526,1	10,1	3914,93	75	0	0
v. Hurlets	3195,55	67,6	74,51	1,58	120,98	2,56	3093,68	65,5	97,84	2,07
v. Butan	5367,53	84,7	146,83	2,32	18,76	0,3	5629,42	68,9	17,27	0,27
v. Kriva bara	1241,35	79,8	94,74	6,09	57,1	3,67	1214,41	78	118,02	7,58
v. Kozloduy	7316,79	68,7	90,46	0,85	2187,42	20,5	3751,48	35,2	1310,84	12,3
v. Leskovets	866,98	48,7	111,83	6,29	0	0	642,62	36,2	494,69	27,8
v. Mizia	4809,63	74,9	294,32	4,59	2127,45	33,1	2128,06	33,2	568,1	8,85
v. Saraevo	178,54	46,5	89,91	23,4	12,46	3,24	171,48	44,6	110,96	28,9
v. Sofronievo	4160,99	73,3	413,56	7,21	916,37	16,9	3229,99	56,9	684,57	12,1
v. Galovo	1974,36	75,4	275,33	10,5	1835	78	252,53	9,64	0	0
v. Krushiovitsa	4050,82	79,7	210,35	4,14	0	0	2959,48	58,2	483,24	9,5
v. Lipnitsaa	2019,69	77,6	175,29	6,74	214,1	8,23	1200,32	46,1	465,08	17,9
v. Botevo	746,39	82,1	74	1,07	455,82	50,1	220,78	24,3	81,22	8,93
v. Hayredin	4593,68	78,7	347,42	5,95	3527,26	60,4	1311,25	22,5	288,99	4,65
v. Burzina	1197,76	72,1	241,66	14,5	1563,16	94,1	0	0	0	0
v. Rogozen	2964,97	70,9	457,37	10,9	3940,89	94,2	0	0	0	0
v. Mihaylovo	2937,19	82,1	245,73	6,87	3024,19	84,5	132,16	3,69	69,72	1,95
v. Manastirishte	1833,33	67,1	164,44	6,02	76,39	2,79	2139,37	78,3	9,91	0,36
Total	**53150,21**		**3657,1**		**20739,07**		**30682,89**		**5281,34**	

Table 3.4-17 Balance under property type of the lands

Settlement	Property types											
	private		public private		state public		municipal private		public private		owned by legal entities	
	(ha)	(%)	(ha)	(%)	(ha)	(%)	(ha)	(%)	(ha)	(%)	(ha)	(%)
v. Dolni Vadin	950,13	51,65	100,49	5,46	275,46	14,97	19,83	1,08	162,1	8,81	183,51	9,98
v. Voivodovo	413,2	54,08	17,79	2,33	3,42	0,45	143,5	18,78	14,99	1,96	55,42	7,25
v. Glozhene	3593,27	68,85	347,28	6,65	3,58	0,07	251,13	4,81	287,41	5,51	0,57	0,01
v. Hurlets	2498,79	52,88	540,39	11,4	98,14	2,08	33,72	0,71	138,43	2,93	1052,5	22,27
v. Butan	4444,63	70,17	442,86	6,99	0	0	119,77	1,88	317,64	5,01	538,53	8,5
v. Kriva bara	1032,21	66,37	44,12	2,83	5,96	0,38	55,91	3,59	48,57	3,12	192,83	12,39
town of Kozloduy	6385,14	59,92	1517,4	14,2	817,56	7,67	194,88	1,83	329,03	3,09	530,41	4,98
v. Leskovets	780,96	43,93	29,72	1,67	485,13	27,29	67,62	3,8	157,17	8,84	149,63	8,42
town of Mizia	3750,55	58,43	646,77	10,1	33,05	0,51	93,9	1,46	164,34	2,56	1171,8	18,26
v. Saraevo	98,76	25,71	30,61	7,97	2,44	0,63	4,31	1,12	11,28	2,94	85,78	22,33
v. Sofronievo	3592,67	63,29	189,73	3,34	50,21	0,88	340,78	6	140,25	2,47	439,28	7,74
v. Galovo	1936,46	73,91	54,42	2,08	5,13	0,2	14,26	0,54	315,83	12,05	63,99	2,44
v. Krushovitsa	2920,19	57,43	428,9	8,43	8,2	0,16	92,97	1,83	313,82	6,17	905,32	17,8
v. Lipnitsa	1921,18	74,01	158,67	6,1	7,61	0,29	87,78	3,37	240,57	9,25	5,55	0,21
v. Botevo	668,01	73,45	62,59	6,88	0	0	13,41	1,48	43,72	4,81	82,54	9,08
v. Hayredin	3884,05	66,55	137,5	2,36	8,39	0,14	342,83	5,87	511,1	8,76	688,42	11,8
v. Burzina	844,84	50,84	192,13	11,6	0	0	16,79	1,01	307,42	18,5	219,97	13,24
v. Rogozen	2771,57	66,26	179,91	4,3	0	0	178,67	4,27	561,3	13,42	226,98	5,43
v. Mihaylovo	2395,87	66,95	78,6	2,2	0	0	114,66	3,2	301,21	8,42	450,67	12,59
v. Manastirishte	1862,96	68,16	160,01	5,85	3,79	0,14	40,76	1,49	249,55	9,13	249,46	9,13
Total	**46745,44**		**5359,85**		**1808,07**		**2227,48**		**4615,73**		**7293,15**	

According to official information received from Romania for EIA-R the 30-kilometer zone around the Kozloduy NPP includes the territories South of Dolj upto Danube River, Romanatilor, plane Bailesti, the rivers Jiu, Jiet and their inflows with an area of 133035ha. This area is dominated by agricultural land with total area of 106976 ha. Settlements occupy 7225 ha.

Detailed information on the use of lands is provided by the Romanian part for the counties Dolj, Gorj, Mehedini, Olt, Teleorman and Valcea (table 3.4-18).

Table 3.4-18 Use of land on Romanian territory, within 30km area around Kozloduy NPP

District	tillable lands	Built up areas	Forests, river bank lands	Lakes, rivers	Marshlands
DOLJ	563178.78	48720.69	94832.91	13193.50	19885.55
GORJ	10328.13	1706.40	7701.76	340.18	572.47
MEHEDINI	114257.11	7653.91	23048.81	1625.75	2168.38
OLT	332219.23	29438.10	37205.86	8931.71	734.03
TELEORMAN	83528.41	5312.30	7779.09	1655.12	96.57
VALCEA	20439.09	2378.91	13175.43	463.81	17.55

Above data in the table show that in all listed areas agricultural lands prevail – appr. 77% of the whole territory. These lands include tillable lands with annual crops, fruit gardens, bery plants, areas with high share of natural vegetation, non-irrigated tillable lands, paddy fields, pastures and vineyards. Forests, coastal lands and sands hold an average of 12% built-up areas - 6%, etc.

The Romanian Party provided data from the laboratory analyses for assessment of the radioecological status of non-tillable and tillable soils – tables 3.4-19, 3.4-20 and 3.4-21.

Table 3.4-19 Specific activity for radionuclides from gamma-spectrometric analyses of soil samples from non-tillable lands (Bq/kg)

Settlement	Year	^{40}K	^{235}U	^{228}Ac	^{210}Pb	^{137}Cs
Bechet	2007	537.400	0.900	25.600	18.200	7.870
	2008	392.400	2.505	20.240	41.050	13.200
	2009	459.365	2.670	24.250	35.465	9.885
	2010	454.300	2.480	25.400	31.450	4.840
Kraiova	2007	800.000	3.580	25.900	43.100	3.100
	2008	453.000	3.110	27.300	52.100	13.100
	2009	487.700	3.120	28.900	61.010	15.960
	2010	488.400	3.510	29.200	56.300	17.300
Dr. Turno Severin Zimnicea	2007	832.600	2.620	21.300	46.300	18.000
	2008	469.500	3.790	35.200	46.600	51.800
	2009	436.000	4.060	36.100	54.700	11.780
Zimnicea	2007	648.600	0.750	6.450	30.900	5.900
	2008	541.300	1.640	38.100	42.900	9.420
	2009	488.600	3.090	26.200	46.500	9.560
	2010	533.450	4.730	38.140	75.150	5.730

Table 3.4-20 Specific activity of radionuclides from gamma-spectrometric analyses of soil samples from non-tillable lands in Bechet county (Bq/kg)

Year	Sample location	^{40}K	^{235}U	^{228}Ac	^{210}Pb	^{137}Cs
2007	Dabuleni	512.700	<LD*	12.600	19.650	14.755
	Nadeia	435.200	<LD*	19.500	35.330	11.200
	Ostroveni	453.450	1.450	19.050	31.150	15.200
2008	Dabuleni	472.850	3.085	28.400	30.800	13.075
	Nadeia	361.850	<LD*	24.300	39.200	37.350
	Ostroveni	455.050	2.105	26.550	35.700	15.650
2009	Dabuleni	407.140	1.490	11.265	27.000	11.135
	Nadeia	277.100	2.785	18.345	34.115	4.855
	Ostroveni	546.085	1.82	21.635	40.100	24.660
2010	Dabuleni	450.500	1.455	13.600	21.150	17.700
	Nadeia	360.400	3.145	27.750	42.350	6.840
	Ostroveni	418.250	1.810	17.150	34.900	14.550

*LD – limit of detection

Table-3.4-21 Specific activity of radionuclides from gamma-spectrometric analyses of soil samples from tillable lands in Bechet (Bq/kg)

Year	Sample location	^{40}K	^{235}U	^{228}Ac	^{210}Pb	^{137}Cs
2007	Dabuleni	485.75	1.045	17	24.1	14.38
	Ostroveni	509.40	1.555	21.1	31	16.000
2008	Dabuleni	428.80	1.450	16.650	30.550	12.765
	Ostroveni	462.75	1.820	25.750	36.400	4.225
2009	Dabuleni	391.95	1.790	15.660	29.230	13.165
	Ostroveni	446.00	2.605	19.700	35.800	10.065
2010	Dabuleni	464.95	1.690	16.600	26.400	8.730
	Ostroveni	425.65	2.980	19.050	29.750	7.855

Found concentrations in the soils from the above areas of Romanian territory are within the natural background. The results of the analysis of the pollution of the soils in the Kozloduy region show that they are in concentrations lower than in other regions of Bulgaria and that the radioecological status of the soils is not compacted by the operation of the power plant. In the materials presented by Romania there are data only about ^{137}Cs in tillable and non-tillable soils and the values are not higher than the ones detected in the region of Kozloduy NPP.

Conclusions:

1. Soils on the territory of Kozloduy NPP and 30-km area around it are black-earth, alluvial, diluvial and gray forest soils. Black-earths are the most distributed soils within 30 km area. Out of the black-earth carbonate there are sandy-clayey, black-earth typical sandy clayey, eroded black-earth carbonate and typical and black-earth leached heavy sandy-clayey.

2. Lands in 30 km area around NPP are mostly agricultural ones. Totally in the lands of all populated areas they are of 64472 ha. Land categories are mostly of IV and III. Area of the lands of IV category is 30 682 ha, and of the ones of III – 20 739 ha. Private lands prevail – 46 745 ha.
3. Resistance of the black-earths from 30km area around the Kozloduy NPP against the anthropogenic impacts depends on the type of the conducted activities. Regarding the mechanical impact by the construction, excavation and embankment works etc. their resistance is extremely high. Pressure impact is related to deterioration of the soil structure, which especially in the carbonate black-earths is very poorly developed.
In view of the chemical impacts such as pollution with nonorganic and organic pollutants the black-earths are very sustainable.
Their cushion property depends on the favorable reaction of the soil solution and high carbonates heavy mechanical composition. Favourable potassium mode is very important for the resistance against radioactive contamination. Gray forest soils are a part of the resistant soils.
4. The analysis of the soil pollution in the region of Kozloduy NPP until 1999, shows that it is not possible to prove the contribution of the power plant for the value of ^{137}Cs and ^{90}Sr content in soils. Until 1986 it is considered that their concentrations are impacted by the experiments with nuclear weapons during many years. After 1986 the radioactive pollution is increased as a result of the Chernobyl accident and within the period 1986-1990 new higher level was determined in 0-5 cm layer as well as penetration of ^{137}Cs and ^{90}Sr in the soil profile. Some local pollution has been determined and the respective measures have been undertaken.
5. The analysis results of the pollution of the soils in 2006-2011 show that the most important pollutants are ^{90}Sr and ^{137}Cs and their concentrations are lower than the other regions in the country which is a sign that the environmental radiological status of the habitats is not impacted by the operation of the power plant.
6. Anthropogenic activity registered in 100 km area is transboundary origin caused by the global deposits and it is comparatively low comparing with other regions of the country.
7. From the official information provided by Romania about the content of radionuclides in the uncultivated and cultivated soils it can be concluded that the soils in 30 km zone around the Kozloduy NPP contain radionuclides within the natural background, which indicates that the soil on the Romanian territory of the above area is not affected by the operation of the plant.

3.5 Earth interior

3.5.1 Properties of geological environment

From the orographic point of view the assessed territory is involved within the Hilly Danube Plain. From the tectonic point of view Kozloduy NPP is situated in the Moesian platform. Approximately everywhere it is coated with quaternary sediment formations of different genesis. The territory itself is very well investigated and by the means of drill works the distribution of sands, clays, marls, marl limestones of Neogene age, clays and marls from Eocene age, Paleocene limestones, Dolomites of Jurassic age, Triassic breccia conglomerates, limestones, dolomitic limestones, dolomites, sandstones, siltstones and argillites is determined. The following lithostratigraphic units are detached covering the Paleozoic, Mesozoic and Neozoic systems:

Paleozoic

During the detail geological investigation there are no rocks of this age proven within the area. Such ones are detected Northern from the town of Montana at 4 km depth.

Mesozoic

It is represented by various sediment rocks constructing the geological section both of the investigated territory and of the 100 km site controlled area.

Triassic system

Triassic sediment rocks are reached in three structure drills P-10, P-12 and P-13 Kozloduy. From the lithostratigraphic point of view they are related to the following units: Petrohan, Iskur and Mizia groups.

- Petrohan group - combines (bottom up) different class of litostratigraphic units (LSU): Red-coloured sandy *combination /1T_1/; Alexandrovska formation* Prevailing sediments are reddish sandstones of different grain-size, at some places they are muddy, interbedded by siltstones and argilites. The thickness of the spit is not determined due to the circumstance that its lower border in the bore section is not reached. Alexandrovska formation is constructed by the alternation of siltstones, sandstones and argilites. Thickness is 52 m.
- Iskur group

The group combines several formations, which sections are mostly constructed of carbonate rocks (bottom up: *Doyrenska /doT_1^{sp} - T_2^a/; Mitrovska / mT_2^1 - T_3^k/; Rusinovdelska /rdT_3^k/; Preslavska /prT_3^k/ c Pisarevscki member)*. Lithological variates are limestones, dolomites, siltstones, argilites, sandstones, interbeds anhydrites (in the Kozloduy area). Total thickness of the crossed sediments is 495 m.

- Mizia group

Only one LSU is included there: *Kozloduy formation /kzT_3^{k-r}/.* It is represented by the unequal alternation of sandstones of different grain size, dark brown to reddish siltstones and alevrolites with single layer of limestones and dolomites. Thickness of the formation reaches 81 m (P-13 – Kozloduy).

Jurassic system

The following lithostratigrafic units are included within the system range:

- *Yavoretska /jJ_2^c - J_3^o/;*
- *Ginska / gJ_3^{o-k} /;*
- *Plevenska / plJ_2^c- J_3^t /.*

Distribution of the sediments of Yavoretska and Ginska formations is proven within the the borders of the site of Kozloduy NPP and 30 km around it. Rocks of the Pleven formation are determined within 100 km area from the site. Lithological varieties are aphanite limestones, slightly cracked at some places with clay substance on the cracks, upper in the sediment section they are converted into pseudoooliths micrograin dolometized limestones and dolomites. Their thickness does not exceed 250m.

Upper Jurassic - Low Cretaceous system

From the chronostratigraphic point of view the system covers two lithostratigraphic units Glozhenska/ *glJ3t - K1bs* /and Kaspichanska / *кJ3t - K1h* / formations. Lithological variates are solid compacted aphanite limestones, which are slightly cracked at some places and cavernous ones and up in the section they are converted into solid compacted limestones of reef type. Later are not of decisive importance for the geological structure of the investigated site. The thickness is 337 m

Low Cretaceous series

It covers three lithostratigraphic units – Salashka/ *sK1bs - b* /, Hayredinska / *hK1b - ap* / and Trumbeshka / *tK1ap - al* /. Lythological varieties are unequal clay limestones, which in some places are converted into marls, clay limestones. In the upper part of the sediment section limestone marls are determined having carbonized plant remains and glauconite limestones. Total thickness of the crossed sediments is 605 m.

-Upper Cretaceous series

Sediments of the upper Cretaceous age are determined in all deeper made boreholes in the region. They are detached in some lithostratigraphic units – Sanadinovska / sK_2^{cm-t} /, *Beloburdska / вв*K_2^{cn-st} /, *Knezhanksa / кп*K_2^{cp} /, *Mezdrenska /mz*K_2^{cp-m} / *and Kaylushka /* $кK_2^{m}$ /. From the lithological point of view the variety is considerable - marls with carbonized clay remains, thick layers of organogenic limestone, lime alveolites, granular limestones, which upper in the sediment section are converted in clay solid and compacted granular limestones, organogenic limestones, porous, cavernous, containing flintstone concretions.. Total thickness of the sediments is 877 m.

Paleogene system

Paleogene sediment rocks determined by deep boreholes are not split under litostratigraphic principle. In the scope of the system there are three unofficial LSU- *limestone /*$2Pg_1$*/, marl-limestone /*$3Pg_2^{1-2}$*/ and clay-marl /*$4Pg_2^3$*/***.** Sediments of the first two stratas are determined within the scope of the three-kilometer zone of Kozloduy NPP and beyond it. Within the range of 30 and 100km all three strata, but not located on the entire area of the last zone. These strata are also located from the North side of the Danube River. From lithological point of view the crossed sediment section is presented by sandy, muddy, compacted limestones, organogenic limestones, thin layers of sandstones, marls and at some places the marls are glaukonite ones. Total rock thickness is variable (200- 502 m).

Neogene system

Neogene rocks are wide distributed in the region. They are proven both in nature outcroppings on the surface as well as with deep drilling. In lythographic aspect there are several official units detached: Deleyska / dlN1b /; Krivodolska / krN1s / with Rakevski and Lesurski wedge; Dimovska /dmN1s /; Furenska / fuN1s /; Florentinska / flN1s /; Smirnenska / smN1m - p / with Lehchevski member / sm-1N1m /; Archarska / arN1p /; Brusarska / brN2 /; Beloslatinska / bsN1m - N2 /. Sediment section is presented by clays, lime clays, band anhydrites, lime clays, detritus limestornes, oolite, arenaceous, detritus, argillaceous, shelly limestones, clays and sandy loams converted in some layers from sands into aleurits. Total thickness is about 1120 m. It is important to point out that the maximal thickness of the cross sediments and their distribution is not everywhere, which impact the local thickness in certain zones of the territory.

First six formations are distributed within approximately all controlled areas[3(2), 30 и 100 km].

Quaternary system

Sediment section is constructed of sediments, which are various from the lithological and genesis point of view. From the hronostratigraphic point of view they are generally involved in the Eo- pleistocene / a-prQeop /, pleistocene / Qp / and holocene / Qh /. Their spatial and hronostratigraphic relationships are not sufficiently

clarified. From the lithological point of view the following formations are traced - gravels, sandy loams, clays, loesses. Clays have high content of the carbonate substance. Buried soils are detected. Thickness of these sediments is quite variable. The one of the Kozloduy loess complex is 40 m.

3.5.2 Tectonic characteristics

From the tectonic point of view the region is involved in the Lom depression located in the west part of the Moesian platform. For clarification of the deep tectonic structure some geophysical, seismo
logical, geomorphological, neotectonic, geodetic, seismological, local and regional investigations are made. Their results are summarized and a complex assessment of the available information is made in view of clarification of the location of separate units of Kozloduy NPP and provision of anti-seismic construction of the facilities.

3.5.2.1 Summarized regional tectonic characteristics

Data about the tectonic of the regional area are received from geophysical investigations under three regional profiles: Mokresh-Shabla, Petrich-Nikopol and Madan-Strazhitsa-Russe. Deep structure and conductivity of the seismic energy in separate zones is investigated through the macroseismic fields of the seismic, magnetic-tellurium drilling, gravimetric and geomagnetic.

In Triassic structure level the North Knezhanska terrace and Beloslatinsko lowering are detached, which are separated by Yarlovsko-Selanovska swell-like strip and Kozloduy-Komoshtitska monoclnal one. In the later a positive structure is formed South-West from the Kozloduy on the roof of medium Triassic period.

In the upper Jurassic-Valangian structure stage there is a positive structure formed to the North-East towards the Triassic one. During the Neogene-Quaternary structure stage the territory is complicated by faults of East-West direction. Trans-regional lineament zones Tsiburski, Boichinovski, Krivodolski, Oriahovsko-Mezdrenski are detached. Following positive structures are also well-distributed: Gornotsiburksa, Kozloduyska, Zlaryiska and Oryahovska.

West part of the Moeasian platform has week seismic and seismodynamic activity. Zones of clearer activity are:

- Berkovska fault zone - passes through Montana and Berkovitsa. It is actively impacted by the Kresna earthquake. This zone is not only a conductor but it alos discharges and accumulates seismic energy;
- Ogostenska fault zone - it is well marked on the microseismic field of Kresnea, Gornooriahovitsa earthquake, earthquakes of Maritsa seismic region and Vrancea - of VI - VII degree. In the region of Kozloduy the impacts are of IV - V degree.

Central part of the Mizia slab is determined between the Iskur-Etropole fault zone and Bukak-Samuilovski fault. It is of higher seismic and geodynamic activity. The following zones are specified here:

- Svishtov-Gorna Oryahovitsa zone- high conductivity of seismic energy established both in the grounds of the data about the microseismic splitting of regions and under geophysical data. Low-velocity layer is registered at 4 - 5 km depth;
- Iskur-Etropole structure - zone of high seismic activity and high sensitivity towards the geodynamic impacts by the microseismic field of Kresna, Gorna Oryahovitsa and field of Maritsa microseismic zone;

- Pordim fault zone - suffers impact by the Gorna Oryahovitsa zone and by the ones of Maritsa seismic region. It is sensitive to geodynamic impacts;
- Suhindol-Svishtov fault - monitors the basalts bodies of Suhindol-Dragomirovo line - very sensitive towards the earthquake impacts;
- Gorna Oriahovitsa fault system source of the destructive earthquake of Gorna Oriahovitsa in 1913. It is monitored from Gabrovo-Sevlievo, through Veliko Turnovo and G. Oryahovitsa Popovo to Razgrad. This regional structure is not reflected in the abnormal gravitation field of in the structure of the crystalline foundation. It is a part of the neotectonics ones. Its most active part is the border between the Mizia platform and the structure zone of the Fore-Balkan. The most severe earthquakes occur here. In 1942 г. Razgrad earthquake is activated in the village of Blagoevo (VII degree) and in 1986the earthquake in Strazhitsa occured that is of VIII degree.

Left tear-fault motions are detected into this structure zone when some elastic energy is accumulated at the border of moving units that is periodically discharged as different earthquakes.

3.5.2.2 Summarized tectonic characteristic of the zone of Kozloduy NPP

There are no abnormal objects detected in view of the conducted gravimetric and geomagnetic investigations. Beyond the territory there is a gravity transition registered towards Northwest-Southeast - South-Mizia fault, which generally reflects the Belogradchik flexcure.

Direct dynamic connection established between the total structure development on the territory and forming of its landscape is used for the assessment of the neotectonics activity of the territory. On the local territory there is calm tectonics regime, reflected in the subhorizontal distribution of the geomorphological levels. Here only the already mentioned fault lines are established that are of subequatorial direction.

They are estimated as active during the Old Cimmerian phase and later they become passive, fossilized under the impact of the powerful Cretaceous-Paleogene and Neogene-Quaternary covering. The same conclusion is made after the analysing of the plan of the river-valley network and number of the hypsometry of the Quaternary terrace complex in the cross-wise developed valleys of the rivers of Ogosta and Skut. These characteristics of the local area are illustrated in the best way by the Neotectonics and geomorphological investigations of the Upper of Upper Villafrasnian morphostructure level and by the location and development of the river terrace Danube River and its left and right tributaries having equal levels on the both sides of the river.

The best clear fault system of the Middle Fore Balkan (Belogradchik flexture) could not be accepted as substantiated as seismic lineament. Seismic activity has different zones of lineament, which are disjunctive units next to Krivodol with the North-East fault of Ogosta, next to Chiren with Chiren North-East fault and next to Gabare-Drashan with Lower Lukovit one.

On the territory of Kozloduy NPP there are no geologic and geomorphologic data available regarding the existence of active fault structures of Quaternary age and the lineament is weakly expressed or it is completely missing.

3.5.3 Physical and geological processes

For the investigated region the typical physical and geological phenomena are the collapse related to the loess materials, falling down of land masses on the slopes,

which is also typical for the loess materials and boggy places in the overflowed terraces of the Danube River.

In the region of Kozloduy NPP the loess is available everywhere and its thickness of 12m is the reason for the main physical and geological processes under development: collapse. In the loess complex up to the bottom the following lithological varieties are discovered:

- sandy loess - average thickness (M_{cp} = 6.90 m);
- Clay-like loess (M_{cp} = 2.10 m);
- loess clay (M_{cp} = 2.40 m).

Loess genesis is related to the period of dry climate. It is not compacted having a high content of the carbonate substance and high porousness. During moistening an important feature of the loess is that it is additionally compacted and reduces its volume. It should be considered when forecasting the relations with the additional anthropogenic load of the geological environment causing formation of considerable deformations.

Based on a number of investigations it is established that loess in the zone of aeration is the strongest collapsed one and this is the zone located over the level of the groundwaters, which is constructed by sandy loess. In the depth of the clayey loess where a zone of water level fluctuation and capillary increase is detected the loess collapse is much decreased. The zone under the water level (zone of the loess clays) the loess collapse does not exist.

During the design and construction works of Kozloduy NPP it is taken into consideration , but nevertheless the undertaken measures at some places there are some unequal settlements available. Considering that there are no exceeds of the permissible values detected the identification of the problems at that stage could be achieved by a complex analysis of the civil structures and ground base. In case of eventual development of the problem faced with the unequal settlements it is needed some engineering and geological investigations to be made for establishment of the actual condition of the geological foundation and the respective measures for strengthening of the ground foundation should be undertaken.

Slope processes - movement of earth masses is typical for the region where loess materials are available. This is a result of the destruction of the natural balance condition of the geological environment caused by the executed additional human activity. In the region of Kozloduy NPP site there are no such landslides recorded.

Boggy places are typical for the low lands next to the Danube River, especially in the sections for protection dikes in the overflowed terraces. Reasons for that is the available drainage system, but at the Kozloduy low land there is also an additional condition - this is the higher level of the plant channels comparing with the level of the groundwaters in the low land.

Engineering and geological conditions

In order to clarify the features of the ground foundation regarding the consideration of the engineering and geological conditions for the foundation and construction of the different facilities of the industrial site of Kozloduy NPP a large scope of engineering and geological investigations is executed. These investigations cover the following types of works:

- drill works;

- static penetration;
- trial load with a die;
- laboratory investigations.

During the investigations not-destroyed and destroyed earth samples are taken for clarification of the physical and mechanic features of the different lithological types of sediment rocks. Static penetration is conducted for some of the boreholes in order to determine the compacting and consistent condition of the separate lithological varieties, as well as their total deformation with summarized cutting angles. Also, some trial loads are conducted with a die of especially adjusted pits in order to clarify the collapse and deformation features of the loess materials.

During the engineering and geological investigations some engineering and geological sorts are determined in the vertical from up to the bottom, which as per their nature are separate lithological types of sediments. Physical and mechanical features of each type are determined and an analysis of the physical and mechanical parameters is made and their spatial change and change into the depth is made. Special attention is paid to the loess collapsing. Based on the analysis of the received engineering and geological information also the normative load for each separate engineering and geological type is determined.

Engineering and geological characteristic also include determination of the organic salts, carbonate substances and water-soluble salts for each engineering type. Slopes of the temporary excavations are determined as well as the depth to which the excavations should be dry and the most favourable time for execution of the construction works.

Available information for the engineering and geological investigations show that they are professionally made and clarify all needed engineering and geological parameters in view of design and execution of the construction works for separate facilities of the power plant.

Protocols of the geodetic measurements show that at some places on the site there is unequal settlements under different types of facilities.

3.5.4. Seismicity

For the purposes of evaluation of seismicity on the territory of the facility some specialized investigations are carried out, the results of which are reflected in brief seismic characteristic.

Seismicity of 320km area of Kozloduy NPP

Data of the catalog for the frequency of earthquake occurrence are used for the period of 1616 durations including 375th years until 1991.Totally 3195 earthquakes are entered into the catalog with magnitude about and above 3.0, of which 1032 earthquakes are of magnitude above 4.0, and the rest 555 are of lower magnitude interval. Parameters of the earthquakes in the catalog are unified and standardized and the intensity assessments are under the scale of MSK scale and the magnitude values are normed towards the MLH scale.

As a whole the area of Kozloduy NPP with radius of 320km is a part of Alpine-Himalaya seismic belt of high seismic activity. Within the commented region the following seismic active zones are determined: Sofia, Gorna Oriahovitsa, Maritsa, Kresna, Negotino-Kraina and Kumpulimg-Vrancea. Typical for these zones are strong srust earthquakes (with M > 5.0 and depth 50 km, and fooor Vrancea- 150 km).

Seismicity in the detached seismic active zones is investigated in details with spatial, temporary ad energy characteristics. At the minimal distance of 80km from the site of Kozloduy NPP the Sofia seismic area is located. For this zone the maximal documented epicenter intensity (I_0) of 9th degree (MSK) of the earthquake in 1641 and 1858. Monitored maximal effect on the site of the Kozloduy NPP by the earthquakes in the Sofia zone is of 3rd degree, Ikoz = 3 (MSK).

The most severe impact on Kozloduy NPP is caused by the focus earthquakes generated by the Vrancea seismic focus. Maximal macroseismic effects on the site Ikoz = 6 - 7 are monitored from the earthquakes in 1977 with M = 7.2 and I_0 = 8.0 (MSK). Effect is a result of the specific in the focus processes (strong prolongation towards SE of the isoseismal field).

Earthquakes generated beyond the above zones are related to the famous fault structures, which could not be defined as detached due to not sufficient data needed to determine their main characteristics. The most severe earthquakes beyond the defined zones are the event in the North Greece from 1828. M = 7.5 and I_0 = 10.0 (MSK) and the earthquake in the region of Dulovo from1882 with M = 7.3 and I_0 = 7.8 (MSK) with macroseismic effects monitored on the site of Kozloduy NPP I_{koz} = 5 - 6 (MSK).

Seismicity in the local area of Kozloduy NPP

Site of Kozloduy NPP is located in the middle of the stable part of the Mizia platform, which had typical seismic activity. During the period of the instrumental registration of earthquakes (1976 - 1990) on the entire territory of the country there are only 3 earthquakes of 3.0 < M < 3.6. There are no historically documented earthquakes in this area. The lack of documented seismic activity and weak sporadic seismic occurrences characterize it as the most "calm" seismic area within 320km region.

Analysis of the neotectonics processes in the Mizia platform is subordinated to the main regularities of the last tectonic cycles. Tectonics denivelationsdisplacements are monitored only on the platform borders. Tectonic processes are completed by the end of the Triassic and beginning of the Jurassic periods. The seismic investigations determined that there are no faults of Jurassic-Paleogene ages. Neogene and Quaternary depositions lay approximately horizontally without any surface features of tectonics breaches.

Available data reject the existence of “capable“ fault, i.e.surface occurred structure of seismic potential as well as structures in the sense of definition stipulated in Safety Guide 50-SG-S1 (rev.1) of the IAEA.

Seismic tectonics model of the local area (30km) is structured by the use of the standard procedure for integration of all available geological and geophysical data. On fig. 4.4.1.3-3 a map of the complex lineament zones is presented, which are marked under data about the Triassic-Jurassic fault system. Lineament zones express the highest degree of inhomogeneity of physical parameters of the Earth crust so they are examined as zones of potential instability.

Lack of evidences about the Quaternary activity and motions in the local area as well as the fact that the most severe earthquakes registered here are of magnitude M = 3.6 provide grounds for the conclusion that in the area no earthquake of M_{max} = 4.0 could be expected. Received result is in compliance with the detachment of seismic regions of the Republic of Bulgaria.

Seismic security of Kozloduy NPP

Main investigations of the BAS Geophysical institute of the seismic security of the Kozloduy NPP power plant, which are examines and accepted by IAEA missions are related to:

- Construction of local seismic monitoring network (LSMN);
- construction of additional accelerograph network (CACKOK);
- processing and analysis of records of strong earthquakes;
- analysis of the seismic hazard of the local and regional sources;
- experimental investigations of the dynamic characteristics of the site and power units;
- determination of the site seismic characteristic;
- neotectonics investigations;
- investigation of the geophysical fields;
- re-assessment of the historical earthquakes;
- re-assessment of the Earthquake Reactor Trip Thresholds.

Besides this comprehensive information there are also a data base available provided by the constructed Local Seismic Network with three seismic stations:

- Malo Peshtene (MPE) with an increase by 1 September 1999 100000/1 Hz;
- Vulchedrum (VLD) with increase of 20 000 / 1 Hz;
- town of Oryahovo (ORH) with increase of 1500 / 1 Hz.

They are constructed on the grounds of the requirements for recognition, registration and localization of the earthquakes in the magnitude range M = 1 - 5 and by them the processes of the seismic events are monitored within the time and space and reliable data are collected about the repetitions of the earthquakes and seismic danger. Based on the preliminary investigations the following data important for the design of the seismic stations are obtained:

- frequency range of the earthquakes 0.05 - 100 Hz, and the upper border could be reduced to the internationally accepted value 50Hz (Regulatory Guide 1.12;
- measured macroseismic noise in 25 points of the region of 12.5 - 40.2 dB interval (converted to base point N 19 in the village of Borovan - 28.8 dB);
- ratio signal / noise - S / N 12 dB.

All units of Kozloduy NPP have a System ofr Industrial Antiseismic Protection installed (IAPS), that trips the reactors in case of earthquakes with accelerations higher than the set threshold. Since 1993 accelerograph system SASCEC is commissioned (system for accelerograph seismic control of equipment and structures). It includes accelerograph of SMA type – 1 (4 pcs), SMA - 2 (3 pcs.) and SSA (4 pcs.), located on the free field and at different elevations of Units 3 and 5.

A matter of interest are the experimental investigations of the dynamic characteristics of the earth beds in the construction sites of Kozloduy NPP, in conformity with which the geotechnical model of "free surface" profile is prepared. Also, field measurements are made for determination of the seismic waves by direct and reverse seismic logging as well as by cross-wise and surface seismic profiling. It is determined that the cross-wise waves (V_s) are distributed in the clays of lower velocity of 170m/s and higher - 680 m/s in the marls and the velocity of the longitudinal waves (V_p) is 470 m/s in the clays and 2 700 m/s in the marls. The range of change of the cutting deformations is from 10^{-6} to 10^{-1} cm/cm, and for each lithological variety the relation to the cutting module ratio is shown G / G_{max} (0.0 up to 1.2) as well as the damping ratio D (0 - 40 %).

The data of the geotechnical seismic model of the "free surface" are summarized, which are valid for the construction site and regardless the inhomogeneous geological conditions they allow to determine the interaction “soil-structures”. It is confirmed by the analyses under the design Benchmark Study of IAEA, the Modernization program of Units 5-6 and others with the participation of European and American Companies with reach experience in the seismic design and seismic re-assessment of Nuclear Power Plants.

3.5.5 Mineral resources

Mineral resources available in the region are related to the geological structure. As per the data of the geological investigations the following mineral resources are discovered in the region:

- fossil fuels - oil and gas shows, lignite coal;
- non-metal (construction materials) – limestone, gypsum, sand, clay, loess.

Oil and gas shows in the region are determined in the medium and Upper Triassic sediment rocks, among the limestones and dolomites of the Doiran formation, siltstone and sandstones of the Mitrovo formation and only gas ones in the dolometes of the formation of Rusindol. These shows are within the Kozloduy buried Triassic system at 3500m depth. They are not estimated as high potential ones due to the poor collector properties of a part of the sediments. Gas field of the village of Butan is related to this structure.

Lignite coal is related to the Brussarska formation and in the region of Kozloduy they are located at a depth of 70 to 110m. Their thickness does not exceed 3m together with the coal clays. It is not a matter of special industrial interest due to severe hydrogeological and engineering geological conditions for bedding.

Non-metal (construction materials)

Gypsum is within the scope of the Deleyska formation of Baden age. Only the region of Oryahovo could be a matter of industrial interest. Shelly limestones of the Furen formation are a valuable deciorative material and are easy for processing - the most interesting are the ones located around the town of Mizia.

Query materials

Sands and gravels are within the rivers of Danube, Ogosta, skut and Tsibritsa and they are mostly of Quaternary age. They could be mostly mined alongside the river of Danube by the Bulgarian dredger inland water transport.

Loess

Investigated loess fields are beyond the investigated region. At some places there are only minor quarries available for local needs - around Kozloduy and Moesian Loess is used for brick manufacturing in the region.

3.6 Landscape

Territory of Kozloduy NPP covers the belt from the Danube River side low lands and the territory of 30 km area around the power plant is involved in the West subarea of the Danube valley that is a part of the Moesia area.

According to the map for **regional landscape detachment** of Bulgaria (1997) [136] the territory of Kozloduy NPP is situated in:

- A. North Bulgarian Landscape zonal area
- **I.** North Danube valley landscape subarea
- 4. Zlatia landscape ***region***
- 5. Dolnoiskurski landscape **region**
- II. South Danube Landscape **subarea**
- 13. Lyutensko-Borovanski landscape **region**

Specified characters and number indexes mark landscape area, subarea and regions and they comply with the regional landscape detachment of the country [136]. . On the territory of 30 km area around Kozloduy NPP the specified structures are presented on the following territories:

- Kozloduy Municipality and Eastern part of Lom- they occupy a part of the Zlatia landscape region (4);
- Municipality of Vulchedrum, Hayredin and Mizia - in Zlatyiski (4) and Lyutensko-Borovanski (13) landscape regions;
- Oriahovo Municipality - in the Dolnoiskurski Landscape Region (5);
- parts incoming in 30 km zone of NPP in the municipalities of Byala slatina, Borovan and Boytchinovtsi - in the Lyutensko-Borovanski landscape region (13);

According to the typological classification system of the landscapes in Bulgaria (1997) the site is involved in the following landscape structures:

1. Class	Plain landscapes
1.1 Type	Landscapes of moderate continental meadow-steppe and forest low lands
1.1.1. Subtype	Landscapes of meadow-steppe low lands
1.1.1.1. Group	Landscapes of meadow-steppe alluvial low lands of medium degree for agricultural utilization
1.1.2. Subtype	Landscapes of meadow-marsh low lands
1.1.2.2. Group	Landscapes of meadow-marsh alluvial low lands of comparatively low degree of agricultural utilization
1.1.3. Subtype	Landscapes of forest low lands
1.1.3.3. Group	Landscape of forest low lands on the river islands
1.1.3.4. Group	Landscape of the forest low lands on the uplands on the overflown terrace of small extent of agricultural utilization
1.2. Type	Landscape of moderate continental steppe, meadow-steppe and forest steppe valleys

1.2.5. Subtype	Landscape of the black-earth meadow-steppe valleys
1.2.5.7. Group	Landscape of the black-earth meadow-steppe valleys of loess rocks of high extent of agricultural utilization
1.2.5.8. Group	Landscape of black-earth meadow-steppe valleys of carbonate rocks of medium extent of agricultural utilization
1.2.6. Subtype	Landscape of loess-steppe valleys
1.2.6.9. Group	Landscape of the loess-steppe valleys of loess rocks of high extent of agricultural utilization
1.2.6.10. Group	Landscape of the loess-steppe valleys of limestone rocks of medium extent of agricultural utilization

Numerous indexes of the landscape taxonomic classes should comply with the "Typological landscape region detachment of the country and reflect the landscape of the examined territory.

Landscapes on the territory of Kozloduy NPP

The site of the Kozloduy NPP (fig. 3.6-1) is a part of landscape "**anthropogenic**". It is a natural-territorial complex, where the anthropogenic impact means construction of different buildings and facilities, roads, electric power lines etc. on the territory of the complex.

Some of the varieties of the anthropogenic landscapes located on the site territory are as follows:

- Landscape "anthropogenic industrial" – it is created by the constructed buildings of the Units of Kozloduy NPP, administrative buildings, electrical and other facilities and parking areas.
- - Landscape "anthropogenic communication". In its structure all road communications located of the territory of Kozloduy NPP are located s well as the existing HV routes.

The landscapes are of different anthropogenic degree. In some of them occurred considerable structure changes - mainly in the industrial landscape where a part of the geological base, soils and vegetation components is destroyed. The territories of the landscape anthropogenic communications, where the changes are reversible are not affected so high

Fig. 3.6-1 Site of Kozloduy NPP.

Forest landscape

The overview of this landscape is determined by the wood plants. For the purposes of grassing and improvement of the environment some plants are planted involving wood and shrubby types**.** Territory of this landscape is not compacted. It is broken by communication connections, buildings, outdoor areas etc. Landscape is established to have environmental forming functions and its availability improves the visual acceptance of the "anthropogenic" landscape, influences favorable the microclimate, air dust load the territories around it are used for recreation etc. Landscape allows self-regulation and due to that feature it could be determined as comparatively stable.

Aquatic landscape

Leading and visualization component in it are the surface waters. It is represented by the cold and hot channels to the power plant. It occupies comparatively big area that provides grounds for an independent landscape. That landscape is unstable on the time point of view and its existence completely depends on the anthropogenic activity.

Meadow landscape

Its territory differs from the rest landscapes with the available grass plants. It has broken horizontal structure by available roads, buildings etc.

Landscapes in the region of investment proposal

Depending on the leading/or physiognomic landscape forming component, the landscapes on the territory of 30km area (fig. 3.6-2) around Kozloduy NPP are classified as follows:

Forest landscape

Leading and physiognomic component of this landscape is the forest vegetation. This are natural-territorial complexes of the forest fund of Kozloduy Municipality, southern part of Lom, Municipalities of Vulchedrum, Hyredin, Mizia, Oryahovo as well as the parts involved in 30km NPP Area of the municipalities of Byala Slatina, Borovan and Boitchinovtsi. Its approximate area is 2552ha. The territory of its horizontal structure is broken. It is situated on the river bank territories and hilly slopes. There is some homogeneity in its vertical structure as far as its geological base has quaternary sediments deposited on the surface and in the landscape positive forms there are Neogene sediment rocks available. In spite the geological section is based

on the grounds of wild range of lithologic rocks of different age the loess nature of the rocks involved in the black-earths formations is very important.
They are the main soil type within 30 km area around Kozloduy NPP and are important component for formation of the landscape structure, i.e. soil.
As a structure forming component there is a number of wood species involved in the vegetation cover, which also form the visual view of the landscape. Alongside the banks there are different species of wills and poplars available. On the hilly slopes there are tiller plants of downy oak, Turkey oak and Italian oak, involving common elm tree, lime-tree etc.
At some places there are some cultures of white acacia. Also, there are pure and mixed cultures of black pine. Alongside the Danube River there are some belts of poplar cultures that occupy the main part of the islands. Amphora trees are the most widely distributed shrubby species.
Stability of the forest "landscape" is determined as high due to its capability for self-regulation.

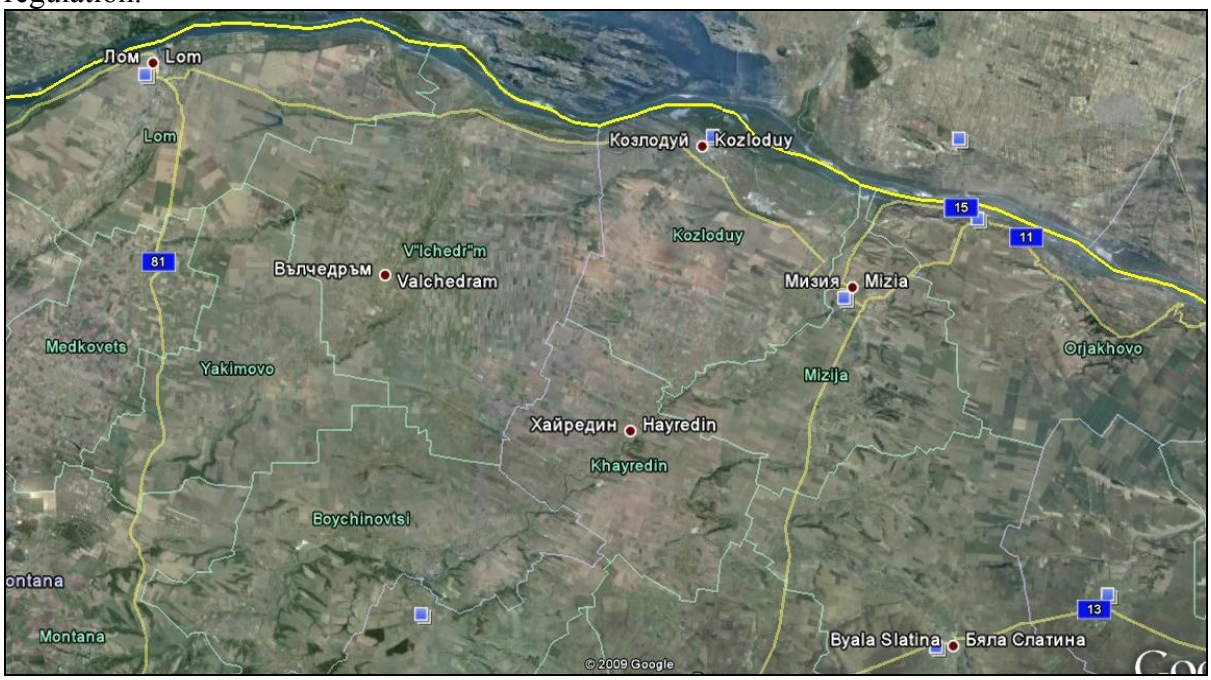


Fig. 3.6-2 30 km area around the site of Kozloduy NPP.

Meadow landscape

Meadow landscape is not typical for the region that is why they occupy some minor areas in the low land grounds. "Meadow marsh" landscape is located in the micro lowering lands of the overflown terraces of the rivers and in certain sections around the marshlands in the region. The ones of most considerable areas are meadow landscapes located in Blatoto area on the overflown terrace the Danube River Northern from the site of the power plant.

Agricultural landscape

The overview of these landscapes is formed by the tillable lands. The agricultural landscapes are natural-territorial complexes of the lands of the municipalities around the NPP territory. They are formed by the impact of directed anthropogenic activity, which causes the landscape changes aiming to satisfy certain needs. The existence of

such landscapes completely depends on the anthropogenic activity - man may continuously maintain them in concrete condition.
Agricultural landscapes occupy bigger part of the Danube valley. Its approximate area is 64472 ha. Most widely distributed landscape is the "agricultural crop rotation" one which area is approximately 53150 ha. Even rarely there is also "agricultural landscape of perennial plants".
Horizontal structure of these landscapes is broken very much by the other landscape types - anthropogenic, aquatic, forest ones.
Vertical structure is very similar to the one of the "forest" landscape. Soil-forming rock is loess, high carbonate rock that plays considerable role in the circle of a number of substances, including the pollutants. High content of the carbonates is an effective migration barrier in the landscape to the polluting substances, including radionuclides. Their mobility is reduced in the alkaline media. The soils themselves, i.e. black-earths, depending on the leaching extent contain carbonates that when being accumulated in different depths also provide migration barriers.
Vegetation component, which takes part in the formation of the vertical structure of the agricultural landscape, is mostly represented by the circulating crops. They change the visual landscape view depending on the seasonal dynamic.
Agricultural landscapes in the region are very much negatively influenced by the anthropogenic activity. A big part of them are deserted agricultural lands. Due to the poor maintenance of the drainage network in some sections the "agricultural" landscape is gradually replaced by "meadow-marsh" type landscape".
Landscape stability of the agricultural landscapes is not high. Vegetation component of them is very sensitive, because its existence depends on the anthropogenic activity. As sustainable components the geological foundation and the soil could be specified.

Aquatic landscape

Leading and physiognomic component are the groundwater. They are represented by "aquaval river". The structure of the landscapes include the flows of the rivers Danube, Skut, Ogosta and Tsibritsa as well as tributaries of their water catchment areas and remoted water main lines and Iskur tiver and Lom river
Next to the site of Kozloduy NPP are located the area of waters of 15 water sources and microdams (in 30km areaa). They are a part of landscape "aquatic" lake. The main channels of the irrigation system (part of the aquatic landscape) are already not in use.
"Aquatic marsh" landscape involves marshlands and protected territories – marshland of the island, Ibisha reserve in the land of the village of Dolni Tsibur, Ostrovsko marshland located at 28 km Southern from the power plant.
Aquatic landscapes are of 2651 ha approximate area.

Anthropogenic landscape

Anthropogenic landscapes within the 30km zone around the NPP "Kozloduy" are of about 4435 ha total area. Depending on the duration of their existence the following varieties are represented.

- Landscape "anthropogenic settlement". Physiognomic component in it are the settlements. It includes natural and territorial complexes with anthropogenic elements typical for the populated areas.
- Landscape "anthropogenic communication". It includes all natural and

territorial complexes, in which the anthropogenic impact is represented in the construction of different categories of roads, including field roads, railways and the electric power lines. In their prevailing part these are of second-class (directed to Lom, Vratsa and Svishtov) and third-class (between the municipalities) roads and in some sections they are of fourth class. Total length of the road infrastructure in the region is about 500km, and its density is about 192.4 km/1000 km^2 with 332.8 km^2 for the country. In the Kozloduy municipality the density of the road network is 142km/1000km^2. They include the narrow-gauge railway between the town of Cherven briag and the town of Oryahovo.

- Landscape "anthropogenic communication". On the30km-territory around Kozloduy NPP there are some industrial enterprises of the populated areas, which are currently closed and abandoned.. Also, there are some farm buildings, destroyed farms, deserted construction areas, storage facilities, quarries and lands backfilled with waste. The existing industrial areas consist mostly of small enterprises of the service field, small construction companies, storage facilities etc.

Formed of the anthropogenic landscapes are influenced in different extend by the human activity. Bigger part of them is only anthropogenic ones. Some of their components are affected, which are mostly vegetation and soils due to the construction activities, construction of compacted covers on the soil surface etc. Caused changes are time-reversible and depend on the direction of the anthropogenic activity. In a small part of the anthropogenic landscapes there are irreversible considerable changes occurred. Typical examples are the quarries that have caused landscape changes. Changes of their landscape structure are permanent.

Depending on the functional use of the landscapes on the territory of 30 km area (fig. 3.6-2) around Kozloduy landscapes with different functions are represented.. They could use one or more of the following functions.

- ***Production of resources***

This function is typical for landscapes agricultural, forest and aquatic.

- ***Environmental forming functions***

These functions are related to the main life factors, such as content of the atmospheric air, water quality, esthetic variety as well as establishment of conditions for sport and recreation. They include landscapes forest and aquatic.

Landscape in the region of Romanian part of the 30 km area around Kozloduy NPP

A part of 30km area around Kozloduy NPP is in Romania. In covers the territories in the south of the county of Dolj, between the Danube River, Romantilor and Bailesti plains. The types of landscapes as described in item 3 are typical for the Romanian part of 30km area.

Depending on the leading/or physiognomic landscape forming component, the landscapes on the territory of 30km area around Kozloduy NPP in the Romanian part are classified as follows.

Agricultural landscape

Its area is largest - 106976 ha. The overview of this landscape is formed by the tillable lands with rotating crops, perennial plants and pastures. They are formed by the

impact of directed anthropogenic activity, which causes the landscape changes aiming to satisfy certain needs. They are formed by the impact of directed anthropogenic activity, which causes the landscape changes aiming to satisfy certain needs.

Aquatic landscape

Leading and physiognomic component are the groundwater. Some of its varieties are "aquatic river" and "aquatic lake". The structure of the landscapes includes the flows of the rivers Danube, Jiu (Old Jiu) and their tributaries Baboaia, Balasan и Giorocel. Lace landscape include the water catchment areas of the lakes Calugareni and Bistret as well as many water sources in the valley.

The total area covered by water is about 10012 ha.

Forest landscape

Its area is the smallest - 9328 ha. Leading and physiognomic component of this landscape is the forest vegetation. Its structure includes three and shrubby types such as forests, protection curtains, forest nurseries, etc

Anthropogenic landscape

In the Romanian territory of 30km area around Kozloduy NPP the anthropogenic landscapes are rarely distributed. They are natural and territorial complexes, where the anthropogenic impact is caused by small populated areas, construction of different buildings and facilities, roads, electric power lines etc.

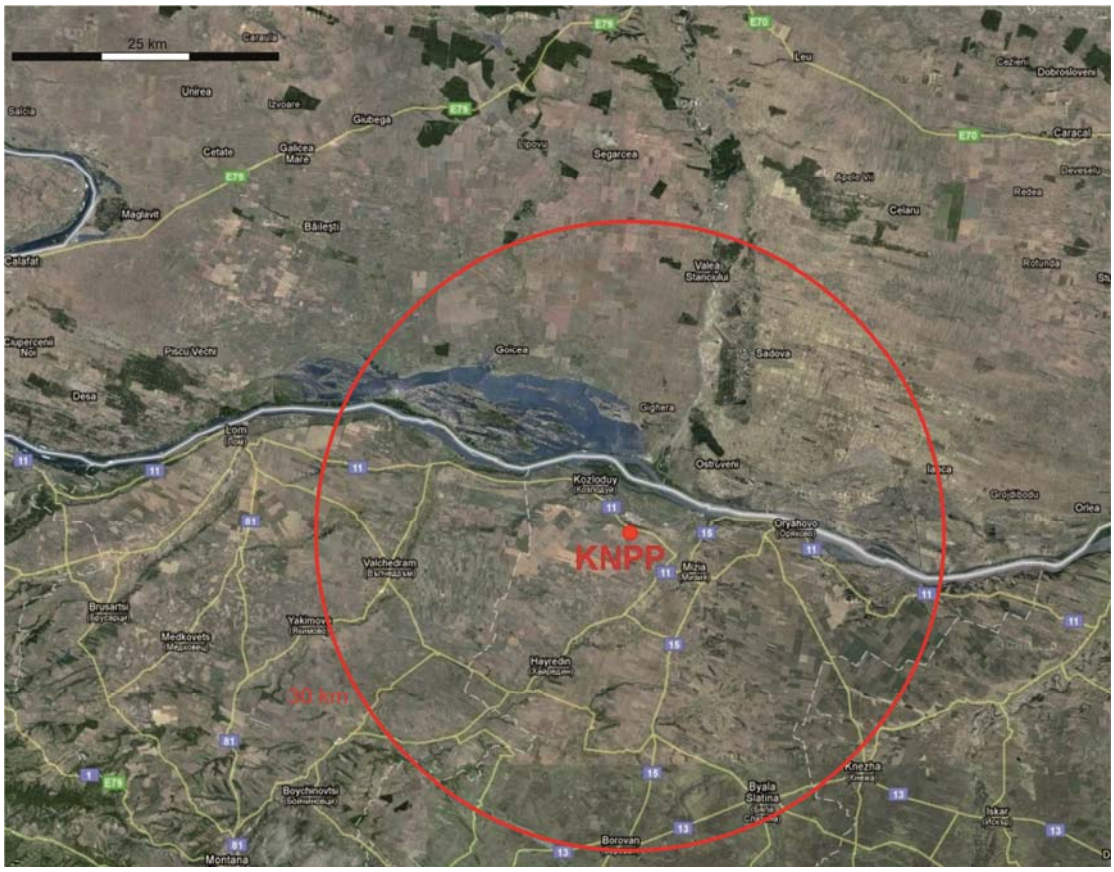


Fig. 3.6-3 30 km area around the site of Kozloduy NPP on the Romanian territory

Conclusions:

1. On the territory of Kozloduy NPP a complicated landscape structure is constructed. There are several very clearly detached landscape types –„anthropogenic", „forest" and „aquatic".
2. Landscape on the territory of Kozloduy NPP is of low stability. Their existence is determined by the human activity. "Forest" landscape is of higher stability and it is self-organizing and self-restoration one.
3. Within 30km area around the territory of Kozloduy NPP landscapes variety is represented by the landscape types - "forest", "meadow", "agricultural", "aquatic" and "anthropogenic". "Forest" landscape" is very stable as well as the "aquatic" one, which is formed by the natural water streams in the water catchment areas of the rivers Danube, Skut, Ogosta and Tsibritsa.
4. An important role for the circulation of the substances in the landscapes plays the loess-type soil forming materials, which by their carbonate composition provide migration barriers for different pollutants, including radionuclide.

3.7 Natural sites

3.7.1 Protected areas under Nature 2000 in the region of Kozloduy NPP

In 30km area from Kozloduy NPP some parts of the following Protected areas under Natura 2000 are located:

- -Kozloduy, code BG0000527 under the Directive for protection of the natural habitats of the wild flora and fauna;
- -Kozloduy islands, code Bg0000533under the Directive for protection of the natural habitats of the wild flora and fauna;
- Tsibur, code BG0000199 under the Directive for protection of the natural habitats of the wild flora and fauna;
- Zlatiata, code BG0002009, under the Directive for protection of the wild birds
- Ogosta River, code BG0000614 under the Directive for protection of the natural habitats of the wild flora and fauna;
- Skut river, code BG0000508 under the Directive for protection of the natural habitats of the wild flora and fauna;

Main objectives of the protection in the Protected are as follows:

- Protection of the area of the natural habitats and habitats of the species and their populations, which are subject to protection within the protected area.
- Preservation of the natural condition of the natural habitats and the habitats of species subject to protection within the framework of the protected areas, including the natural species types, typical species and environmental conditions.
- Reclamation, if needed, of the area and the natural condition of the priority natural habitats and habitats of species as well as of the population of species subject to protection within the framework of the protected area.

Kozloduy protected area **with code BG0000527**

Protected area is according to the Directive for habitats 92/43/EEC, [146], but it also involves a protected area according to the Bird Directive. Area of the protected zone is 25.38 ha and is located at 62 and 142 m altitude.
In class of earth covering, in percentages the territory is allocated as follows:

Classes Earth covering	% Covering
Shrubby communities	8
Dry grass communities, steppe	48
Extensive grain corps (including rotating corps and are periodically let lie fallow)	7
Artificial forest monoculture (e.g. plants of poplars or exotic trees)	37
	Total Covering 100%

Protected area BG0000527 Kozloduy is connected with protected territories BG0002009 Zlatiata under the Bird Directives.

General characteristic of the areas – Area is a steep loess wall between the town of Kozloduy and village of Gorni Tsibur. Ridge of the wall is occupied by the steppe plants involving some endemic species. Dominants are Stipa capillata, Artemisia campestris; endemics are Centaurea rumelica, Stachys arenariaeformis, Chamaecytisus supinus. On the divides there are a lot of forest cultures mostly of acacia. Site is one of the Bulgarian most important habitat 6250 Panonski loess steppe grass communities. It has a typical florist composition and involves a lot of endemic and relict steppe species, such as Centaurea rumelica, Stachys arenariaeformis. Region is strongly affected by the human activity. Steppe vegetation remains only on the highest parts of the loess forms. Region is surrounded by agricultural lands.
In the standard form of the area one habitat is specified as a protection object - 6250*Panonski loess steppe grass communities.

Community occupies 48% of the area territory and is of European importance. Habitat is of considerable representativeness. Relative area covered with the habitat compared with the total area of the national territory occupied by this habitat is between 0 and 2 %.

From the species, included in Appendix I of Dir of Dir.79/409/EEC and Appendix II of the Directive 92/43 EEC[146] vegetation species are missing and the animal species are specified: Romanian hamster /Mesocricetus newtoni/ and our-lined snake /Elaphe quatuorlineata/.

Group "Other important vegetation and animal species", which are related to the environmental protection and site management includes the following species.

Tax.group	**NAME (in English)** *NAME (in latin)*	**Local population**	**Motivation**
A	Green Toad *Bufo viridis*	P	C
P	Star thistle *Centaurea rumelica*	P	B
R	Large whip snake *Coluber caspius*	P	C
R	European Green Lizard *Lacerta viridis*	P	C
A	Common spadefood Toad *Pelobates fuscus*	P	C
R	Common Wall Lizard *Podarcis muralis*	P	C
R	Balkan Wall Lizard *Podarcis taurica*	P	C
P	Stachys Balcanica *Stachys arenariaeformis*	P	B
R	Long-nosed *Vipera ammodytes*	P	C

Where:

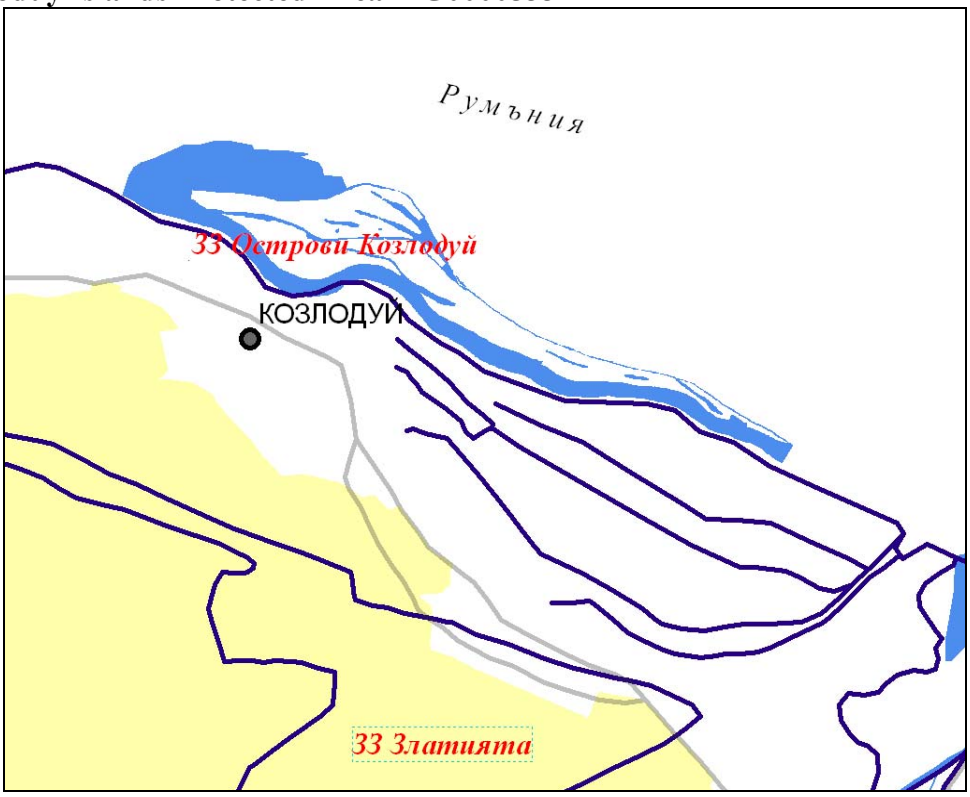
Tax. group – taxonomic group of the respective species is marked according to the following nomenclature: B – birds M – mammalian, A – amphibian; R – reptiles; F – fishes; I – invertebrates; P – plants.

Name – name of the species.

Local population– data about the typical maximal size and numbers of the population are specified. In the cases when there are no digital data available the size/density of the population is shown specifying whether the species are typical (C), rare (R) or extremely rare (V). When there are no data about the population it is marked as existing (P).

Motivation – motivation about inclusion of each species is indicated when using the following categories: A) National Red Book; B) endemic species; C) international conventions (incl. Bern, Bonn and Convention for biodiversity); D) other reasons.

Kozloduy Islands Protected Area BG0000533



Protected area is under the Directive for habitats 92/43/EEC[146],, but it also contains an area protected under the Birds Directive. The area of the protected territory is 605.67 ha. It is located within the range of 20 and 34m height. In class of earth covering, in percentages the territory is allocated as follows:

Classes Earth covering	% Covering
Coastal sand dunes, sandy beaches	9
- Water inland areas (not running and running waters)	33
- Swamps, marshlands, vegetation alongside the banks of water basins, bogs 4	4
Shrubby communities	12
Broad-leaved deciduous forests	7
Artificial forest monoculture (e.g. plants of poplars or exotic trees)	34
	Total 100%

Total characteristic of the area - Area includes three larger islands. About 70% of the Kozloduy Islands are covered by forest plants. West part of Svraka Island is covered with sandy alluvial. Site is of medium up to high conservation value .
Northern part of the Svraka Island and the foreland of the Kozloduy island are comparatively not affected by the human activity. Southern part of the Svraka Island and the tail of the Kozloduy Island are endangered by the invasion of introduced wood and shrubby species.

Site is of medium up to high conservation value. In the protected area the natural forests of Salix alba, Ulmus minor and Populus nigra are preserved.
In the standard form of the zone as a protected site the following habitats and species are included

NATURAL HABITATS:

91E0* Alluvial forests with Alnus glutinosa и Fraxinus excelsior (Alno-Pandion, Alnion incanae, Salicion albae)
Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-Padion, Alnion incanae, Salicion albae)

3130 Olithotrophic to mesotrophic standing waters with vegetation of Littorelletea uniflorae and/or Isoeto-Nanojuncetea
Oligotrophic to mesotrophic standing waters with vegetation of the Littorelletea uniflorae and/or of the Isoлto-Nanojuncetea

3270 Rivers with muddy banks with Chenopodion rubri and Bidention p.p.
Rivers with muddy banks with Chenopodion rubri p.p.and Bidention p.p. vegetation

91F0 Riparian mixed forest of Quercus robur, Ulmus laevis and Ulmus minor, Fraxinus excelsior or Fraxinus excelsior orFraxinus
angustifolia alongside big rivers (Ulmenion minoris)
Riparian mixed forest of Quercus robur, Ulmus laevis and Ulmus minor, Fraxinus excelsior or Fraxinus angustifolia along the great rivers (Ulmenion minoris)

* - Priority habitat or species under the Directive 92/43/EEC

In the table of separate habitats an assessment of the following indicators is shown:
Representativeness/provides indication how far a certain habitat is "typical" Following classification system is used: The following classification system is used: A-excellent representativeness; B-good representativeness; C- considerable representativeness; D- negligible existence;
Relative area /area of the site covered by a certain habitat compared with the total area of the national territory covered by this habitat/.. Intervals used in classes are as follows: A) 100 >= p >15%; B) 15 >= p > 2%; C) 2 >= p >0;
Equated extent /the extent of protection of structure and function of certain habitat and possibility for its restoration is assessed/. Following classification system is used:. The following classification system is used: A-excellent protection; B-good protection; C-average or weak protection
Total assessment of the site value for protection of a certain type of natural habitat/integrated assessment of the previous criteria considering their different weight for the examined habitat. The following classification system is used: A-excellent value; B-good value; C- important value.
Habitat 91 E0 - Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-Pandion, Alnion incanae, Salicion albae) is formed on rich, alluvial soils that are periodically flooded during the seasonable increase of the level of the Danube River. In the formed riverside, flooded forests mostly the species of Salix alba, Populus alba, Populus nigra and Salix fragilis dominate. Vegetation communities are involve in the union of Salicion albae. The communities involve also species of Ulmus laevis, Ulmus minor, Quercus robur, Rubus caesius, Clematis vitalba, Humulus lupulus, Vitis sylvestris, Solanum dilcamara, Euphorbia lucida, Lythrum salicaria, Phragmites australis, Typha latifolia, Leucojum astivum etc.
Habitat 91 F0 - Riverside mixed forests of Quercus robur, Ulmus laevi and Fraxinus excelsior or Fraxinus angustifolia alongside big rivers (Ulmenion minoris) is formed on newer periodically flooded alluvial depositions. Vegetation communities are

usually related to the association Scutellario altissimae-Quercetum roburis. Participation of the lians is relatively small comparing with the dense forests and the grass covering is of well-formed spring nature of Scilla bifolia, Anemone ranunculoides, Ranunculuc ficaria, Polygonatum ssp etc.

MAMMALIAN

European Otter
Lutra lutra

AMPHIBIAN AND REPTILES:

Fire-bellied toad
Bombina bombina
European pond turtle
Emys orbicularis
Danube crested Newt
Triturus dobrogicus

FISHES

Danube streber
Zingel streber
Alosa immaculata
Cyprinidae
Aspius aspius
Balkan loach
Cobitis elongata
Spinned loach
Cobitis taenia
Ukrainian brook lamprey
Eudontomyzon mariae
White-finned gudgeon
Gobio albipinnatus
Balon's ruffle
Gymnocephalus baloni
Stripped ruffle
Gymnocephalus schraetzer
Ziege
Pelecus cultratus
Fish linn
Rhodeus sericeus amarus
Linaeus
Zingel zingel

INVERTEBRATES:

Thick shelled river mussel
Unio crassus
Stag beetle
Lucanus cervus
* Rosalia longicom
Rosalia alpina

Other important vegetation and animal species related to the nature protection and site management.

Group “Other important vegetation and animal species”, which are related to the environmental protection and site management includes the following species.

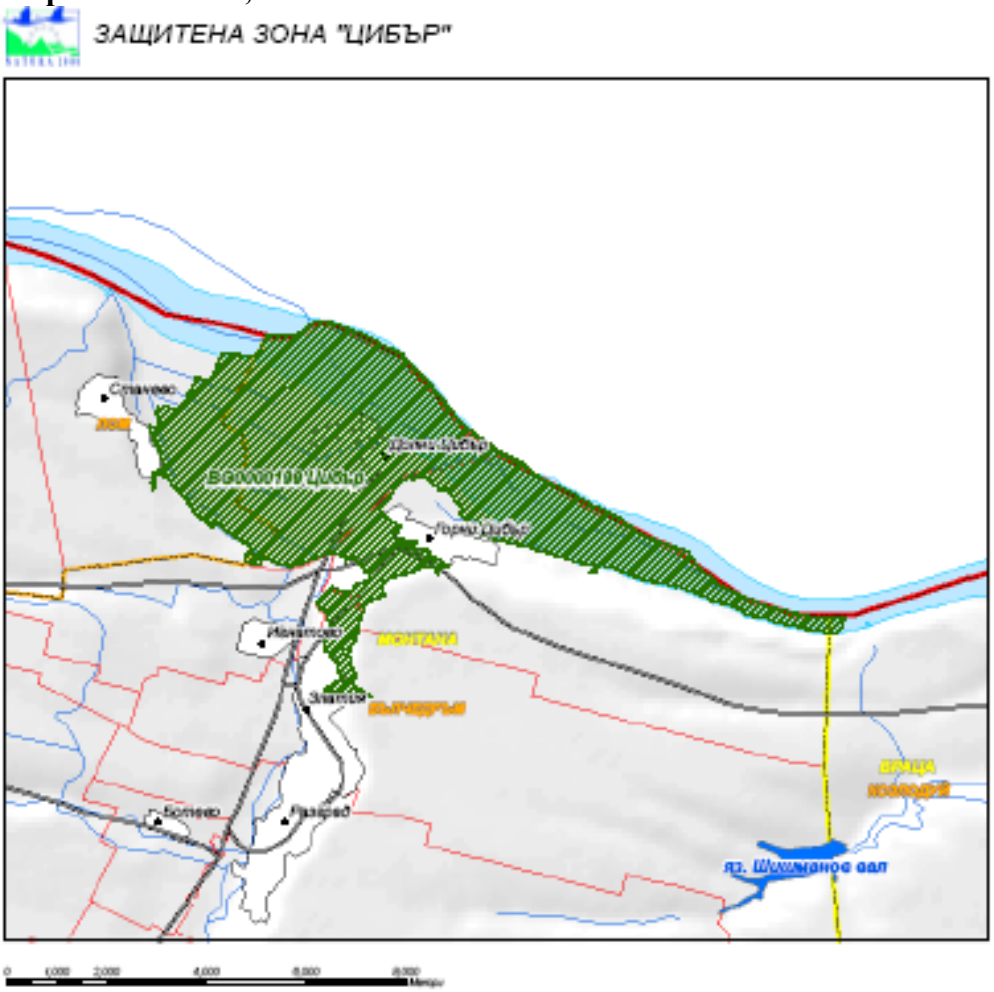
Tax. group	Name (in English) Name (in Latin)	Local population	Motivation
P	Shining spurge *Euphorbia lucida*	R	D
P	Summer snowflake *Leucojum aestivum*	R	D

Where:
Tax.group – taxonomic group of the respective species is marked according to the following nomenclature: P – plants
Name – name of the species.
Local population – specified data about the typical maximal number of the population, the number is described according to the explanatory notes in section 3.2.
Motivation – motivation about inclusion of each species is indicated when using the following categories: A) National Red Book; B) endemic species; C) international conventions (incl. Bern, Bonn and Convention for biodiversity); D) other reasons.

Tax.group	NAME (in Bulgarian *NAME(in Latin)*	Local population	Motivation
F	Russian sturgeon *Acipenser gueldenstaedti*	P	C
F	Russian Sterlet *Acipenser ruthenus*	P	C
F	Starry sturgeon *Acipenser stellatus*	P	C
F	Carp bream *Abramis brama*	C	D
F	Barbel *Barbus barbus*	C	D
F	Common carp *Cyprinus carpio*	C	A
P	Shining spurge *Euphorbia lucida*	R	D
F	Beluga Huso huso	P	C
P	Summer snowflake *Leucojum aestivum*	R	D
R	Dice snake *Natrix tessellata*	C	
F	Bulgarian golden loach *Sabanejewia bulgarica*	P	B
F	Sheatfish *Silurus glanis*	C	C
F	Volga-Zander *Stizostedion volgense*	R	A
F	Black stripped pipefish *Syngnathus abaster*	P	C

Where:
Tax.group – taxonomic group of the respective species is marked according to the following nomenclature: R – reptiles; F – fishes;; P – plants.
Name – name of the species.
Local population – there are data indicating the typical maximal size of the population, numbers are described according to the explanatory notes in section 3.2.
Motivation – motivation about inclusion of each species is indicated when using the following categories: A) National Red Book; B) endemic species; C) international conventions (incl. Bern, Bonn and Convention for biodiversity); D) other reasons.

Tsibur protected area, with code BG0000199



Protected area is under the Directive for habitats 92/43/EEC [146],, but it also contains an area protected under the Birds Directive. The area of the Protected territory is 2.97 ha. It is located within the range of 20 and 169m height. In class of earth covering, in percentages the territory is allocated as follows:

Classes Earth covering	% Covering
Salty marshlands, salty pastures, salty steppes	7
Water inland areas (not running and running waters)	25
Swamps, marshlands, vegetation alongside the banks of water basins, bogs	7
Shrubby communities	2
Dry grass communities, steppe	6
Extensive grain corps (including rotating corps and are periodically let lie fallow)	33
Broad-leaved deciduous forests	5
Artificial forest monoculture (e.g. plants of poplars or exotic trees)	13
Not forest regions, cultivated with wood vegetation (incl. fruit trees, , vineyard, wayside	2
	Total 100%

Protected area is related to the following sites of Nature 2000:
Object code Object name
BG0002007 Ibisha Island
BG0002008 Iland next to Gorni Tsibur
BG0002009 Zlatiata
BG0002104 Tsibur marshland
Protected area completely covers the **maintained Ibisha reserve.**
Total characteristic of the area - site is one of the richest of different habitat types alongside the Bulgarian bank of Danube. This is the former overflown low land of Danube, one big and several small new islands covered with overflown forests. There are specific sandy dunes, salty pastures and marshlands in the low land. Small loess steppes are survived on the highest Danube terrace next to the villages of Zlatia village A lot of ducks and gulls are concentrated on the sandy belts formed during the summer time. During the winter the some Pelicanus crispus (Bruch) stay there. There are also colonies of Sterna Hirundo (Common Tern) on the sandy belt. Site protects rare habitats for Bulgaria 2340, 6250, 1530. There is a big mixed colony of water-loving birds on the Ibisha Island.
In the standard form of the protected area the following types of habitats, protection sites are included:
3.1. HABITAT TYPES from Appendix I of the Directive 92/43/EEC[146]
CODE App. NAME
91E0* Alluvial forests with Alnus glutinosa и Fraxinus
excelsior (Alno-Pandion, Alnion incanae,
Salicion albae
)1530 * Panonski salty steppes and salty marshlands
2340 * panonski inland dunes
3130 Olithotrophic to mesothrophic standing waters with
vegetation of Littorelletea uniflorae and/or
Isoeto-Nanojuncetea
3150 Natural euthrophic lakes with vegetation of
Magnopotamion or Hydrocharition
3270 Rivers with muddy banks with Chenopodion rubri and
Bidention p.p
.6250 * Panonski loess steppe grass communities
2. SPECIES, included in Appendix I of Dir 79/409/EEC and Appendix II of Dir 92/43 EEC
2.a. BIRDS, included in Appendix I of Dir.79/409/EEC
CODE NAME (in English)
NAME (in Latin)
A097 Red-footed falcon
Falco vespertinus
A195 Little tern
Sterna albifrons
A234 Grey-headed Woodpecker
Picus canus
A238 Middle spotted woodpecker
Dendrocopos medius
A393 Pygmy cormorant
Phalacrocorax pygmeus
A439 Olive tree warbler
Hippolais olivetorum
A177 Little gull
Larus minutus
A193 Common Tern

Sterna hirundo
A429 Syrian woodpecker
Dendrocopos syriacus
A094 Osprey
Pandion haliaetus
A034 Eurasian spoonbill
Platalea leucorodia
A031 White stork
Ciconia ciconia
A020 Dalmatian pelican
Pelecanus crispus
A030 Black stork
Ciconia nigra
A026 Little egret
Egretta garzetta
A024 Squacco heron
Ardeola ralloides
A023 Black-crowned night Heron
Nycticorax nycticorax
A229 Common Kingfisher
Alcedo atthis
A176 Mediterranean gull
Larus melanocephalus

2.b. Regularly met migrating brds that are not included in annex. I of Directive
CODE NAME (in English)
NAME (in Latin)
A162 Common redshank
Tringa totanus
A161Spotted redshank
Tringa erythropus
A147 Curlew sandpiper
Calidris ferruginea
A145 Little stint
Calidris minuta
A142 Northern Lapwing
Vanellus vanellus
A136 Little Ringed Plover
Charadrius dubius
A230 European Bee-eater
Merops apiaster
A099 Eurasian Hobby
Falco subbuteo
A149 Dunlin
Calidris alpina
A054 Northern pintail
Anas acuta
A053 Mallard
Anas platyrhynchos
A052 Common teal
Anas crecca
A051 Gadwall
Anas strepera
A050 Eurasian Wigeon
Anas penelope
A048 Shelduck
Tadorna tadorna
A028 Grey Heron

Ardea cinerea
A017 Great Cormorant
Phalacrocorax carbo
A130 Eurasian Oystercatcher
Haematopus ostralegus
A359 Chaffinch
Fringilla coelebs
A249 Sand Martin
Riparia riparia
A146 Temminck's Stint
Calidris temminckii
A459 Yellow-legged Gull
Larus cachinnans
A363 Carduelis chloris
Carduelis chloris
A329 Blue Tit
Parus caeruleus
A311m The Blackcap
Sylvia atricapilla
A304 Subalpine Warbler
Sylvia cantillans
A283 Blackbird
Turdus merula
A271 Nightingale
Luscinia megarhynchos
A269 European Robin
Erithacus rubecula
A059 Common Pochard
Aythya ferina
White-winged Black Tern
Chlidonias leucopterus
A179 Black-headed Gull
Larus ridibundus
A165 Green Sandpiper
Tringa ochropus

2.c. MAMMILIANS, included in Appendix II of Directive 92/43/EEC

CODE NAME (in English)
NAME (in Latin) Popul. Reprod. Winter stay. Migration. Popul. Protection Insulation Entire colouring
1355 European Otter 5-6i CA CA
Lutra lutra
2609 Romanian hamster V CBCC
Mesocricetus newtoni
1335 Ground squirrel, V CBCC
Spermophilus citellus

2.d. AMPHIBIAN AND REPTILES, included in Appendix II of Directive 92/43/EEC [146]

CODE NAME (in English)
NAME (in Latin)
1188 Fire-bellied toad
Bombina bombina
1220 European pond turtle
Emys orbicularis
1217 Hermann's Tortorise
Testudo hermanni
1993 Danube crested Newt
Triturus dobrogicus
1160 Zingel streber

2.e. FISHES, included in Appendix II of Directive 92/43/EEC
CODE NAME (in English)
NAME (in Latin)
Danube streber
4125 Alosa immaculata
1130 Cyprinidae
Aspius aspius
1138 Mediterranean barbel
Barbus meridionalis
2533 Balkan loach
Cobitis elongata
1149 Spinned loach
Cobitis taenia
2484 Ukrainian brook lamprey
Eudontomyzon mariae
1124 White-finned gudgeon
Gobio albipinnatus
2555 Balon's ruffle
Gymnocephalus baloni
1157 Stripped ruffle
Gymnocephalus schraetzer
2522 Ziege
Pelecus cultratus
1134 Fish linn
Rhodeus sericeus amarus
1146 Golden Spined Loach
Sabanejewia aurata
1159 Linaeus
Zingel zingel

2.f. INVERTEBRATES, included in Appendix II of Directive 92/43/EEC [146]
CODE NAME (in English)
NAME (in Latin)
1032 Thick shelled river mussel
Unio crassus
1083 Stag beetle
Lucanus cervus
1087 Rosalia longicom
Rosalia alpina

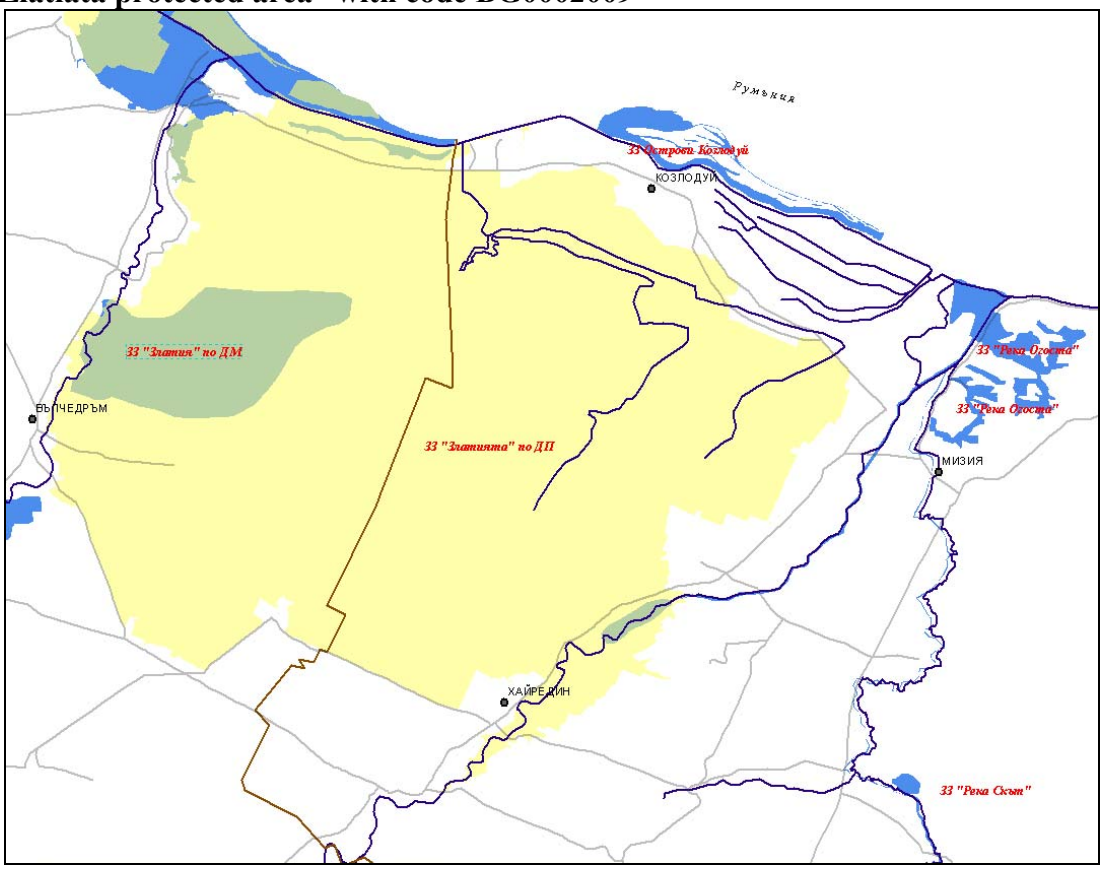
3 Other important vegetation and animal species

Tax.group	NA\ME (in Bulgarian a NAME in Latin)	*Local population*	Motivation
F	Russian sturgeon Acipenser gueldenstaedti	P	C
F	Russian Sterlet Acipenser ruthenus	P	C
F	Starry sturgeon Acipenser stellatus	P	C
B	Greet Reed Warbler Acrocephalus arundinaceus	P	A
B	Marsh warbler Acrocephalus pallustris	P	A
B	Sedge Warbler Acrocephalus schoenobaenus	P	A
B	Eurasian Reed Warbler Acrocephalus scirpaceus	P	A
B	Goshawk Accipiter gentilis	P	A

P Boraginaceae RA
Alkanna tinctoria
B Long-Eared Owl P A
Asio otus
P Astragal Pontyiski RA
Astragalus ponticus
A Green Toad P A
Bufo viridis
B Gold finch P A
Carduelis carduelis
B Eurasian siskin P A
Carduelis spinus
P KnapweedRA
Centaurea arenaria
P Star thistleP B
Centaurea rumelica
F Common Nase P D
Chondrostoma nasus
F Common Nase P D
Chondrostoma nasus
B Hawfinch P A
Coccothraustes coccothraustes
R Large whip snake P A
Coluber caspius
European Hamster P A
Cricetus cricetus
M Bicolored Shrew CC
Crocidura leucodon
M Lesser white Toothed ShrewCC
Crocidura suaveolens
B Common Cuckoo CA
Cuculus canorus
F Common carpCA
Cyprinus carpio
B Great Spotted Woodpecker P A
Dendrocopos major
B Lesser Spotted Woodpecker P A
Dendrocopos minor
B Rock Bunting P A
Emberiza cia
M Southern white-breasted hedgehog P A
Erinaceus concolor
M European wildcat P A
Felis silvestris
F BelugaP C
Huso huso
A European Green Treefrog CA
Hyla arborea
R European Green Lizard CC
Lacerta viridis
P Lemnaceae A
Lemna gibba
P Summer snowfalke A
Leucojum aestivum
B Savi's Warbler P A
Locustella luscinioides
B Thrush Nightingale P A

Luscinia luscinia
BWhite Wagtail CA
Motacilla alba
BYellow wagtail CA
Motacilla flava M P A
Mustela eversmanni
M Weasel CA
Mustela nivalis
M Lesser Mole Rat P C
Nannospalax leucodon
RDice snake CC
Natrix tessellata
M Mediterranean water shrew CC
Neomys anomalus
BGolden oriole P A
Oriolus oriolus
BGreat tit P A
Parus major
A Common spadefood Toad P A
Pelobates fuscus
A Eastern Spadefoot Toad CC
Pelobates syriacus
BWestern Bonelli's warbler P A
Phylloscopus bonelli
BChiffchaff P A
Phylloscopus collybita
BWood Warbler P A
Phylloscopus sibilatrix
BWillow warbler P A
Phylloscopus trochilus
RBalkan Wall LizardCC
Podarcis taurica
BDunnock P A
Prunella modularis
A Agile Frog RC
Rana dalmatina
P Floating Watermoss RC
Salvinia natans
F Sheatfish P C
Silurus glanis
BNuthath P A
Sitta europaea
P Lamb's ear B
Stachys arenariaeformis
F Volga-Zander P C
Stizostedion volgense
BGarden Warbler P A
Sylvia borin
BWhitethroat P A
Sylvia communis
BLesser Whitethroat P A
Sylvia curruca
BWinter Wren P A
Troglodytes troglodytes
RLong-nosed P C
Vipera ammodytes 29,717.30

Zlatiata protected area" with code BG0002009



Protected area BG0002009 Zlatiata under the Bird directive covers area of 434944.40 dca. In class of earth covering, in percentages the territory is allocated in the following groups:

Classes Earth covering	% Covering
Water inland areas (not running and running waters)	1
Shrubby communities	0
Dry grass communities, steppe	4
Extensive grain corps (including rotating corps and are periodically let lie fallow)	90
Other plough land	0
Broad-leaved deciduous forests	1
Not forest regions, cultivated with wood vegetation (incl. fruit trees, , vineyard, wayside	1
Rocks within the island, taluses, sands, permanent snow and glaciers	0
Other lands (including towns, villages, roads, dumping-ground, mines, industrial sites)	3
	Total 100%

Area is related to the following other sites of Nature 2000

Object code	*Name of the object*	*Object type*
BG0000614	Ogosta River	K
BG0000199	Tsibur	K
BG0000527	Kozloduy	G
BG0000336	Zlatiata	K

General characteristics. Protected Area BG BG0002009 Zlatiata is located in the North-West Bulgaria, in the Danube valley between the Danube River and the town of Kozloduy to the North, road connecting the town of Vulchedrum and Hayredin to the South and flows of the rivers Tsibritsa and Ogosta from the West and East. It is located on tableland-like leveled land with outdoor grass areas of steppe type and agricultural areas. At some places there are earth loess walls and low trees and bushes, mainly of Common Hawthorn /Crataegus monogyna/, dog rose /Rosa canina/ and etc.On the ground walls there are plenty of Begonia Altissima /Ailantis altissima/. On the territory of the Zlatia Shishmanov val Dam is located. Also, there are spread pastures, fruit gardens, vineyards, field protection belts and small forests of broad-leaved trees as well as river-side forests alongside the Ogosta River.
There are 122 bird species determined, of which 28 are entered into the Red book of Bulgaria and 53 types are of European environmental Protection Importance (SPEC) (Bird Life International, 2004). As worldwide endangered ones category SPEC1 include 5 types and as endangered in Europe category SPEC2 includes – 15 and category SPEC3 – 36 species. The place is one of the most important in the country, which are also important for the European Union related mainly to the open yard areas – White Stork /Ciconia ciconia/, Marsh Harrier /Circus aeruginosus/, Montagu's Harrier /Circus pygargus/, Levant Sparrowhawk /Accipiter brevipes/, Red-Footed Falcon /Falco vespertinus/, Twany Pipit /Anthus campestris/, Greater Short-toed Lark /Calandrella brachydactyla/, Ortolan Bunting /Emberiza hortulana/ etc.In Zlatiata there are considerable nesting populations of bee-eater /Merops apiaster/, Skylark /Alauda arvensis/ Common Quail /Coturnix coturnix/. This is the only place in Bulgaria where the Great Bustard /Otis tarda/ could be seen. During the winter in Zlatiata there is another endangered species that could be seen – Lesser white-fronted goose /Anser erythropus/, which uses the fields for feeding together with the flocks of Great white-fronted goose /Anser albifrons/.
Zlatiata is the biggest compacted not populated plain territory in the country. It is affected by the human activities that are mainly related to the agriculture, forest management and development of the infrastructure. Intensification of the agriculture, use of pesticides and fertilizers, removal of green fences and bushes are the activities having the most serious negative quality on the habitats. Cutting of the river-side forests and trees lead to fast and sharp reduction of the population of the red-footed falcon, because of the elimination of nesting places.
In 1977 a small territory is nominated by the BirdLife International as Ornithological Important Place. In 2005 the entire territory of Zlatiata is nominated as Ornithological important place.

Subject to protection in Protected Areas BG 0002009 are the following bird groups:
BIRDS, included in Appendix I of Dir.79/409/EEC
CODE NAME (in English)
NAME (in Latin)

A402 Levant sparrowhawk
Accipiter brevipes
A229 Common Kingfisher
Alcedo atthis
A231 European Roller
Coracias garrulus
A234 Grey-headed Woodpecker
Picus canus
A224 European Nightjar
Caprimulgus europaeus
A242 Calandra Lark
Melanocorypha calandra
A429 Syrian woodpecker
Dendrocopos syriacus
A243 Greater Short-toed Lark
Calandrella brachydactyla
A246 Woodlark
Lullula arborea
A255 Tawny Pipit
Anthus campestris
A307 Barred Warbler
Sylvia nisoria
A338 Red-backed shrike
Lanius collurio
A379 Ortolan Bunting
Emberiza hortulana
A081 Marsh harrier
Circus aeruginosus
A403 Long-legged buzzard
Buteo rufinus
A129 Great Bustards
Otis tarda
A339 Lesser Grey Shrike
Lanius minor
A031 White stork
Ciconia ciconia
A083 Pallid Harrier
Circus macrourus
A022 Little Bittern
Ixobrychus minutus
A127 Common Crane
Grus grus
A029 Purple Heron
Ardea purpurea
A021 Bittern
Botaurus stellaris
A072 Honey Buzzard
Pernis apivorus
A073 Black Kite
Milvus migrans
A080 Short-toed Eagle
Circaetus gallicus
A082 Hen Harrier
Circus cyaneus
A084 Montagu's Harrier
Circus pygargus
A089 Lesser Spotted Eagle

Aquila pomarina
A097 Red-footed falcon
Falco vespertinus
A098 Merlin
Falco columbarius
A103 Peregrine Falcon
Falco peregrinus
A026 Little egret
Egretta garzetta
Regularly met migrating brds that are not included in annex. I of Directive 79/409/EEC
CODE NAME (in English)
NAME (in Latin)
A087 Common Buzzard
Buteo buteo
A096 Common Kestrel
Falco tinnunculus
A142 Northern Lapwing
Vanellus vanellus
A118 Water rail
Rallus aquaticus
A005 Great crested grebe
Podiceps cristatus
A008 Black-necked Grebe
Podiceps nigricollis
A017 Great Cormorant
Phalacrocorax carbo
A123 Common Moorhen
Gallinula chloropus
A004 Little Grebe
Tachybaptus ruficollis
A136 Little Ringed Plover
Charadrius dubius
A028 Grey Heron
Ardea cinerea
A055 Garganey
Anas querquedula
A053 Mallard
Anas platyrhynchos
A086 Eurasian Sparrowhawk
Accipiter nisus
A249 Sand Martin
Riparia riparia
A230 European Bee-eater
Merops apiaster
A099 Eurasian Hobby
Falco subbuteo
A125 Eurasian Coot
Fulica atra
Other important vegetation and animal species
Tax.group NA\ME (in Bulgarian *Local population* Motivation
a NAME in Latin)
BField-lark 47870p C
Alauda arvensis
BLittle Owl 10p C
Athene noctua
BCarduelis chloris 220p C
Carduelis chloris

BJackdaw 320p D
Corvus monedula
BCommon Quail 900p
Coturnix coturnix
BCirl Bunting5p C
Emberiza cirlus
BBlack-headed Bunting 95p C
Emberiza melanocephala
BEuropean Robin 55p C
Erithacus rubecula
BChaffinch 193p C
Fringilla coelebs
BCrested Lark 220p C
Galerida cristata
BBarn Swallow850p C
Hirundo rustica
BWryneck 70p C
Jynx torquilla
BNightingale 1500p C
Luscinia megarhynchos
BCorn bunting 1750p C
Miliaria calandra
BCommon Scops Owl 15p C
Otus scops
BBlue Tit 18p C
Parus caeruleus
BGreen Woodpecker34p C
Picus viridis
BAfrican Stonechat 15p C
Saxicola torquata
BTurtle dove 183p C
Streptopelia turtur
BThe Blackcap 650p C
Sylvia atricapilla
BBlackbird 320p C
Turdus merula
BSong Thrush 155p C
Turdus philomelos

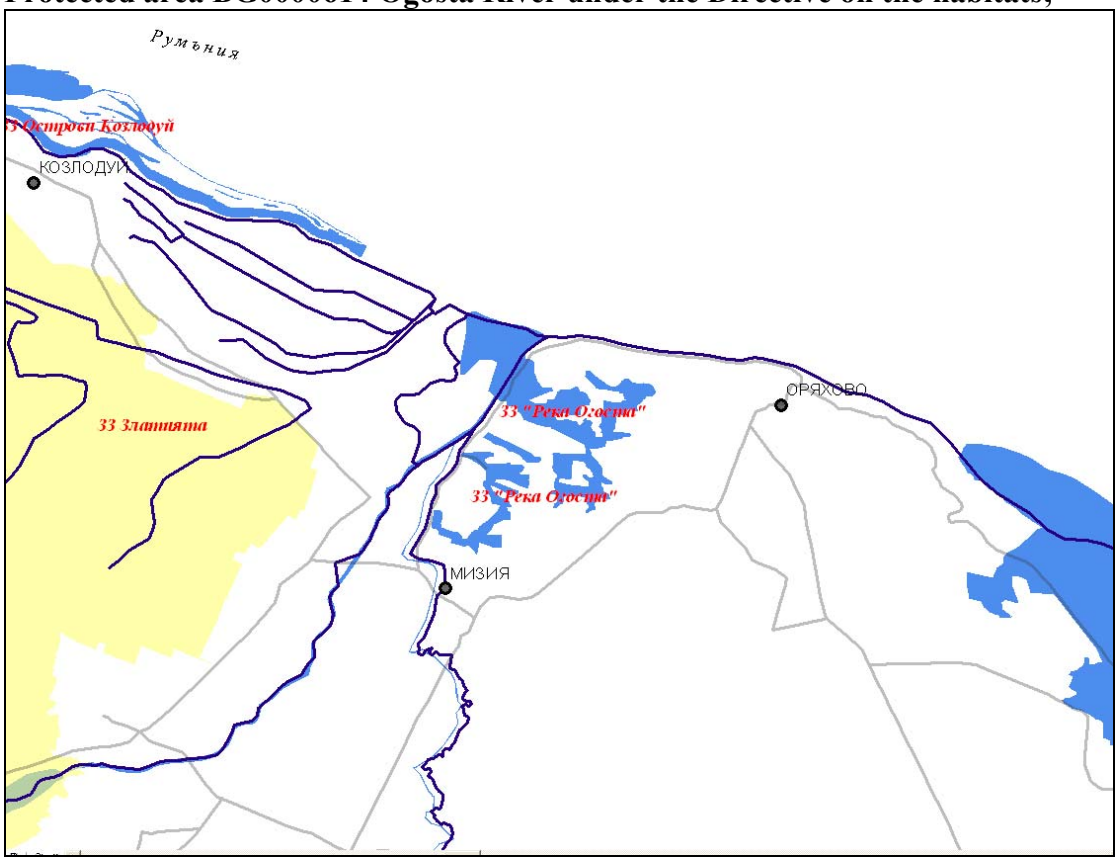
Species, included in Appendix 2 of the Low for biodiversity (Appendix I of Directive 79/409/EEC)
Levant sparrowhawk Accipiter brevipes
Common Kingfisher Alcedo atthis
European Roller Coracias garrulus
Grey-headed Woodpecker Picus canus
European Nightjar Caprimulgus europaeus
Calandra LarkMelanocorypha calandra
Syrian Woodpecker Dendrocopos syriacus
Greater Short-toed Lark Calandrella brachydactyla
Woodlark Lullula arborea
Tawny Pipit Anthus campestris
Barred Warbler Sylvia nisoria
Red-backed shrike Lanius collurio
Ortolan Bunting Emberiza hortulana
Marsh harrier Circus aeruginosus
Long-legged Buzzard Buteo rufinus
Great Bustards Otis tarda
Lesser Grey Shrike Lanius minor
White stork Ciconia ciconia

Pallid Harrier Circus macrourus
Little Bittern Ixobrychus minutus
Common Crane Grus grus
Purple Heron Ardea purpurea
Eurasian Bittern Botaurus stellaris
Honey Buzzard Pernis apivorus
Black Kite Milvus migrans
Short-toed Eagle Circaetus gallicus
Hen Harrier Circus cyaneus
Montagu's Harrier Circus pygargus
Lesser Spotted Eagle Aquila pomarina
Red-footed Falcon Falco vespertinus
Merlin Falco columbarius
Peregrine Falcon Falco peregrinus
Little Egret Egretta garzetta

Regularly met migrating brds that are not included in Appendix 2 of the Law for biodiversity (Appendix I of Directive 79/409/EEC)

Common Buzzard Buteo buteo
Common Kestrel Falco tinnunculus
Northern Lapwing Vanellus vanellus
Water rail Rallus aquaticus
Great crested grebe Podiceps cristatus
Black-necked Grebe Podiceps nigricollis
Great Cormorant Phalacrocorax carbo
Common Moorhen Gallinula chloropus
Little Grebe Tachybaptus ruficollis
Little Ringed Plover Charadrius dubius
Grey Heron Ardea cinerea
Garganey Anas querquedula
Mallard Anas platyrhynchos
Eurasian Sparrowhawk Accipiter nisus
Sand Martin Riparia riparia
European Bee-eaterMerops apiaster
Eurasian Hobby Falco subbuteo
Eurasian CootFulica atra

Protected area BG0000614 Ogosta River under the Directive on the habitats;



Protected area "Ogosta River" BG0000614 is of K type under the Directive 92/43/EEC for protection of the natural habitats and wild flora and fauna. Total area of the Protected zone is 12,532.40 dca. It is located within the range of altitude between 19 and 183 and is connected with other protected areas under Natura 2000

Object code	Name of the object	Object type
BG0000508	Skut river	E
BG0002009	Zlatiata	J

Protected area BG0000614 is connected with one protected territory:

Name	Category	T %
Daneva mogila	Protected area*	0.02

The protected area is included in the river valley of Ogosta River The banks of the Ogosta River are supported, the bottom has a lot of deposits and the water is euthrophic, which is a result of the dam next to Montana. The accumulation and the euthrophic water are reason for formation of habitats 3260 and 3270, кwhich are of European importance. Next to Kriva bara there is an old river bed remained, which is 5km and is turned into euthrophic lake with mactophites. On the right bank of Ogosta River the protected area Daneva mogila is located established with Order 413 from 10 May 1982. It is a place with beautiful landscape and a group of old threes Quercus robur. Next to the Ogosta mouth "Blatoto" area is located (3150). The last 4-5 km (3260) of the river flow are overgrown with aquatic vegetation (3260) and have plenty of fish. On the slopes of the bog to the West from Oryahovo town there is Panonnian loess steppe vegetation* (3260) with variety of the flora and founa.

In class of earth covering, the territory or the protected area is allocated in the following groups:

Classes Earth covering	% Covering
Water inland areas (not running and running waters)	3
Swamps, marshlands, vegetation alongside the banks of water basins, bogs	7
Dry grass communities, steppe	2
Extensive grain corps (including corps and are periodically let lie fallow)	20
Improved pastures (artificially created grass areas)	56
Broad-leaved deciduous forests	2
Artificial forest monoculture (e.g. plants of poplars or exotic trees)	10
	Total 100%

In the standard form of the zone as a protected site the following habitats and vegetation species are included

HABITAT TYPES from Appendix I of the Directive 92/43/EEC

91E0 * Alluvial forests with Alnus glutinosa и Fraxinus excelsior (Alno-Pandion, Alnion incanae, Salicion albae)
3150 Natural euthrophic lakes with vegetation of Magnopotamion or Hydrocharition type
3260 Valleys or mountain rivers with vegetation of Ranunculion fluitantis and Callitricho-Batrachion
3270 Rivers with muddy banks with Chenopodion rubri and Bidention p.p.
6250 * Panonski loess steppe grass communities
91Z0 Mizia forests of small-leaf lime-tree

Habitat 91 E0 - Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-Pandion, Alnion incanae, Salicion albae) is formed on rich, alluvial soils that are periodically flooded during the seasonable increase of the level of the Danube River. The habitat in this area is assessed as having „excellent representativeness“, and under the relative area it is involved in class C) 2 >= p >0; the equated degree provides "excellent protection“ and complete assessment of the site regarding its protection is "excellent value".

Jabitate 3150 – In the natural euthrophic lakes with vegetation of Magnopotamion or Hydrocharition various hydrophobic communities are formed from free floating plants and rooted to the bottom plants with floating leaves and submerged macrophites of Potamonion union. The habitat in this area is assessed as having „excellent representativeness“, and under the relative area it is involved in class C) 2 >= p >0; the equated degree provides "excellent protection“ and complete assessment of the site regarding its protection is "excellent value".

Habitat 3260 - Valley or mountain rivers with vegetation Ranunculion fluitantis and Callitricho-Batrachion in this area is presented by river sections in the lower stream with attached aquatic plants. The bottom is silty-cleye and silty-sandy The habitat in

this area is assessed as having „excellent representativeness“, and under the relative area it is involved in class C) 2 >= p >0; the equated degree provides "excellent protection“and complete assessment of the site regarding its protection is "excellent value".
Habitat 3270 Rivers with muddy banks with Chenopodion rubri and Bidention p.p. This habitat is formed flow of the Ogosta River and Danube River along the riversides where annual nitrophilous and ruderal communities. The habitat in this area is assessed as having „excellent representativeness“, and under the relative area it is involved in class C) 2 >= p >0; the equated degree provides "excellent protection“ and complete assessment of the site regarding its protection is "excellent value".
Habitat 6250 - Panonski loess steppe grass communities dominated by wheat grasses. Depending on the soil thickness compacted hassock steppes are formed with prevailing Chrysopogon gryllus, Dichantium ischaemum и and open communities with prevailing Stipa capilata, Agropyron cristatum, Artemisia campestris. The habitat in this area is assessed as having „excellent representativeness“, and under the relative area it is involved in class C) 2 >= p >0; the equated degree provides "excellent protection“ and complete assessment of the site regarding its protection is "excellent value".
Habitat 91Z0 - Mizia forests of Tilia tomentosa (Silver Lime). Formed vegetation communities are xerophyte and mesoxerophyte including both xerophyte species of Quercetalia and mesophyte species of Fagetalia. In this area the habitat is assessed with "minor representativeness" and regarding the relative area it is included in class C) 2 >= p >0.

Group “Other important vegetation and animal species”, which are related to the environmental protection and site management includes the following vegetation species.

Tax. group Name (in English) Local population Motivation
a NAME (in Latin)
P Stachys Balcanica P A
Stachys arenariaeformis
P Wolffia arrhiza P A
Wolffia arrhiza

Animal species- subject to protection
Invertebrates (Invertebrata)

Molluscs/Musses, Snails– Mollusca/Bivalvia, Gastropoda Thick shelled river mussel – *Unio crassus* Rare species according to the form, but in very good natural protected condition. The biggest part of Ogosta River is very silty and this environment is not sutable as a habitat of this river mussel. During our visits to the protected area this specie has been never folund. Only in the mouth area of the river some shells have been found many times. On the Ogosta River bank we have found some shells of marsh mussels, which are indicative for the life conditions in this sector. Stripped theodoxus. – *Theodoxus transvrsalis* This is very rare species. In the Ogosta River it was found only in its lower river. Preferred bottoms are with big rock parts. In the Danube River its density is relatively high. The reduction of its density as per the experts is caused by chemical and organic pollution. It is considered mussel species in the Danube River are additional competitive factor, which impacts

negatively its density.

Insects/Diabrotica spp

Stag beetle – *Lucanus cervus* This is rare type according to the form. During our one-year investigations the specie was found as available very often, especially in the areas, where the carrion wood plants have not been removed. Rosalia longicom – *Rosalia alpine.* According to the fomr this type is rare, but there are no data about its present condition. Durin our lcontinuous field surveys in the region the specie has not been found. Long-horned beetle - *Morimus funereus.* It is very rare type for the region as a whole. It has been detected as a specie due to some single specimens in the region of Sofronievo village *Bolbelasmus unicornis.* This type could be hardly found. All habitats on the Danube valley are rarely registered. The type depends on carrion wooden substances. The larvae eat mushroom mycelium, which destroy dead and carrion stubs. **Vertebrates, (***Vertebrata*) Agnatha/Cyclostomata. Ukrainian brook lamprey - *Eudontomyzon mariae.* According to the form data it is very rare species and there is no data about its condition.

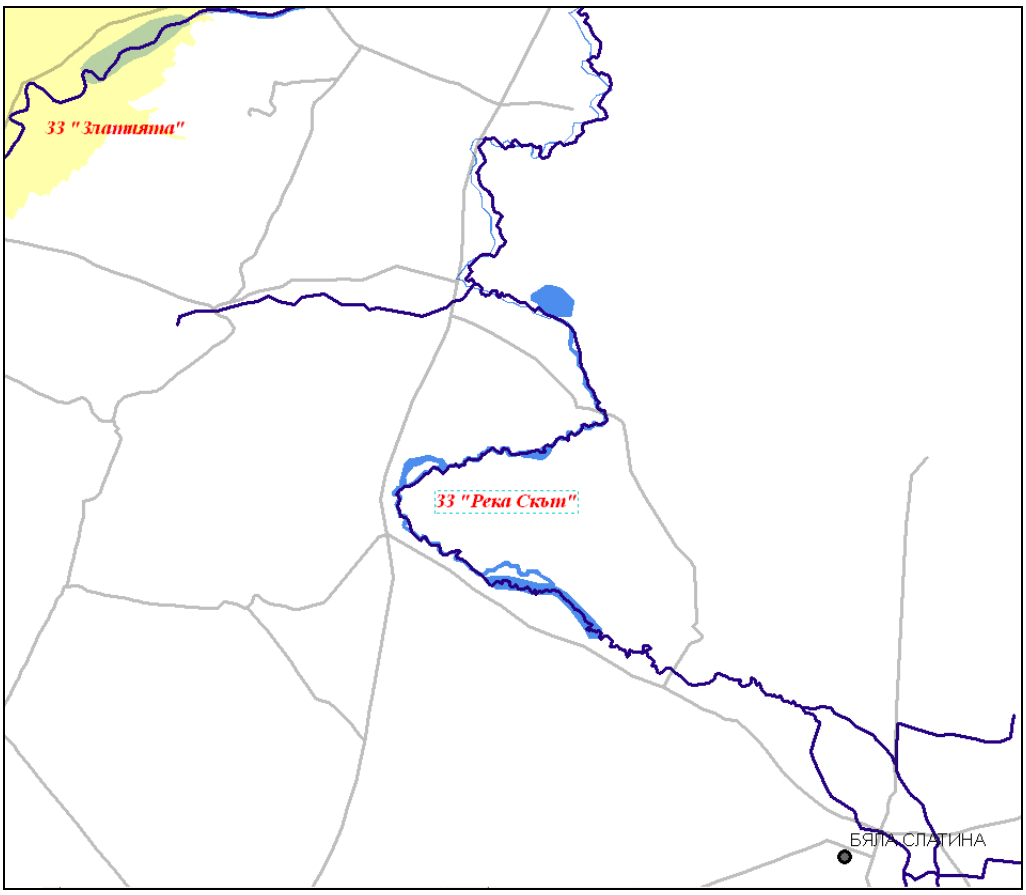
Pisces/Osteichthyes. - *Alosa immaculata* This specie does not enter tributaries. The reproduction occurs onlly in the middle flow of the Danube River with high water column. Cyprinidae - *Aspius aspius* this specie is rare for Ogosta. Oftenly, it is detected in the mouth and during the reproduction migrations. Mediterranean barbel – *Barbus meridionalis.* The number of species is strongly decreased after the construction of Ogosta dam It is considered that the dam is a serious barrier for the reproduction of this specie so under the dam wall it became a rare species. White-finned gudgeon - *Gobio albipinnatus.* Rare species and it is assumed that the dam barrier impacts it negatively. More often it could be found next to the mouth. Ziege - *Pelecus cultratus.* It could be found only next to the river mouth. Fish linn - *Rhodeus sericeus amarus.* Its number is reduced very much due to the fouling of the river bottom and strong parodentium. The next three species are ground species preferring the sandy bottoms. All three species are found relatively often. Balkan loach - *Cobitis elongata* Spinned loach - *Cobitis taenia*Виюн - *Misgurnus fossilis* The four species below are typical for the Danube River and probably they have entered the Ogosta River occasionally. Balon's ruffle - *Gymnocephalus baloni* Striped Ruffe - *Gymnocephalus scraetzer. Stripped ruffle* - *Zingel zingel*Danube streber - *Zingel streber*

Amphibian - *Amphibia* Danube newt – Triturus dobrogicusGreat crested newt– *Triturus karelinii* .Both species are competitive and that is why they could hardly found in one and the same habitats. Great crested newt is typical for not flowing water sources and for water sources with low running and the Danube newlt is accomodated for running waters. The data in the form have no specifications. Fire-bellied toad – *Bombina bombina* Yellow-bellied toad– *Bombina variegate.* Both species could be found in different habitats. Fire-bellied toad is typical for the Danube River and the Yellow-bellied toad is a specie, which could be rarely found mostly in pre-mountain and mountain areas.

Reptiles – *Reptilia*Hermann's Tortorise – *Testudo hermanni.* This specie is rarely found in the region, but single individuals, including eyas are continuously found. European pond turtle – *Emys orbicularis.* It is typical inhabitant of the area with relative high and constant density. The data from the form show stable and excellent natural protected condition. four-lined snake – *Elaphe quatuorlineata* The spotted snake is considered In the scientific literature there are no data about the specie, but in view of the requirements of this specie the region is very siutable.

Mamals – *Mammalia* Ground squirrel - *Spermophilus citellus* Romanian hamster - *Mesocricetus newtoni* .These two species live in similar and very often in one and the same habitats.. The columns of the Romanian hamster are rare and it is difficult to found them, they are located mostly in wheatfields, medics or next to agricultural crops, which they use for feeding. The specie is slightly investigated on the territory of Bulgaria and all data about the distribution are occasional or pellets of birds of prey. Some individuals or traces of the specie have been found next to Hayredin village and Mihaylovo village. European Otter – *Lutra lutra.* The specie is typical. Faeces and traces may be found approximately along the entire riverside involved in the protected areas. As per the form data the region is inhabited by 2-3 individuals and there are no data about counting.

Protected area BG0000508 Skat River under the Directive of habitats.



Protected area BG0000508 “Skut is of E type under the Directive 92/43/EEC for protection of the natural habitats and wild flora and fauna. Total area of the protected zone is 4,085.90decares. It is located within the range of altitude between 24 and 141 m. The protected area is connected only with one other protected territory under Natura 2000

Skut river is right tributary of Ogosta River Between the villages of Turnava and Altimir alongside the river valley there is comparatively wide belt of *Salix alba, Populus nigra, Populus alba, Quercus robur* и *Fraxinus oxycarpa* (91E0). 2 km Northern from Altimir cthere is dense forest of *Fraxinus oxycarpa* (91F0) with high conservation activity. A part of the Altimir region is one of a few remained habitats of *Gobio anoscopus.* The area is important for protection of salty meadow, small remained flooded forest and some steppe communities with rare endemic type of Star thistle *(Centaurea rumelica).*

Protected area BG0000508 “Skut is of E type under the Directive 92/43/EEC for protection of the natural habitats and wild flora and fauna. Total area of the Protected zone is 4,085.90decares. It is located within the range of altitude between 24 and 141 m. The protected area is related only to one of the other protected territories 2000.

In class of earth covering, the territory or the protected area is allocated in the following groups:

Classes Earth covering % Covering

Water inland areas (not running and running waters)3

Shrubby communities 3
Dry grass communities, steppe 18
Extensive grain corps (including rotating corps and are periodically let lie fallow) 36
Improved pastures (artificially established grass mixtures) 28
Broad-leaved deciduous forests 12
Total Covering 100

In the standard form of the zone as a protected site the following habitats and species are included

HABITAT TYPES from Appendix I of the Directive 92/43/EEC

code Пр. NAME% Covering Repres.. Relative area Natural statute Integrity. .

91E0 Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-Pandion, Alnion incanae, Salicion albae) 2.205 A C A A*
*1530 * Panonski salty steppes and salty marshlands 0.03 B C B B*
3260 Valley or mountain rivers with vegetation from Ranunculion fluitantis and Callitricho-Batrachion 0.06 D C
3270 Rivers with muddy banks with Chenopodion rubri and Bidention p.p. 0.03 D C
*6250 * Panonski loess steppe grass communities 0.397 A C A A*
91F0 Riverside mixed forests of Quercus robur, Ulmus laevis u Fraxinus excelsior или Fraxinus angustifolia alongside big rivers (Ulmenion minoris) 9 A C A A

Group "Other important vegetation and animal species", which are related to the environmental protection and site management includes the following vegetation species.

Tax. group Name (in English) Local population Motivation a Name in Latin)
P Star thistle Centaurea rumelica P B
P Lemnaceae Lemna gibba P A

Animal species- subject to protection

Invertebrates *(Invertebrata)*Mollouscan/Mussels, Snails – Mollusca/Bivalvia, Gastropoda.Thick shelled river mussel– *Unio crassus*. Rare species due to residential and organic pollution of the river and processes of eurotrofication. Many of the sewage channels in the populaed areas through which the river flows are directly connected. Insects/ Stag beetle– *Lucanus cervus*. Rosalia longicom– *Rosalia alpina*. Both species are rare and not typical due to the lack of suitable habitats in the region.

Vertebrates *(Vertebrata)*.Челюстноусти/Костни риби - Pisces/Osteichthyes.Mediterranean barbel – *Barbus meridionalis* .It could be found in a small sector of the area. The pollution of the river is the reason for its strong decrease. Danube Gudgeon*Gobio uranoscopus* . The species is detected in a small and short sector of the rover and in the rest part it is disappeared due to changes of the environmental conditions. Fish linn - *Rhodeus sericeus amarus*.Spinned loach - *Cobitis taenia.*

Amphibian – *Amphibia*. Danube newt – *Triturus dobrogicus*.Fire-bellied toad – *Bombina bombina.*Both species are relatively rare and in the form there is no information about the condition of their populations.

Reptiles – *Reptilia.*Hermann's Tortorise – *Testudo hermanni* .Very rare and endangered species in the area.. Single individuals may be found. According to the form the environmentally protected condition of the species is excellent. Usually .European Pond Turtle – *Emys orbicularis* .Very frequently met species in the spills of the river and its separate sections. The condition is assessed as excellent. Four-lined snake – *Elaphe quatuorlineata.* Four-lined snake is considered. The assessment is that it's very rare species. The only information about the species is one snake found in a pool of the river next to the village of Lipnitsa in 2006.

Mamals – *Mammalia.*long-fingered bat - *Myotis capaccinii.*No concrete data about the species.Dobrudja hamster- *Mesocricetus newtoni.* The type is not proven for the region on the scientific point of view, but it is quite probable due to the vicinity of the habitats, where it has been proven. It is possible the region to be occupied by the Romanian hamster. European Otter – *Lutra lutra* .The small flow rate of the river and its strong freezing do not provide good life conditions, due to which the density of this species is quite high. .

3.7.2 Protected areas under Nature 2000 in the region of 30 km im Kozloduy NPP on the Romanian territory.

According the formally submitted data from the Romanian side for the purposes of the EIA-R, three protected areas on the Romanian territory are included in the 30-km area surrounding Kozloduy NPP. The Protected Area ROSCI0045 is under the Habitat Directive and Protected Areas ROSPA0010 и ROSPA0023 are under the Bird Directive

Their location in Kozloduy NPP is presented on fig. **3.7.2-1**.

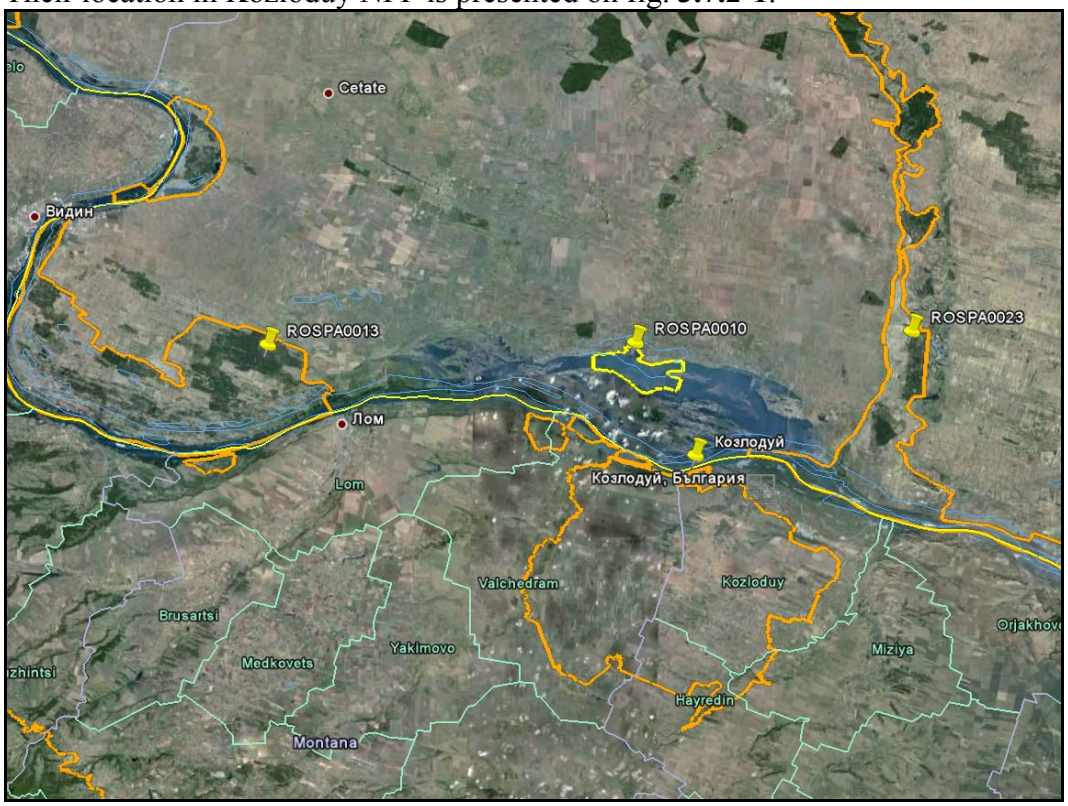


Fig. 3.7.2-1 Protected areas under the Bird Directive on the left bank of the Dan ube river in the region of Kozloduy

Protected area ROSCI0045

Protected area with code ROSCI 0045 Coridorul Jiului occupies 71,394 ha. It is located in Dolj, Olt, Mehedinty, Gorj county.

In class of earth covering, the territory or the protected area is allocated in the following groups: rivers, lakes (16%), marshlands (11%), tillable lands (14%), pastures(15%), other cultivated areas (2%), deciduous forests (38%), forest habitats (4%).

General characteristics

The territory located along the middle and the lower stream of the river Jiu, includes some of the most rare and relict representative samples of European-type lawn evolved to a lesser extent (coordinates: 23 ° 30 '02 "and 24 ° 14' 05" east longitude, 43 ° 42 '01 "and 44 ° 54' 55" north latitude, 128 km length, direction NNV-SSE). The area crosses 4 (27%) of 15-ecological areas (Getic plateau and Gavanu-Burdea valley, Romanian forest-steppe valley, Danube valley) of the continental biogeographic region of Romania. The difference in the altitude varies from 50 to 405 cm. The territory covers a number of ecosystems with total area of 147540 ha, most of which are natural 33543ha (23%), with considerable variety and local abundance, which exceeds many times the average values, typical for the Romanian forest, which makes it of extreme biogeographical importance..

Quality and importance

The territory is related to the priority areas for protection of the continental biodiversity and it is of big importance. In spite it covers only 0.5% of the national forest area and 0.6% of the natural areas, it includes: natural forest habitats, protected by the Romanian and European legislation (9 of 28 types) (91EO, 91FO, 91IO, 91MO, 91YD, 913O, 91VO, 917O, 92AO); forest formation (22 of 50); forest types, detected in the country (97 out of 306). Jiu Valley is one of the main transbalcanic migration corridors (central-European-Bulgarian route) followed by a great numbers of birds. Together with the sedentary one, in Jiu Corridor have been identified 135 of the 406 avi-fauna species reported in Romania, 114 of them are protected by community and Romanian law In the area were found some perennial animals and vegetation populations, whose conservation requires designation of special conservation areas, avifauna special protection areas and strict protection

Among the significant populations within the life inventory of the country are many rare sub-Mediterranean elements, other endemic species and some protected ones. This provides remarkable specificity to the territory, which is underlined by: the concentration of vegetal associations with high bio-historical value, reflecting the interference of the southern thermophile elements with the central-European ones; the preservation of certain unaltered relict fragments of the archetypal forest structures located at the border of biogeographical areas or even disjunctively disposed or insularised by human beings (the greyish oak in the Braniştea Bistreţului Forest etc.); the lodging of important vegetal and animal populations whose preservation requires the appearance of special preservation areas and a strict observance of the protection etc. The sustainable use of this exceptional natural patrimony justifies and imposes:

- The use of the natural forest as a management standard for the applied forestry that is close to the nature;
- the preservation of wild life, of certain relict natural habitats and of a local spring on important genes;

- the responsible management of the entire local natural patrimony and especially of the forest;
- the maintenance of certain rare, uncommon forest landscapes;
- the official declaration of a nature park that, through its multiple functions, would ensure the basis for the reconversion of the local labour force and employment in a field of national and international interest;
- the creation of a natural space for the ecological education and training;
- the promoting of ecotourism as a non-polluting income source, through the perpetuation of traditional local activities;
- the improvement of the decision making process, the sustainable environmental preservation, the protection of life and health and the increase of living quality.

Vulnerability

Localities within the three counties and near the town of Craiova underly a reasonable Plan for Spatial Development (PSD), which can be updated every ten years on the basis of a general development plan (GDP) of the nearby settlements. Once updated, GDP allows the development of zonal development plan (ZDP), which arises from the detailed development plan (DDP). The creation of PSD is carried out to harmonize all existing and future interests of this diverse area in which the proportion of forest fund (34%) and forest (33%) cannot be reduced, and other categories of land containing natural areas protected by Romanian and European legislation.

Thus, the pollution, the urbanization and other effects of the eco-destructive human intervention can be reconciled with the major requirements of sustainable development and of biodiversity preservation carried out by the man.

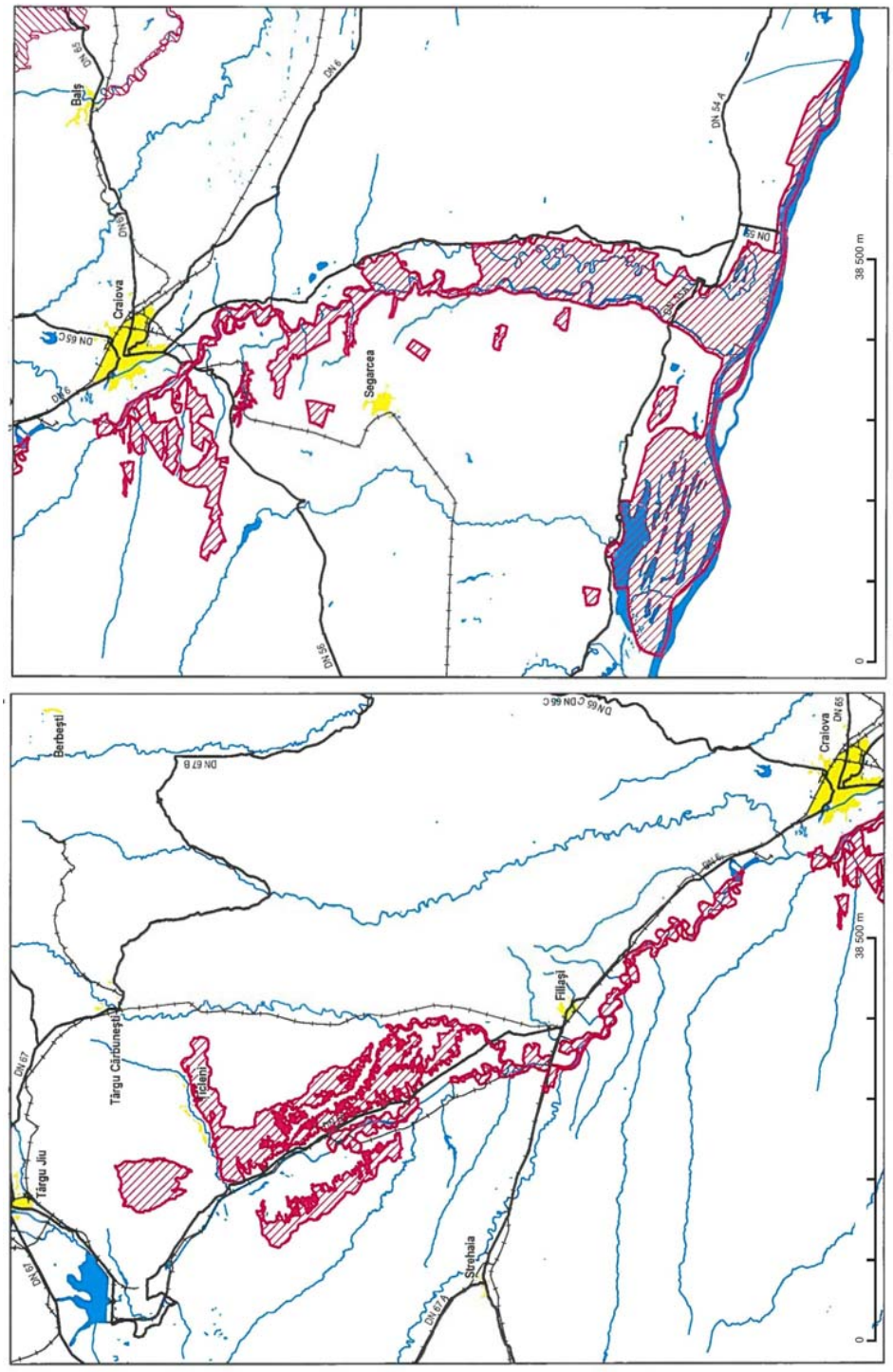


Fig. 3.7.2-2 Protected Area ROSCI0045 (source: Monitorul official al Romaniei, Porteal, Nr. 98 bis/7.II2008

Protected area ROSPA0010

Indicative denomination of the site: ROSPA0010 Bistret River (Bistreţ) (1,915.6 ha) – Dolj County

Land cover (type and percent): Rivers, lakes (90%); swamps (8%); pastures (2%)

Quality and importance It lodges important populations of certain protected bird species:

a) Number of species in Annex 1 of the Birds Directive: 24.

Number of other migrant species, listed in the annexes of the Convention on migrant species (Bonn): 72.

Number of globally endangered species: 7.

The site is important for the nesting populations of the species: Platalea leucorodia, Ardeola ralloides, Egretta garzetta, Aytya nyroca and Cyrcus aeruginosus.

The site is important for the nesting populations of the species: Platalea leucorodia, Ardeola ralloides, Egretta garzetta, Aytya nyroca and Cyrcus aeruginosus.

Vulnerability

Located in the flood-prone area, the site is covered by water every time the Danube flow gets very high. Within the site there has to be noticed the fisheries activities, with direct and indirect negative impact on the aquatic bird populations of the area.

The species listed in Annex I of the Birds Directive which could be affected adversely during the Decommissioning of KNPP Units 1 to 4 are:

1. Dalmatian Pelican (*Pelecanus crispus*) – globally endangered species with 3-59 migrant birds and global assessment mention B. The species inhabits the wetlands of Bistretsu where its hunting area is and where it stays for the night and rests next to the sand spits of the adjacent islands of Danube River. No significant adverse impact on the species is predicted.

2. Great White Pelican *(Pelecanus onocrotalus*) – migrant species with 50-150 migrant birds and global assessment mention B. During migrations the species inhabits the wetlands of Bistretsu, where its trophic area is and where it stays for the night and rests next to the sand spits of the adjacent islands of Danube River. No significant adverse impact on the species is predicted. Danube River. No significant adverse impact on the species is predicted.

3. Little Cormorant (*Phalacrocorax pygmeus*) – wintering and passerine species with 15 wintering and 1000 passing birds and global assessment mention A. No significant adverse impact on the species is predicted.

4. Eurasian Spoonbill (*Platalea leucorodia*) – nesting (34-41 couples) and passerine species (180-211 specimens.) with global assessment mention C. The species inhabits the wetlands of the Danube River. No significant adverse impact on the species is predicted.

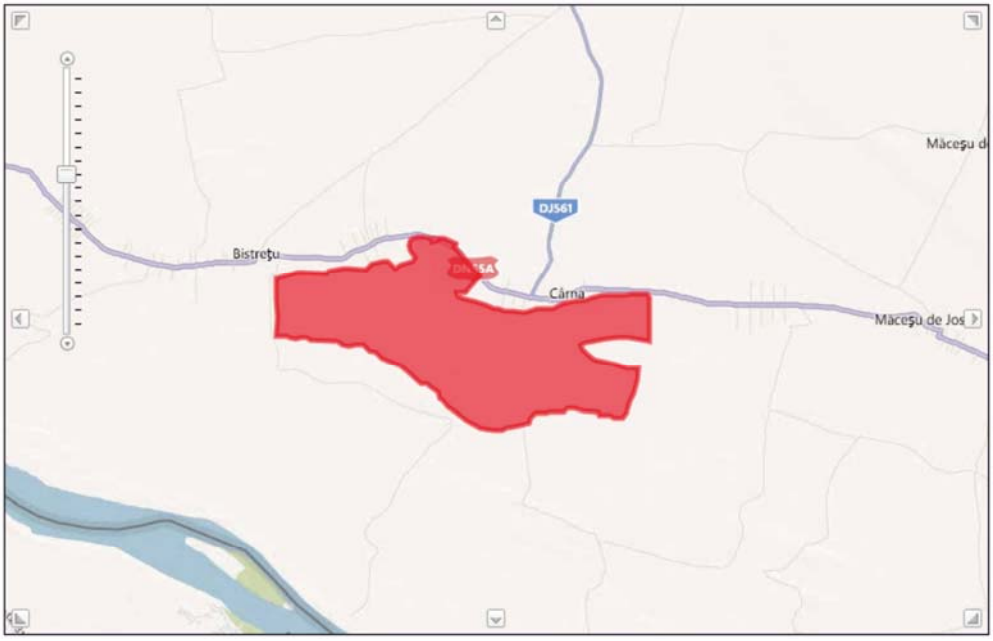


Fig. 3.7.2-3 Protected Area ROSPA0010 (source: **http://natura2000eea.europa.eu**

Protected area ROSPA0023

Indicative denomination of the site ROSPA0023 Jiu River –Danube River Confluences (Confluenţa Jiu – Dunăre) (21,999.9ha) - Olt, Dolj Counties

Land cover (type and percent): rivers/lakes (17%), crops/arable land (22%), pastures (11%), other arable fields (4%), broadleaved forests (40%), transition forests (6%)

Quality and importance It lodges important populations of certain protected bird species:

a) Number of species in Annex 1 of the Birds Directive: 34

Number of other migrant species, listed in the annexes of the Convention on migrant species (Bonn): 77

Number of globally endangered species: 5

The site is important for the nesting populations of the species: Crex crex, Haliaetus albicilla, Ciconia ciconia, Burhinus oedicnemus. In the migration period, it becomes important for the following species: Tringa glareola, Pelecanus crispus, Platalea leucorodia, Plecadis falcinellus, while during the winter it is important for the species Phalacrocorax pygmaeus

Vulnerability: The extension of the human modified surfaces and the pollution of the watercourses have negative influences upon the bird species within the area.

The species listed in Annex I of the Birds Directive which could be affected adversely during the Decommissioning of KNPP Units 1 to 4 are:

1. Dalmatian Pelican (*Pelecanus crispus*) – globally endangered species with 3-59 migrant birds and global assessment mention B. The species inhabits the wetlands of Bistretsu where its hunting area is and where it stays for the night and rests next to the sand spits of the adjacent islands of Danube River. No significant adverse impact on the species is predicted.

2. Little Cormorant (*Phalacrocorax pygmeus*) – wintering and passerine species with 15 wintering and 1000 passing birds and global assessment mention A. No significant adverse impact on the species is predicted.

3. Eurasian Spoonbill (*Platalea leucorodia*) – nesting (34-41 couples) and passerine species (180-211 specimens.) with global assessment mention C. The species inhabits the wetlands of the Danube River. No significant adverse impact on the species is predicted.
4. White stork *Ciconia ciconia* – nesting (20-30couples) and passerine species with global assessment mention C. The species inhabits the wetlands of the Danube River valley. No significant adverse impact on the species is predicted. Danube River. No significant adverse impact on the species is predicted.
It can be summarized that the protected areas on both sides of Danube River are interconnected and form a complex ecological system which shall be considered as a whole. The adverse impact on it due to the implementation of KNPP Units 1 to -4 decommissioning is assessed as insignificant.

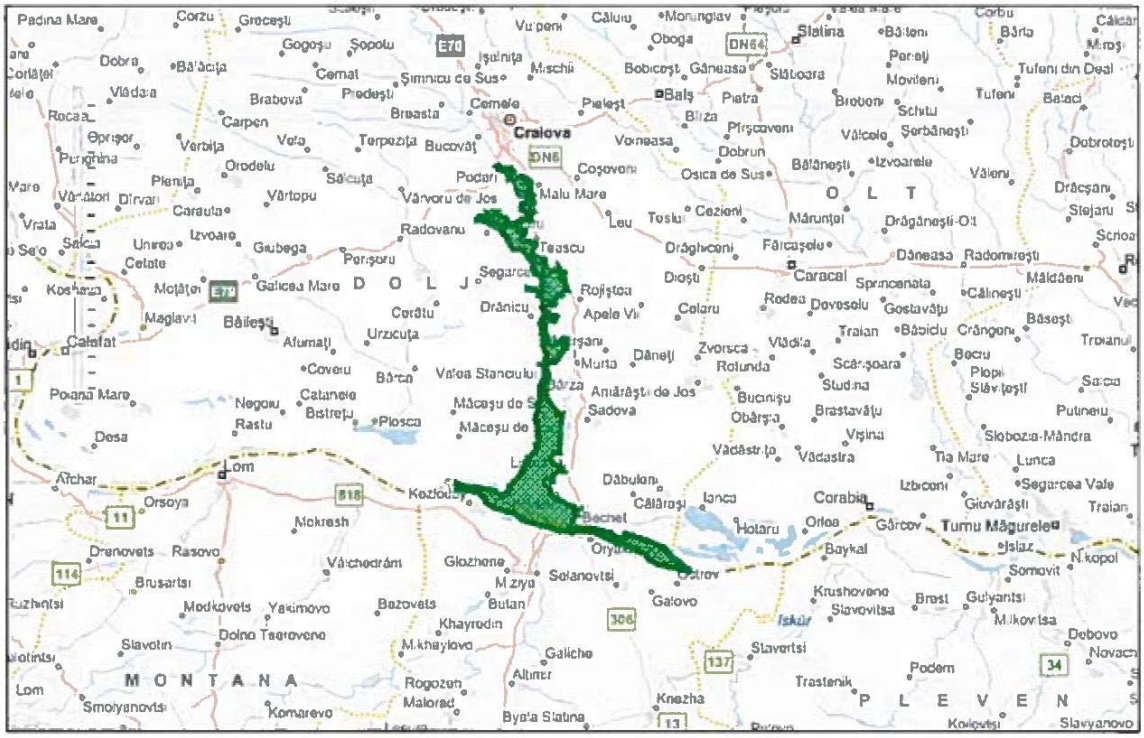


Fig. 3.7.2-4 ROSPA0023 (source: **http://natura2000.eea.europa.eu**)

3.7.3 Protected Territories

According to the documents "Programme for protection of the environment in municipality Kozloduy for a period 2004-2010"] in the area of the municipality Kozloduy there are no protected territories. [161].

About 28-30 km away from Kozloduy NPP within the lands of the village of Selanovtsi- municipality of Oryahovo there are announced protected areas where some habitats of rare and endangered vegetation species are subject to protection.

Protected Area Kochumina is situated on 25 decares in the area of Kochumina in the land of the village of Selanovtsi including also the field of White water lily (Nymphaea alba L.). Protected Area is nominated with Order N 2109/1984 of EPC with the CM (SG issue 3 1985). Also, as Protected Territories the fields of yellow pond-lily (Nuphar lutea (L.) are nominated Sibth. and Sm.) in the area "Gola bara" of 20 decares and field of Water Soldier (Stratoides aloides L.) in the area Kalugerski grad in the land of Selanovtsi village nominated with order N 2109/1984 of EPC with the CM (SG issue 3 1985).

3.7.4 Transboundary territories

The Romanian territory located in the area around KNPP behind the Danube River is considered and assessed in the present EIA Report.

The Border of the next nearby neighbouring state Serbia is located in a distance of about 100 km from Kozloduy NPP and thus is this territory negligible for assessment.

3.8 Biodiversity

3.8.1 Flora and vegetation

3.8.1.1 General characteristic of the flora and vegetation in the region of Kozloduy NPP"

The territory of the Kozloduy NPP is related to the Zlatiiski geobotanic region of the Danube side District and Low Danube River province of the Eurasian steppe and forest steppe area. Zlatyiski region is situated on the area alongside the Danube River bordered from the West of the town of Lom and Eastern from the river of Vit. The larger part of the territory includes agricultural lands where cereal plants are grown.

In the past the root vegetable on the territory of Zlatyiski region was formed by the forest community where Virgillian Oak (Quercus virgilliana Ten.) and White Oak (Quercus pubescens Willd) prevail. In the contemporary forest remains and derivative forest community Flowering Ash (Fraxinus ornus L.), Turkey Oak (Quercus cerris L.) and white oak (Quercus pubescens Willd.) prevail. At some separate places there are forest crops where acacia (Robinia pseudoacacia) prevails. Typical for the region are the steppe species Camphorosma monspeliaca L., Potentilla pirotensis (Borbas) Markova and Chamaecytisus danubialis (Vel.) Rothm.

In the contemporary vegetation agrophytocenoses and secondary grass communities prevail, which are formed on agricultural lands at the place of mixed forests of Turkey oak (Quercus cerris L.) and Virgillian Oak (Quercus virgilliana Ten.) L.

In some sections there are derivative xerotherm vegetation where prevail Poa bulbosa L., Bermuda Grass (Cynodon dactylon (L.)Pers.), Rye-Grass (Lolium perenne L.) etc This vegetation is typical for pasture-ground territories where at more slightly trampled places where Lolium perenne L. (Rye-Grass) and White Trefoil (Trifolium repens, L.) and at the better trampled places Bermuda Grass (Cynodon dactylon), Poa bulbosa, Beard Grass (Dichantium iscaemum(L.) Roberty) and Valesian Flescue (Festuca velesiaca Schl.).).

On inclines and steep slopes xerotherm grass europhitia are formed with the prevalence of Beard Grass (Dichantium ischaemum (L.) In the europhitia of the Beard Grass there are considerable share of the species of Black Beard Grass (Chrysopogon gryllus (L)) Trin., Poa bulbosa L., Panonic Thyme (Thymus panonicus All.), Poley (Teucrium pollium L.), Vetch (Astragalus onobrychis L.), Myrsin Sperge (Euphorbia myrsinites L)., Cyprus Sperge (Euphorbia cyparissias L.), Salad Burnet (Sanguisorba minor L.), Small-Fruit Medic (Medicago minima (L.)Bart)., Ajuga chia Sch., Cylindrical Wild Wheat (Aegilops cylindrical Host.), Hop clover (Trifolium arvense L.), Rough Clover (Trifolium scabrum L.), Meadow Holly (Eryngium campestre L.), willowleaf frostweed (Helianthemum salicifolium L.), Palestinian Cress (Crepis sanctha (L.) Astera Ceae (Leontodon crispus Vill.), Astera Cantabrica (Convolvulus cantabrica L.), Ononis arvensis L. (Common Restharrow), Polygala major Jacq. (Polygalaceae), Plantago lanceolata L. (Ribwort Plantain), Scabiosa micratha Desf. etc.

At some overmoistened places alongside the At some overmoistened places alongside the Danube River there are some forest communities where White Willow (Salix alba), White Poplar (Populus alba L.) and Black Poplar Prevail (Populus nigra L.).

In some sections there are forest cultures of hybrid Poplars (Populus X euroamericana).
At some overmoistuned habitats there are swampy and marshy grass vegetation with prevailing reed (Phragmites australis (Cav.) Trin ex Stend.), Lasser Reedmace (Typha angustifolia L.) and Schoenoplectus lacustris L. (Lakeshore Burlush).
In the mesophyte grass vegetation prevail the Festuca pratensis Huds (Poaceae), Elymus repens (L.) Gould.(quack grass), Agrostis stolonifera L.(creeping bentgrass), Poa pretensis L (Smooth-stalked Meadow grass) etc.
Base on the accepted dominant and florist classification approach the agrophytocenosis, derivative grass communities are involved into the following classification diagram:

- - Class Stellarietea mediae Br.-Bl. 1931, Tx., Lohm., Prsg.,1950
- Order Centauretalia cyani Tx.,Lohm., Prsg., 1950
- Union Agrostidion spica venti (Krusem. et Vligeger,1939) Tx.., Oberd., 1949
- Association Anthemis austriaca+ Vicia pannonica + Myosotis striata Kol., 1976
- Association Anthemis austriaca – Hypecoum grandiflorum Kol., 1976
- Union Caucalion lappulae Tx., 1950
- Association Sinapis arvensis + Bifora radians + Vicia striata + Veronica hederifolia Kol., 1979
- Association Sisymbrium orientale – Bifora radians – Camelina rumelica Kol., 1978
- Association Anthemis austriaca – Delphinium orientale Kol., 1976
- Union Lolium remoti – Linion Tx., 1950
- Association Eruca sativs Kol., 1976
- Order Chenopodetelia albi Tx. Et Lohm., 1950
- Union Sisymbrion officinalis Tx., Lohm., Prsg., 1959;
- Union Panico – Setarion Sissingh, 1946;
- Association Cynodon dactylon – Hibiscus trionum Kol., 1976;
- Association Chondrilla juncea + Sorghum halepensis Kol., 1976;
- Association Equisetum arvense – Xanthium italicum Kol., 1976;
- Association Echinochloa crus-galli – Galinsoga parviflora Kol., 1976;
- Class Festuco-Brometea Br.-Bl. et R. Tx. in Br.-Bl.,1949 (Brachipodio-Chrysopogonetea Horvatic, 1958)
- Class Molinio-Arrhenatheretea R. Tx., 1937
- Class Artemisietea vulgaris Lohmeyer et al. ex von Rochow, 1951;
- Class Galio-Urticetea Passarge ex Kopecky, 1969;
- Class Phragmito-Magnocaricetea Klika in Klika et Novak 1941.
- Class Quercetea pubescentis Doing-Kraft ex Scamoni, 1959.
- Class Salicetea purpurea Moor, 1958.

Green system on the territory of Kozloduy NPP includs grass areas, different individuals and groups of wood and shrubby species.
Around the administrative buildings in the green system are included Aesculus hippocastanum L. (Horse chestnut), Platanus X acerifilia Willd (hibrid plane-tree), Platanus orientalis L. (East Plane-tree), Tilia cordata Mill (small-leave lime tree), and Picea pungens Engelm. (Silver Spruce), Acer pseudoplatanus L. (common

sycamore), Betula pendula Roth (common birch), Vinca minor L. (common periwincle), Deutzia scabra Thunb. (fuzzy pride-of-Rochester), Thuja occidentalis L (West Thuja), Picea abies Karst. (Common Spruce), Cotoneaster horizontalis Decne (Rock cotoneaster), Fraxinus americana L. (American Ash-tree), Syringa vulgaris, Euonymus japonica, Ligustrum vulgare, Amorpha fruticosa, Populus pyramydalis, Acer negundo, Spiraea sp.

In a forest park in front of the entrance of Kozloduy NPP there are mostly forest species of Platanus X acerifilia Willd. (Hybrid Plane-tree), Tilia cordata Mill. (small-leaf lime-tree), Betula pendula Roth. (Common Birch), Pseudotsuga menziesii (Mirb.) Franko (Douglas-fir), Thuja occidentalis L. (West Thuja), Pseudo Cyprus (Chamaecyparis lawsoniana Parl.) etc.

In different parts on the territory of Kozloduy NPP there are some grass areas, which are in different stages of ongoing vegetation fluctuations. In the established green areas of different mixtures of English rye-grass, Medow Grass, Estuca and other grass species some secondary changes of the vegetation fluctuations occurred in different aspects and the different phytocenoses in different quantitative ratios include the following species Potentilla reptans L. (creeping cinquefoil), Cynodon dactylon (L.) Pers.(couch-grass), Agropyrum hispidus (Opiz.) Meld.(twitch-grass), Polygonom aviculare L. (prostare knodweed) Achillea setaria Waldst. and Kit. twitch-grass), Polygonom aviculare L. (prostare knodweed) Achillea setaria Waldst. and Kit. (Even-leaved milfoil), Convolvulus arvensis L. (Bindweed), Taraxacum officinale Web. (Common Dandelion), Trifolium pratense L. (Red Trefoil) Trifolium repens L. (White Trefoil), Oxalis corniculata L. (Creeping Woodsorel), Erodium cicutarium (L.) L, Her.,

Ranunculus repens L. (Creeping buttercup), Reseda lutea L. (Dyer's Rocket Weld), and Cichorium intybus L. (Common Chicory), Setaria viridis (L.) Beauv. (Green Bristle-grass), Plantago lanceolata L. (Ribwort Plantain), Eichinochloa crus-galli (L.) Beauv. (Cock's Millet), Sinapis arvensis L. (Cock's Millet), Malva pusilla Sm. (low mallow), Senecio vulgaris L. (old-man-in-the-spring), Medicago lupulina L. (Black Medick Yellow Trefoil), Coronilla varia L. (Coronilla varia L.), Vicia angustifolia Grufb. (Garden Vetch) etc.

3.8.1.2 Impact of Kozloduy NPP on the flora and vegetation on the territory of the Republic of Bulgaria

Vegetation in the region of Kozloduy NPP could be considered as an object impacted by the power plant on one part and, on the other part, as an indicator of the environmental impact.

Analysis of the data from Annual reports of the Department RREC "Results of the environmental radiation control" of Kozloduy NPP of the investigated grass vegetation (4 times per year the points in Kozloduy, Hurlets and Oriahovo, twice per year on the industrial site and once per year at the points of Lom, Pleven and Berkovitsa) within the period 1993-1997 [82] allows making the following conclusions:

- Gamma spectrometric measurements of the grass samples show that the anthropogenic nuclides typical for the NPP (^{137}Cs, ^{60}Co and ^{54}Mn) are recorded only on the territory of the power plant. For instance, the value of ^{137}Cs in the grass for 1998 at point 32 (with considerably higher cesium content in the soil), is also higher. Values of the NPP site are 5.06□19.5Bq/kg

a.d.w. As a comparison, in the beginning of the investigated period, e.g. for 1994 higher values were recorded at the same point – from 11 to 24.8 Bq/kg a.d.w.

- Content of ^{60}Co at the points of the plant is from 1.2 to 29.6 Bq/kg a.d.w., and in 1997 with 3 times lower upper limit (1.2 from 7.9). Such higher values are recorded also for ^{54}Mn – up to 9.29 Bq/kg a.d.w., (and in 1997 below MPA);
- Approximately all samples of the points beyond the industrial site show results for ^{137}Cs about 1 Bq/kg a.d.w. When for the samples from the NPP site higher values are assumed due to the higher content of the radionuclides in the soil at some places, for the places beyond the protected territories it could be said that the recorded activity is a result of the Chernobyl radiocesium in the soils.
- Content of ^{90}Sr in the vegetation in 1998 is 0.30□2.52Bq/kg a.d.w. Before commissioning of the NPP the measured average values were 4.4 □ 0.3Bq/kg a.w.e in 1994 0.17□1.64 Bq/kg a.d.w. It is hardly possible to explain the higher values of strontium before the commissioning of the power plant and may be it could be assumed that there is considerable difference between the methods applied 25 years ago and the current ones as well as in their accuracy. May be, some experiments have been made with parallel measurements (there are no such ones known), but if they have not been made it is expedient to do so in order the facts to be added to the annual reports and the needed comment to be made as well.

Sampling made in four sectors in 3-km area allows determining that the sunflower (heads) in the sector to the East from KNPP has the highest beta activity - 1022 Bq/kg a.d.w. and close to it in the Northern sector - 915 Bq/kg a.d.w. As a comparison, in 1994 values around 1000 Bq/kg a.d.w were detected for the sunflower in three directions – N, E and W. Considerably lower are the values of barley (straw) - 288 Bq/kg a.d.w, corn (cobs) - 176 Bq/kg a.d.w. or around these values in different years. 90Sr content is quite lower - for the sunflower it is 3.36 Bq/kg a.d.w.; medick - 1.74; wheat (straw) - 1.07 Bq/kg a.d.w; barley (straw) - 0.83 Bq/kg a.d.w.

Investigations related to the EIA elaborated in August 1999 [82] show corresponding results with the ones taken from RREC. With the analyses in the National Center for environment and sustainable development of the samples taken by the experts it is determined that the content of ^{137}Cs in the leaves of papers from the greenhouse of Kozloduy NPP 0.7, and in the grass next to the stadium in Glozhene – 10 Bq/kg, while in the sample of the grass area in front of SB-1 it is 8.7 Bq/kg. This is a confirmation that the plant territory has quite higher content of the anthropogenic raionuclides comparing with the region beyond the sanitary protected zone –e.g. the points in Kozloduy, Glozhene etc.

Based on the analyses of heavy metal in the vegetation samples from Kozloduy NPP greenhouse content of Fe 79.7 mg/kg and 54.1 mg/kg dry weight is determined, while in the village of Glozhene it is 117.5 mg/kg dry weight. Content of Mn is the highest in the sample from Botev alley -140 mg/kg dry mass, and in the grass before SB -1 it is 114.88Bq/kg. Analyses made of the soil samples, grass and leaves from the greenhouse of Kozloduy NPP and several points from the site and around it show that both of the samples (P1 and P2) from the greenhouse are with higher content of iron, manganese and zinc. Sample P2 show higher copper content – 31.13 mg/kg dry mass.

In the annual report of "Results of the environmental radiological monitoring of the environment in Kozloduy NPP"-2007"(III, 2008) some results are presented of the investigations made of grass vegetation 4 times per year at the points of Kozloduy, Hurlets and Oryahovo (gamma spectrometry and ^{90}Sr), 2 per year on the sites of KNPP (gamma spectrometry) and at the points of Lom, Pleven and Berkovitsa (gamma spectrometry and ^{90}Sr) once per year. Collection of the samples is made next to the points at the same places from where the samples have been taken. In 2007 12 samples were analyzed in 100 km monitoring area.

Results received for the content of ^{90}Sr in the grass vegetation are within the range of 0.18 - 2.75 Bq/kg a.d.w., of average value of 1.43 Bq/kg a.d.w. Results are comparable with the ones measured during the previous years. Maximal value is recorded at point 9 (village of Hurlets. Determined differences are related to the differences of the vegetation composition during the years and seasonable features of the taken samples. For instance, during long lasting dry periods there is no possibility for collection of the samples of fresh grass and dry caulis containing more cellulose.

Long term studies (1994-2007) of ^{90}Sr in the vegetation at 100 km monitoring area show variation of 0.18 - 4.75 Bq/kg a.d.w. Before commissioning of Kozloduy NPP the measured average activities were 4.4 +/- 0.3 Bq/kg a.d.w.

The activity of ^{137}Cs in vegetation for 2007 is within the range of 0.80-5.35 Bq/kg a.d.w. All samples, including the ones from the industrial site have shown ^{54}Mn, ^{60}Co и ^{134}Cs lower than the respective MPA.

Monitoring of the vegetation in the agrophytocenoses covers the main agricultural crops. Barley, wheat, corn, sunflower etc. have been studied. For all tests a separate analysis is made of the grain and straw (cobs, sunflower heads). In order to facilitate the processing of the results the sampling from the agricultural production within 3 km Sanitary Protection Zone is made in 4 sectors provisionally split fewer than 900 towards N-E-S-W.

In 2007 there were 18 analyses made of the grain-wheaten crops, put of which there are 6 gamma-spectrometric, 6 radiometric of total beta activity and 6 determinations of ^{90}Sr. Investigation results show activity of ^{137}Cs within the interval from 0.5 to 6.0 Bq/kg a.d.w. The registered activity of ^{90}Sr is within the range of 0.037-1.3 Bq/kg a.d.w., and the higher values are measured in the straw of the analyzed agricultural products. This fact complies with the standard facts (33) for the distribution of the radionuclides in different parts of the plants. Results of the performed gamma-spectrometric measurements show that the recorded total beta activity dominates in the straw (cobs, heads) and varies within normal range from 188 Bq/kg a.d.w. for the grain and 388 Bq/kg a.d.w. in the wheat straw. Received results are comparable with the ones for previous years.

Detailed results are also received during the monitoring held in 2008.

In 2009, the grass was tested four times a year in stations in the town of Kozloduy, Harlets and Oriahovo (gamma spectrometry and 90Sr), twice-yearly in site NPP "Kozloduy" (gamma spectrometry) and stations in Lom, Pleven and Berkovitza (gamma spectrometry, 90Sr once a year). Sampling was carried out in close proximity to the stations, on the same premises from which they were taken and soil samples. There were collected in about 2 kg grass at a height of more than 2 cm from the ground. Submitted to the laboratory samples were primary preparation and processing for further analysis, including operations such as milling, homogenization, drying to constant weight and weighing air-dry substance. Prepared samples are direct gamma

spectrometry (Marinelli-ldm3, 60000 s), such as MDA for l37Cs under these conditions is in the range 0.75 + 2.30 Bq / kg adw Separately vegetation is burned at 450 ° C, aliquots were analyzed ash for 90Sr. Determination of 90Sr is based on the extraction of ash (k.HCl + k.HN03), separation of Ca with sodium hydroxide and liquid scintillation spectrometry of 90Y (mode "Cherenkov counting") after the establishment of radioactive equilibrium. In such described conditions for measuring time 10,000 s, MDA for 90Sr is average of 0.20 Bq / kg adw.
In 2009, the adopted methodology analyzed a total of 22 samples in a 100 km zone of observation. The number of analyzes carried out for 37 - 22 respectively gamma spectrometry and 15 with radiochemical isolation of strontium.
The results obtained for the content of 90Sr in vegetation in 2009 were in the range of <0.32 d-5.18 Bq / kg adw, with a mean of 1.31 Bq / kg adw The results are comparable to the measured in previous years.
The maximum value is recorded on station p. 30 (Berkovitza).
The observed differences are due to different vegetation types over the years and seasonal characteristics. For example, in lasting droughts do not allow sampling of fresh grass and often selects dry vegetation (stems) contained more cellulose.
The activity of 137Cs in vegetation in 2009 was in the range of <0.89 d-5.00 Bq / kg adw, average 1.65 Bq / kg adw Maximum value measured on post-32 of NPP "Kozloduy" near "Genova" mound where possible wind distribution of contaminated soil on the soil layer. All samples, including those from the production site have shown results 34Mn, 60Co and l34Cs lower than the corresponding MDA.
Based on the results of the monitoring of vegetation is concluded that radioactivity in the samples examined is normal for these plants. It is not known influence of NPP "Kozloduy" on vegetation outside the site.
In 2009, monitoring of agricultural products of vegetable origin study covers basic types of fodder crops produced in a 2 km zone - barley, wheat, maize, sunflower and others. For all samples was carried out split analysis of grain and straw (cakes, books). The analysis methods were similar to those used to analyze the plants. In order to locate the possible impact of NPP "Kozloduy" and facilitate the processing of the results of sampling to the agricultural production in a 2 km zone is carried out in four sections conditionally separated at angle of 90 °, north-east-south-west.
In accordance with the methodology adopted in 2009 have been conducted analysis of corn and 44 plants, including 22 gamma - spectrometric, radiometric 15 of total beta activity and 7 determinations of 90Sr. The results showed no activity over 137Cs MDA in the range of from <0.25 to <2.41 Bq / kg adw Recorded activity of 90Sr ranges 0.026 + 0.65 Bq / kg adw The results of the gamma spectrometric measurements show that the registered total beta activity in samples is almost entirely due to natural 40K. Total beta activity dominates in straw (cakes, cob) and varies within the normal range of 82.5 Bq / kg adw Grains of maize to 770 Bq / kg adw in the sunflower cakes. Higher values for measurements of silage (straw, cakes, books) than in the grain of the analyzed products, consistent with the literature data [34], the distribution of radionuclides in different parts of the crops. Results for 2009 are in the normal range and are comparable with data from previous years for the same crops.
In 2010, the grass plants was tested four times a year in stations in the town of Kozloduy, Harlets and Oriahovo (gamma spectrometry and 90Sr), twice-yearly on site NPP "Kozloduy" (gamma spectrometry) and posts in Lom, Pleven and Berkovitza (gamma spectrometry, 90Sr once a year). Sampling was carried out in close proximity

to the office, on the same premises from which they were taken and soil samples. There were collected in about 2 kg grass at a height of more than 2 cm from the ground. Submitted to the laboratory samples were primary preparation and processing for further analysis, including operations such as milling, homogenization, drying to constant weight and weighing air-dry substance. Prepared samples are direct gamma spectrometry (Marinelli-ldm3, 60000 s), such as MDA for 137Cs in these conditions is in the range 0.96-n 2.54 Bq / kg adw Separately vegetation is burned at 450 ° C, aliquots were analyzed for ash 90Sr. Determination of 90Sr is based on the extraction of ash (k.NS1 + k.N1MOz) separation of Ca with sodium hydroxide and liquid scintillation spectrometry of 90Y (In standby "Cherenkov counting") after the establishment of radioactive equilibrium. In such described conditions for measuring time 10,000 s, MDA for 90Sr is average of 0.21 Bq / kg adw.

In accordance with the methodology adopted in 2010 analyzed a total of 20 plant samples in a 100 km zone. The number of the analyzes is 35 - 20 respectively gamma spectrometry and 15 with radiochemical isolation of strontium.

The results obtained for the content of 90Sr in vegetation in 2010 were in the range of 0.33 2.39 Bq / kg adw, with an average value of 1,13 Bq / kg adw The results are comparable to the measured in previous years. The maximum value is recorded on station p. 27 (Oriahovo). The observed differences are due to different vegetation types over the years and seasonal characteristics.

For example, in lasting droughts do not allow sampling of fresh grass and often selects dry vegetation (stems) contained more cellulose.

Activity l37Cs vegetation in 2010 is in a range of MDA <0.96 n-<2.54 Bq / kg adw Traces 2.17 Bq / kg adw of 137Cs was measured only a single station p-27 (Oriahovo). Not measured technogenic activity 54Mn, 60Co and 134Cs in any sample. Due to regular mowing the lawn at the site in 2010, no samples were taken for analysis.

Based on the results of the monitoring of vegetation is concluded that radioactivity in the samples examined is normal for these plants. It is not known influence of NPP "Kozloduy" on vegetation outside the site.

In 2010, monitoring of agricultural products of vegetable origin study covers basic types of fodder crops produced in a 2 km zone - barley, wheat, maize, sunflower and others. For all samples was carried out split analysis of grain and straw (cakes, books). The analysis methods were similar to those used to analyze the plants (see section 11.1). In order to locate the possible impact of NPP "Kozloduy" and facilitate the processing of results, sampling of agricultural production in a 2 km zone is carried out in four sections conditionally separated at angle of 90 °, north-east-south-west.

In accordance with the methodology adopted in 2010 have been analyzed 20 samples of cereals, which have been conducted analyzing 56 - 20 gamaspektrometrichni, 20 radiometric of total beta activity and 16 analysis of 90Sr.

Total beta activity dominates in straw (cakes, cob) and varies within the normal range of 82.0 Bq / kg adw Grains of barley to 1074 Bq / kg adw in the sunflower cakes. Higher values for measurements of silage (straw, cakes, books) than in the grain of the analyzed products, consistent with the literature data [34], the distribution of radionuclides in different parts of the crops.

The results of the gamma spectrometric measurements show that the registered total beta activity in samples is almost entirely due to natural 40K. In 2010, as in previous years, it is measured foreground activity l37Cs and other anthropogenic radionuclides

(137Cs MDA is <0.29 to <5.0 Bq / kg adw). Recorded activity of Sr is in the range 0.064-f-3.09 Bq / kg adw The maximum value for sunflower cakes - 2nd district. Results for 2010 are in the normal range and are comparable with data from previous years for the same crops.

In 2011, the grass was tested four times a year in stations in the town of Kozloduy, Harlets and Oriahovo (gamma spectrometry and 90Sr), twice a year at the plant site (gamma spectrometry) and in stations in the cities Lom, Pleven and Berkovitza (gamma spectrometry, 90Sr once a year). Sampling was carried out in close proximity to the stations, on the same premises from which they were taken and soil samples. Thre were collected in about 2 kg grass at a height of more than 2 cm from the ground. Submitted to the laboratory samples were primary preparation and processing for further analysis, including operations such as milling, homogenization, drying to constant weight and weighing air-dry substance. Prepared samples are direct gamma spectrometry (Marinelli-ldm, 60000 s), such as MDA for Cs under these conditions is in the range 0.78 N-2.55 Bq / kg adw Separately vegetation is burned at 450 ° C, aliquots were analyzed ash for 90Sr. Determination of 90Sr is based on extraction from the ashes (K.HCl + k.HN03), separation of Ca with sodium hydroxide and liquid scintillation spectrometry of 90Y (In standby "Cherenkov counting") after the establishment of radioactive equilibrium. In such described conditions for measuring time 10,000 s, MDA for 90Sr average of 0.18 Bq / kg adw

In 2011 analyzed a total of 22 plant samples in a 100 km zone. The number of analyzes carried out for 37 - 22 respectively gamma spectrometry and 15 with radiochemical isolation of strontium.

The activity of 137Cs in vegetation for 2011 in the range of MDA <0.78 n-<2.55 Bq / kg adw Traces 1.8 Bq / kg adw of 137Cs was measured only a single station p-13 (RM department). Not measured technogenic activity 54Mn, 60Co and 134Cs in any sample. Due to regular mowing the lawn at the site in 2011, no samples were taken for analysis.

Based on the results of the monitoring of vegetation is concluded that radioactivity in the samples examined is normal for these plants. It is not known influence of NPP "Kozloduy" on vegetation outside the site.

In 2011, monitoring of agricultural products of vegetable origin study covers basic types of fodder crops produced in a 2 km zone - barley, wheat, maize, sunflower and others. For all samples was carried out split analysis of grain and straw (cakes, books). The analysis methods were similar to those used to analyze the plants (see section 11.1). In order to locate the possible impact of NPP "Kozloduy" and facilitate the processing of the results of sampling to the agricultural production in a 2 km zone is carried out in four sections conditionally separated at angle of 90 °, north-east-south-west.

In accordance with the methodology adopted in 2011 have been analyzed 18 samples of cereals, which have been conducted analyzing 43 - 18 gamaspektrometrichni 18 radiometric of total beta activity and 7 analysis of 90Sr.

Total beta activity dominates in straw (cakes, cob) and varies within the normal range of 98.7 Bq / kg adw Grains of corn to 1083.0 Bq / kg adw in the sunflower cakes. Higher values for measurements of silage (straw, cakes, books) than in the grain of the analyzed products, consistent with the literature data [34], the distribution of radionuclides in different parts of the crops.

The results of the gamma spectrometric measurements show that the registered total beta activity in samples is almost entirely due to natural 40K. In 2011. as in previous years, it is measured foreground activity of 137Cs and other anthropogenic radionuclides (137Cs MDA is <0.23 to <1.75 Bq / kg adw). Recorded activity of Sr is in the range of 0.073 h-1.54 Bq / kg adw The maximum value for sunflower cakes - 3-second district. Results for 2011 are in the normal range and are comparable with data from previous years for the same crops.

Conclusions

1. The contemporary green system on the territory of Kozloduy NPP involves the same groups of wood and shrubby species of different age, which are created in different periods. On the grass areas there are mostly derivative and secondary plant communities formed upon the vegetation fluctuations of the grass communities formed by grass mixtures.
2. In the vegetation of the territories adjacent to the Kozloduy NPP from 5km and 30km the agricultural plants prevail. On the desolated agricultural lands some derivative and secondary grass communities are formed, which consist of wide distributed grass species. Contemporary forest communities are of considerably poor stability.
3. The results of studies on the impact on natural vegetation and crops showed that the radioactivity in the samples examined in the normal range for the examined species. It is not known influence of NPP "Kozloduy" on vegetation outside the site.

3.8.1.3 Impact of Kozloduy NPP on the flora and vegetation on the territory of Romania

In Romania the National Environmental Radioactivity Surveillance Network (NERSN) performs monitoring of the radioactivity for the purposes of assessment of Kozloduy NPP Bulgaria in 4 laboratories, - Stations for Surveillance and Control of the Radioactivity SSRM. SSRM Bechet, SSRM Craiova, SSRM Drobeta Turnu Severin и SSRM Zimnicea and 13 automatic monitoring stations (11 in the District of Dolj, 1 in the district of Mehedinti and in the District of 1 in the District of Teleorman) for determination of gamma background. So far, there is no evidence of increased quantities of radioactive substances in plants under the influence of NPP Kozloduy. In tables 3.8.1.3.1 and 3.8.1.3.2 presents the results of radiological monitoring of parts of plants used for food.

Table 3.8.1.3-1- Results from radiological monitoring in Romania 30 km far from Kozloduy NPP

Sample	Year	District	Location	Measuring unit	Total beta activity
Wheat	15.12.2008.	Dj	Gighera	Bq/kg	89.9±7.2
Wheat	14.12.2009.	Dj	Gighera	Bq/kg	81.2±6.7
Wheat	12.11.2010.	Dj	Gighera	Bq/kg	79.5±7.2
Apple	15.12.2008.	Dj	Gighera	Bq/kg	37.7±4.9
Apple	14.12.2009.	Dj	Gighera	Bq/kg	34.7±5.1
Apple	13.12.2010.	Dj	Gighera	Bq/kg	39.3±3.8
Potato	15.12.2008.	Dj	Gighera	Bq/kg	132.7±6.7
Potato	14.12.2009.	Dj	Gighera	Bq/kg	129.9±9.7

Table 3.8.1.3-2- Results from radiological monitoring in Romania 30 km far from Kozloduy NPP

Sample	Year	District	Location	Measuring unit	^{137}Cs	^{90}Sr	^{Ra}226
Milk	15.12.2008.	Dj	Gighera	Bq/l	0.13±0.04	0.022±0.009	0.0056±0-002
Milk	14.12.2009.	Dj	Gighera	Bq/l	0.041±0.01	0.039±0.01	0.0054±0-003
Milk	13.12.2010.	Dj	Gighera	Bq/l	0.044±0.01	0.035±0.015	0.0049±0.003
Wheat	15.12.2008.	Dj	Gighera	Bq/kg	0.41±0.16	0.18±0.069	0.029±0.008
Weat	14.12.2009.	Dj	Gighera	Bq/kg	0.34±0.008	0.13±0.04	0.028±0.007
Wheat	12.11.2010.	Dj	Gighera	Bq/kg	0.33±0.014	0.11±0.043	0.023±0.001
Aples	15.12.2008.	Dj	Gighera	Bq/kg	0.039±0.013	0.019±0.005	0.0064±0.0028
Apple	14.12.2009.	Dj	Gighera	Bq/kg	0.035±0.014	0.014±0.001	0.003±0.001
Apple	13.12.2010.	Dj	Gighera	Bq/kg	0.037±0.01	0.016±0.007	0.0028±0.001
Potato	15.12.2008.	Dj	Gighera	Bq/kg	0.047±0.016	0.014±0.006	0.022±0.009
Potato	14.12.2009.	Dj	Gighera	Bq/kg	0.035±0.015	0.003±0.001	0.006±0.01

Conclusions

1. In Romania adjacent vegetation within the 30 km area around Kozloduy NPP are predominantly agricultural crops. Derivatives and secondary grasslands developed on abandoned agricultural lands. Specific plant ecosystems are formed of flooded areas and swamps.
2. There is no known negative impact of Kozloduy NPP on derivatives, natural vegetation and agricultural crops.

3.8.1.4 General characteristic of the vegetation in 30km area on the territory of Romania

According to official information received from Romania for the purposes of EIA-R within 30-kilometer zone around the Kozloduy NPP a matter of interest are Dolj up to the Danube River, Romanatilor, plane Bailesti, the rivers Jiu, Jiet and their inflows with an area of 133035ha. The vegetation in this area is mostly secondary and

derivative origin since most agricultural land with total area of 106976 ha, on which crops are grown. Forests, coastal lands and sands hold an average of 12% built-up areas - 6%, etc.

Information provided by the Romanian side on the distribution area of land cover classes in the areas of Dolj, Gorj, Mehedini, Olt, Teleorman Valcea and is presented in Table 3.8.1.4-1.

Table 3.8.1.4-1 Distribution of the Romanian territory in the land cover classes, within a 30 km zone around the NPP Kozloduy.

District	tillable lands	Built up areas	Forests, river bank lands	Lakes, rivers	Marshlands
DOLJ	563178.78	48720.69	94832.91	13193.50	19885.55
DOLJ	10328.13	1706.40	7701.76	340.18	572.47
MEHEDINI	114257.11	7653.91	23048.81	1625.75	2168.38
OLT	332219.23	29438.10	37205.86	8931.71	734.03
TELEORMAN	83528.41	5312.30	7779.09	1655.12	96.57
VALCEA	20439.09	2378.91	13175.43	463.81	17.55

The data in the table shows that all these areas are dominated by farmland - about 77% of the area. In these lands annual crops are cultivated, orchards, berry plantations, vineyards and more can be found. A significant participation of the agricultural land has natural vegetation in pastures and uncultivated agricultural lands.

In southern Dolj district native vegetation is replaced by secondary and derived vegetation of arable and uncultivated lands in more than 90% of the area. Separate areas of plantations are dominated by hairy oak (Quercus pubescens) or pedunculiflora oak (Quercus pedunculiflora). Grass communities are in grade type. They are formed by species resistant to drought and can refer to class formations Aestiduriherbosa.

The vegetation in the valley of the southern part of Dolj district, as part of the forest-steppe zone includes forest plantations dominated by Quercus pubescens and Quercus pedunculiflora and glades (Quercus pubescens and Quercus pedunculiflora), reaching near floodplain areas along the Danube River.

After the deforestation of the sandy lands, wind's action has reactivated sand dislocation, a fact that imposed planting with Robinia spp. of the sand dunes. These trees build now a protective forest-belt for the following settlements: Maglavit, Ciuperceni, Poiana Mare, Desa, Piscu Vechi, Ghidici. O the left side of Jiu river for: Rojistea, Apele Vii, Celaru, Amarasti, Piscu Sadovei, Bechet, Calarasi and Dabuleni.

The vegetation of Danube meadow and Jiu meadow is affected by sandy lands, up-level of ground water layer and by the presence of wet silts.

There are also groups of willow trees (Salix), poplar trees (Populus) and osier willows (Salix fragilis) which create riverside vegetation.

Also, there are Quercus spp. in association with filbert tree, wild rose tree and box thorn brushes.

At the lakes and in the wetlands areas hydrophilic vegetation as:common reed, mace reed, white water lily and sedge, shave grass (Scirpus maritimus), Ranunculus repens and Lemna minor can be found.

In the lake planning sector of Danube meadow (Ghidici-Rast-Bistret, Jiu-Bechet-Dabuleni), the associations of willow trees and poplar trees have been mostly cleared (deforested), but still exist on some small islands.Their place is being taken by hybrids of Populus nigra and Salix spp.

In floristic approach to classification of vegetation agrofitotsenozite, derived grasslands, forest communities and other derivatives and secondary communities in the adjacent area of the Kozloduy NPP in Romania can be related to the following groups:

- Communities of free-floating cormophyte plants Class Lemnetea R.Tx. 1955;
- Communities in freshwater pools attached to the bottom and floating plants Class Potametea Klika in Klika et Novak, 1941;
- Water and round-water vegetation attached to the bottom of freshwater and brackish swamps Class Phragmito-Magnocaricetea Klika in Klika et Novak, 1941;
- Weed plants in rice fields of the class Oryzetea sativae Miyawaki, 1960;
- Sinantrop communities dominated by annual species of disturbed habitats over-humid Class Bidentetea tripartite R.Tx. et all. Ex von Rochow, 1951;
- The communities of annual plants on degraded terrains and weed communities in row crops Stellarietea mediae Br.-Bl.,1931, Tx.,Lohm., Prsg.,1950;
- Steppes and sandy grassland class Festuco-Brometea Br.-Bl. et R. Tx. in Br.-Bl., 1949 (Brachipodio-Chrysopogonetea Horvatic, 1958);
- Mesophytic grassland class Molinio-Arrhenatheretea R. Tx., 1937
- Poplar and willow riverside forests and shrubs Class Salicetea purpurea Moor, 1958;
- Thermophilic oak forests Class Quercetea pubescentis Doing-Kraft ex Scamoni, 1959.

Conclusions

1. The contemporary green system on the territory of Kozloduy NPP involves the same groups of wood and shrubby species of different age, which are created in different periods. On the grass areas there are mostly derivative and secondary plant communities formed upon the vegetation fluctuations of the grass communities formed by grass mixtures.
2. In the vegetation of the territories adjacent to the Kozloduy NPP from 5 km and 30 km the agricultural plants prevail. On the desolated agricultural lands some derivative and secondary grass communities are formed, which consist of wide distributed grass species. Contemporary forest communities are of considerably poor stability.
3. Adverse impact on the natural and derivative flora and agricultural crop is not established.
4. In Romania adjacent vegetation within the 30 km area around Kozloduy NPP are predominantly agricultural crops. Derivatives and secondary grasslands developed on abandoned agricultural lands. Specific plant ecosystems are formed of flooded areas and swamps.
5. There is no known negative impact of Kozloduy NPP on derivatives, natural vegetation and agricultural crops.

3.8.2 Fauna

3.8.2.1 Animal kingdom

The area of the Investment proposal (IP) for decommissioning of Units 1-4 of Kozloduy NPP is located in the north-west part of the Danube valley. NPP is located close to Kozloduy town about 1,5-2 km away from the bank of the Danube River and is at the foundation of the low table land closed between the rivers Danube, Tsibritsa and Ogosta Climate in this region is moderate continental. It has some typical features. Maximal rainfalls are during the summer (August) and minimal ones are during the winter (February). Torrential rainfalls and stormy winds are typical for the region. Annual temperature fluctuations dare very big, which is typical for the continental climate. There is severe cold weather during the winter and heat and dry periods during the summer. There are severe cold weather periods during the winter and heat and dry periods during the summer. Snow cover occurs in December and melts in the second half of March.

As per B. Gruev and B. Kuzmanov (1994) moderate continental climate is favorable for distribution of the Northern biota and decreases strongly the possibility some Southern elements to settle there. In the opinion of the same authors European-Siberia, Medium European, holarctic and holopaleoarctic species are typical for the region as well as a lot of steppe species in the treeless territories and a number of sub-Mediterranean species too.

Young biota is typical for the Northern Bulgarian region that is distributed and developed in there during the quaternary. There are nearly no paleoendemits and and tertiary relicts available, because the tertiary lands in the present North Bulgaria have been overflowed by waters that have buried the remains of the Pliocene flora and Hyperion fauna.

According to the zoo-geographic classifications the territory of the IP is involved in the Danube subregion of the Northern Bulgarian Region. This subregion covers the strip of land alongside the Danube River bordered to the South with the fore-Balkan and Ludogorie region and with Dobrudzha region to the east. In this most plain part of our country that is cut by plenty of rivers the primary forest steppe vegetation is strongly reduced due to the use of the land for agricultural purposes. Remains of the natural vegetation are kept on the terraces of the right, eastern situated banks of some rivers (e.g. Ogosta). These natural vegetation communities include Hungarian oak, Turkey oak, Italian Pubescent Oak and English Oak. At some places there are mesophilic groups of Quercus pedunculiflora, manna ash and lime-tree and on the river banks there are hydrophilic communities of willows, white poplars with developed understory of elderberry, morus, Polish elm and ash-tree. In many land parts where the agricultural use of the land has been terminated a secondary grass vegetation of steppe type is grown, which often is mixed with weeds and ruderali. These grass communities consist mainly of Medium-European, Palearctic and European-Asian (steppe) types. Beard-grass communities are very typical too. On the territories of loess soil located in a narrow strip of land next to Danube a steppe vegetation gowns where the fauna of prevailing steppe elements is habited. Such loess steppes or pseudo steppes are the reason for detachment of Protected territories unde Natura 2000 in order o protect and keep its specific flora and fauna.

Especially valuables are the communities developed on extremely loess surfaces. Such places, where the upper black-earth layer is completely destroyed or is missing

are the vertical levels alongside the Danube Riverside as well as hills and steep banks of the rivers flowing into the Danube River. In such section between two rivers Tsibritsa and Ogosta the ground within the Kozloduy NPP is located.
Out of the species typical only for the Danube zoo-geographic subregion (and partially for the Dobrudzha region) there are a lot of species of Danube fishes, amphibians are represented by the Danube newt and Common Spadefoot and the mammalian are represented by two species of European hamsters (in the Danube River and riverside territories). Other species are typical for the river valleys, low lands and riverside territories. As such ones the fire-bellied toad and spotted snake could be classified.
According to the modern opinions in view of the zoo-geographic regional detachment of Bulgaria the fauna in the region consists mostly of the European and Euro-Siberian and other northern species that entered and habitted the region during the Quaternary. A lot of steppe animals have come here from northeast and currently there are a small number of steppe refigiums available. A part of these species has accommodated to live in wheat and some other agrocenosis and another stenobiont part has survived only in the natural and semi-natural steppes. In the Danube fauna there is also quite significant as ranging Eurasian biota available, which has used wheat agrocenoses as an ecological corridor for its colonization expansion. Sometimes this Euroasian agro-steppe biota is not correctly determined as a priority one. Actually, it should be considered as invasive and secondary and not to be mixed with the typical steppe elements. In contrast to the steppe fauna, which has a limited distribution these fauna is comparatively wide distributed including the open agrocenoses and secondary grass formations.
The ones of the invertebrates habiting the loess steppes as well as another from the wet areas and old mesophilic and overflowed forests have formed specific complexes. In the forms of Kozloduy Protected Area, Kozloduy Islands Protected Area and Zlatia Protected Area announced under the Habitat Directive a number of animal species is included and some of them could be found out in the region of the IP and its surrounding areas. The invertebrates in the region of the IP are represented not only by amphibian and water species (some of them are riverside inhabitants) but also by some other typical water species.
Hydrobiont fauna of the channels related to the Kozloduy NPP cooling system is more or less the same like the one of the Danube River and rivers from this water catchment area.
In the forms of relatively closely situated Protected areas there are two invertebrates species involved, which distribution is related to the river ecological systems and it is not expected they to be impacted by the IP. These two species are Depressed River Mussel (wrongly called - pearly mussel) and fore-operculum snail - stripped theodoxus. There are two terrestial fauna species determined for the region of the Kozloduy Islands - Stag Beetle and Rosalia longicom. These two species are inhabited in broad-leaved threes and the Stag Beetle prefers oak trees, but the Rosalia prefers elm tree, ash tree and some other riverside trees. Second specie has been never determined by any experts in this region.
There is an interested fauna in the region of IP consisting of some steppe species living in the wheat agrocenoses as well as in the steppe biota and overflown forests. A lot of these fauna complexes became exotic and other ones are completely

disappeared due to the changes occured in their habitats or due to the physical destroying of their habitats.
Ichthyofauna in the region is specific and peculiar due to the vicinity of the Danube River to the region that is subject to IP. Danube River and its water catchment area are the only places where these species could be found. a lot of these species became exotic and that is why they are included in international documents aiming to protect them. For seven of the species included in the forms of the Natura zones the water catchment area is a relict and endemic one. These species are Balkan Loach, Balkan Golden Loach, Mediterranean barbel and Danube streber, Balon's ruffle and Stripped ruffle as well as White-finned gudgeon, which are endemits of the Danube and its water catchment area.
According to the contemporary investigations the Spinned loach (*Cobitis taenia*) has been never discovered on the Balkan Peninsula. These species inhabit North Europe and in our latitudes there are another specific species that very long time have been wrongly considered as Spined Loach. Available species are also endemic for the Danube water catchment area and are called -*C.elongoides.*
IP specifics does not suppose any impact on the river and water territories so we do not consider need to analyse these part of the fauna.
Aphibians in the IP region are probable 9 - 10 species Typical species for the IP region are both terrestrial amphibians such as Common spade footand Green Toad as well as "water" amphibians such as Danube Crested Newt, Fire-bellied toadand Green Lake Frogs. Rest frog species are more or less related to the aquatic and amphibian media or to the forest complexes as well. Such species are discovered in some territories comparatively close to the region. Due to the lack of forest territories it is senseless to analyze both species of caudata related to the aquatic areas or forest habitats. There are no such species close to the IP. The territory of the IP is of greatest importance for the Common spade foot, which populations are of relatively high density. There is a high number of this animal in natural and semi-natural habitats and his number in the agrocenoses is relatively high. These facts could be caused by many reasons but the most probable ones are the temporary status of the agrocenosis and their plough out during the autumn and print season as well as the treatment of the agricultural crops with vegetation protection agents. Also, in the IP region there are Danube Crested Newt and Fire-bellied toad, which during the most part of the year live close to the water catchment areas (such artificial water source in the IP region is the artificial channel that could be a media for habitation of these animals).
Reptiles in the region have been never subject to special studies. Generally for he Danube valley three turtle species, five lizard species and seven snake species are typical. For the IP region only Balkan Wall Lizard and green lizards could be mentioned, which live everywhere as well as the the European lizard, which could be found also in synatrope landscapes. There are two reptile species mentioned in the zone papers – European pond turtle and four-lined snake which has no habitats in the region of the IP. While the European Pond Turtle is registered in the region of the wet areas of the Protected Zone, i.e. around the rivers Tsibritsa, Ogosta and Danube the four-lined snake has been never registered in the region. Its closed plausible habitat is the town of Nikopol. For these species the IP is the Western end border of the habitat. There are to species of grass-snake that could be registered in the IP region - Caspian whip snake and Aesculapian snake.

Mammalian fauna of the region has been never studied up to the moment. There are only some data about some big mammalians that are subject of management and use. During the monitoring held in the region of the protected areas of Zlatia and Kozloduy 10 species of small terrestrial mammalians, three bats and 6 species of big animals were determined in the region of IP. Of the small terrestrial mammalians the Romanian hamster and the Black-bellied Hamster are subject to protection in the Protected Zone and are included in the Habitat Directive. While the Romanian hamster habits in the semi-natural and natural steppe communities the Black-bellied Hamster habits mostly in agrocenoses. Specimens of this animal have been established at several areas situated close to the IP region. These species are clearly related to the agrocenoses and probably the IP would not impact on its distribution and population condition. Rest complex of species includes both common species and some species or restricted habitation. House mouse and probably the European Hamster could be classified as such species.

Bat fauna has not been also investigated up to the moment. In the IP region there are three bat types but no one of them is included in the Habitat Directive. According to the experts' consideration the reason for smaller number of individuals and the relatively small number of species is a result of the unfavorable microclimatic features (very often there is strong wind blown) as well as due to the large areas occupied by agricultural crops. Entomofauna of the agricultural crops is poor and does not offer the needed set of nutritious resources needed for the normal existence of bats. Determined species are: Serotine bat *Eptesicus serotinus* (Schreber, 1774), Pipistrel *Pipistrellus pipistrellus* (Schreber, 1774), Nathusius's pipistrelle *Pipistrellus nathusii* (Keyserling et Blasius, 1839). There is more various bat fauna next to the riverside territories of Danube River but due to the big remoteness of the analyzed ground it would not be investigated.

Big mammalians in the region are represented by 6 pecies of predators and two species of cloven-footed animals. Abundance of rodents eating wheat crops is a prerequisite for the high number of predators there. Most numerous predators are the jacal followed by the fox and badger. As per our investigations in the region of Zlatia and Kozloduy protected area some traces and faeces of a small polecat have been found, which is probably either marbled polecat or Siberian polecat. Both species are related to the columns of Romanian Hamster of European Hamster so we could assume that both species are habited there. IP specific will not have any impact affecting these animals. As species directly related to the waterside territories and water sources the Otter is also not a subject to the analysis.

Analysis made on the grounds of a concrete fauna in the IP regions stipulates that there is relatively weak interrelation between the offered IP and the sites subject to protection within the protected areas situated relatively close.

Detail protection measures as a result of the analysis of the possible negative impacts will be reviewed in the following chapters of the Report.

According to the data provided in [179] concerning fauna on the concerned Romanian territory it can be summarized that the following plants and animals exist: herbaceous plants as graminaceae species; induce mammalian species as: ground squirrel, field mouse, rat, small preys: polecat, weasel and also big mammalian species as fox and hare, ground squirrel, field mouse, rat, small preys: polecat, weasel and also big mammalian species as fox and hare.

The following bird species can be found here: quail, partridge, lark, and starling. The species beeeater and martin nestle live on clayey or sandy banks. Close to the rivers and meadows, in reed plots, one can find nests of wild ducks and geese or other birds which find their food in these wetlands: stork, common tern, whistler, diver and rarely, the egret.
In aquatic field we find fish species which lives in ponds at: Bistret, Cetate, Fantanele, Vartop, Cornu, Caraula and Preajba but also in natural lakes from Danube and Jiu meadow and even in small rivers.

3.8.2.2 Birds

Kozloduy NPP is located in the North-West part of Bulgaria on the territory of Vratsa District, Kozloduy Municipality, mainly in the lands of the town the town of Kozloduy and the village of Its location is shown on the geographic map in the Appendix 11.3.5. Site consists respectively of about 3.5 km south-east from Kozloduy, 4.0 km northwest from the village of Hurlets, 65 km northern from the District Centre of the town of Vratsa and 200 km Northern from the town of Sofia. It is almost entirely located on the first not overflowed terrace of the Danube River, which is located about 3 km away to the North *(*Fig. 3.8.2-1).

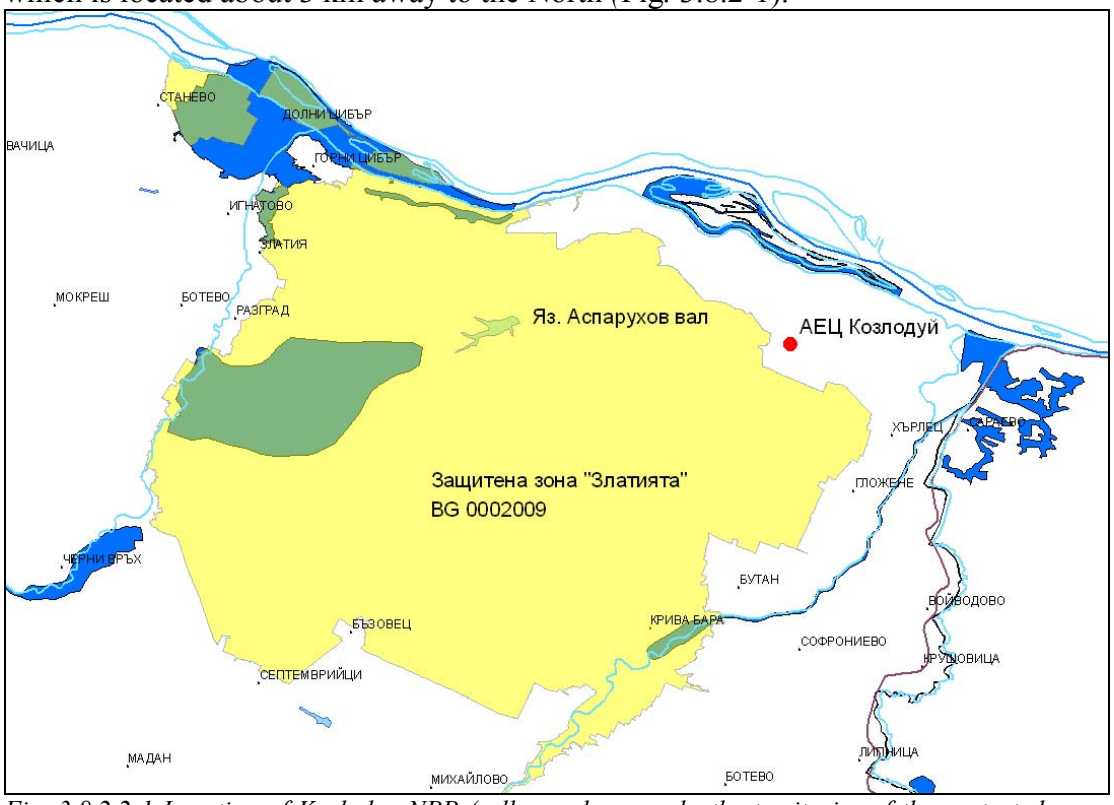


Fig. 3.8.2.2-1 Location of Kozloduy NPP (yellow colour marks the territories of the protected zones according to the Bird Directive, blue colours marks the territories under the Directive for inhabitats and green colour - under both directives).

Main part of the Hygiene Protection Area (HPA) of the power plant covers agricultural lands of the adjacent region. To the North from Kozloduy NPP these are the lands of Blatoto area, in the overflowed terrace of the river, a part of which after the construction of a drainage network are not boggy and are usable. In the river of the Danube River also Kozloduy Island is located. After it there are some other islands located the biggest of which is Tsibur (Ibisha) island.. Lands of the first not

overflowed terrace and higher terraces are located to the East. To the South the green belt of the bank area and lands under the loess tableland Zltatiata are involved within the borders of HPA having typical steppe fauna. Asparuhov (Shishmanov) bank and 5 micro dams are located there and the biggest of them is located next to the village of Septemvriitsi. Except agricultural lands there are linear facilities, communications, heat pipeline etc. located to the West.

According to the zoological and geographic allocation of the regions made by Georgiev (2002) region of Kozloduy NPP is a part of the Danube zoological and geographic region. It covers the territory of the Danube valley, Ludogorie and a part of the Dobrudzha tableland. Most types of its fauna are of European-Siberian and European elements. This is also valid for the nesting birds, which are very similar to the ones of the Black seacoast – 85.6%. Mediterranean Bird species are represented most rarely comparing with the other zoological geographic regions and the Northern species are distributed 4 times more than the ones of Southern type.

3.8.2.1 Generative period

About the birds of Kozloduy NPP there are some brief data published by Patev (1950) [93], Paspaleva-Antonova (1961) [92], Simeonov etc. (1990) [94], and Nankinov etc. (1997) [91]. Recently, in connection with the construction of the national environmental network Natura 2000, some ornithological information is published by Kostadinova, Gramatikova (2007) [95]. There is a valuable information abouth the bird species pursuant to the Bird Directive contained also in the standard forms for the protected areas Zlatiata, Tsibur bog, Ibisha and the Island next to Gorni Tsibur. Data about the species and quantitative composition of the nesting ornithological fauna of UTM squares, where Zlatiata is situated are presented by Yankov (2007) [97] and Michev etc.(2008) [91]. Information on the animal kingdom, including birds is contained in the EIA-R of Kozloduy NPP elaborated in 1999 (Appendix 4.7.3-1, and 4.7.3-2 [82]).

Based on the literature review it could be concluded that within the region around the site of Kozloduy NPP there are above 120 bird species including several ecological groups. The most numerous is the group of the water-loving birds followed by the species of the open areas etc. In the investigated region there are 23 species of nesting birds determined. Also, there are three registered nests of long-legged Buzzard (*Buteo rufinus*). In the populated areas around the investigated region there are totally 65 inhabited nests of white storks and the most nests (12) are located in the village of Dolno Tserovene (municipality of Yakimovo).

There are several bird species having special status in comparing with the rest ones. These are species of worldwide importance that exceeds 1% Ramsar threshold, species of the Bulgarian Red Book, species of single habitats in the country, species-subject to environmental protection, the most numerous migrants etc. All they will be examined consequently:

- Dalmatian Pelican *(Pelecanus crispus)* – Hunts in the neighbour Romanian marshlands and stays for the night and rests next to the sand spits of the adjacent islands. Single birds and small flocks are monitored when making food migrations to the Dam next to the village of Septemvriitsi. During the migration big concentrations are made (between 150 and 252) in the Island Protected Area next to the Gorni Tsibur BG0000 2008.

- White stork *(Ciconia ciconia)* – common nesting species nesting in the villages around "Zlatiata". In 1994 there are above 50 nests on the territory of Kozloduy municipality and in 2004 – between 60 and 130. It is at fourth place among the migrants during the autumn migration in the region amounting to 1106 birds.
- Little white-fronted goose *(Anser erythropus)* –there are no data available in the Bulgarian ornithological literature about these world jeopardized species in the examined region but in the standard forms there are data about the hibernating single birds.
- Montagu's harrier *(Circus pygargus)*. In the standard form for the protected area of "Zlatiata" it is specified as a nesting type. During the migration there are 127 spring and 16 autumn migrants recorded (Michev etc., 2008 [91]).
- Red-footed falcon *(Falco vespertinus)*. In the standard form of the protected area "Zlatiata" it is specified as nesting species, but there is no nesting proven for sure. On the ground of the industrial site and in the rest part of the protected area a big part of the threes is cut where usually the nests of these species are located.
- Great bustard *(Otis tarda)*. In the standard form for the protected area of "Zlatiata" it is specified as a nesting type.No nesting is proven for sure. As a result of the monitoring (Michev etc., 2008 [91]) no nesting is found for sure. Considering the presence of many people and agricultural equipment in Zlatiata there are no conditions for reproduction of great bustards.
- Golden plover (*Pluvialis apricaria)* – the most numerous migrant during the spring migration in the investigated region amounting to 1318 birds (Michev etc., 2008).[91])

Field-lark (Alauda arvensis) - the most numerous nesting species amounting to 1155 birds or 2.4% of the total number (47870 species) of the birds in the Protected Area „Zlatiata".

During the visit on 29 October 2009 on the site of Kozloduy NPP (between the administrative buildings, Unit 2 and the beginning of both channels) the following bird species has been found:

- Long-legged buzzard (*Buteo rufinus*) – one old bird migrating over the Access Control Point in the south part of the plant region;
- Black-headed gull (*Larus ridibundus*) – a flock of 6 birds migrating over the beginning of the hot channel;
- Fantail pigeon (*Columba domestica*) – a flock of 25 birds migrating over the western part of the power plant;
- House Martin (*Delichon urbica*) – old nests on the building of Unit 2;
- Great tit (*Parus major*) – one bird in the grass areas in front of the administrative building;
- Jackdaw (*Coleus monedula*) – nest of 12 birds in the beginning of both channels;
- Mag pie (*Pica pica*) – two migrating birds over the grass areas next to the administrative buildings of the power plant.
- *Passer montanus* – birds fly off and in into old nests of the House Martins.

3.8.2.2 Migration period

During the migration in the examined region (from the monitoring point in the NorthWest part of the Zlatiata) there are spring 4382 birds and 25509 of autumn migrants (Michev etc., 2008 [91]). The most numerous migrant in the spring is the

Golden Plover (*Pluvialis apricaria*), nd during the autumn this is common starling (*Sturnus vulgaris).* Among the 10 most numerous spring and autumn migrants there are some species subject to protection into the protected area (white and black stork, duck-hawk and Montagu's Harrier). Main migration direction of the birds through Zlatiata is North-West - North-East (NW – SE).

On the grounds of the received results a conclusion could be made that over the examined region there are no numerous migrants passing through. Its territory is not crossed by considerable migration roads. As a whole the migration of the flying birds is small.

As per the ecological groups the of migrants are allocated as follows (Table 3.8.2.2-1):

Table 3.8.2.2-1 Allocation of the migrants by ecological groups during the spring and autumn migration of 2008 over the NP Zlatiata.

Season	Flying	Sparrow-like	water-loving	Other	Total
Spring	1302	844	2001	235	4382
Autumn	2236	22014	523	736	25509
Total	3538	22858	2524	971	29891

3.8.2.3 Hibernating period

Regarding the hibernating period of the water loving birds there is considerable number of information available. It is collected during the annual Mediterranean counting since 1977 (Kostadinova, Dereliev 2001; Michev & Profirov, 2003 [96]). It is established that a big part of the territory of the Zlatiata when there is no snow covering and icing of the Danube and the dam of Asparuhov val could be a solid nutrition facility mostly for the great white-fronted *(Anser albifrons)* and grey gooses *(Anser anser.* For the section of the Danube River, incl. Asparuhov val, Michev & Profirov (2003[96]) specifies average numerous of 25 years between 5600 and 7000 birds of 8-16 species*).* In the dam of Septemvriitsi (located to the South of the protected area Zlatiata) Kostadinova and Dereliev (2001) [96] found 11 hibernating water-loving birds (*Anser albifrons* -5 birds *Gallinago gallinago* – 6 species.).

3.8.2.4 Summary of the ornithological situation in the region of Zlatiata protected area

As a result of the information accumulated by the birds' monitoring in the investigated territory the following picture could be prepared, which is shown on the satellite picture of Google Earth (Fig. 3.8.2.4-1).

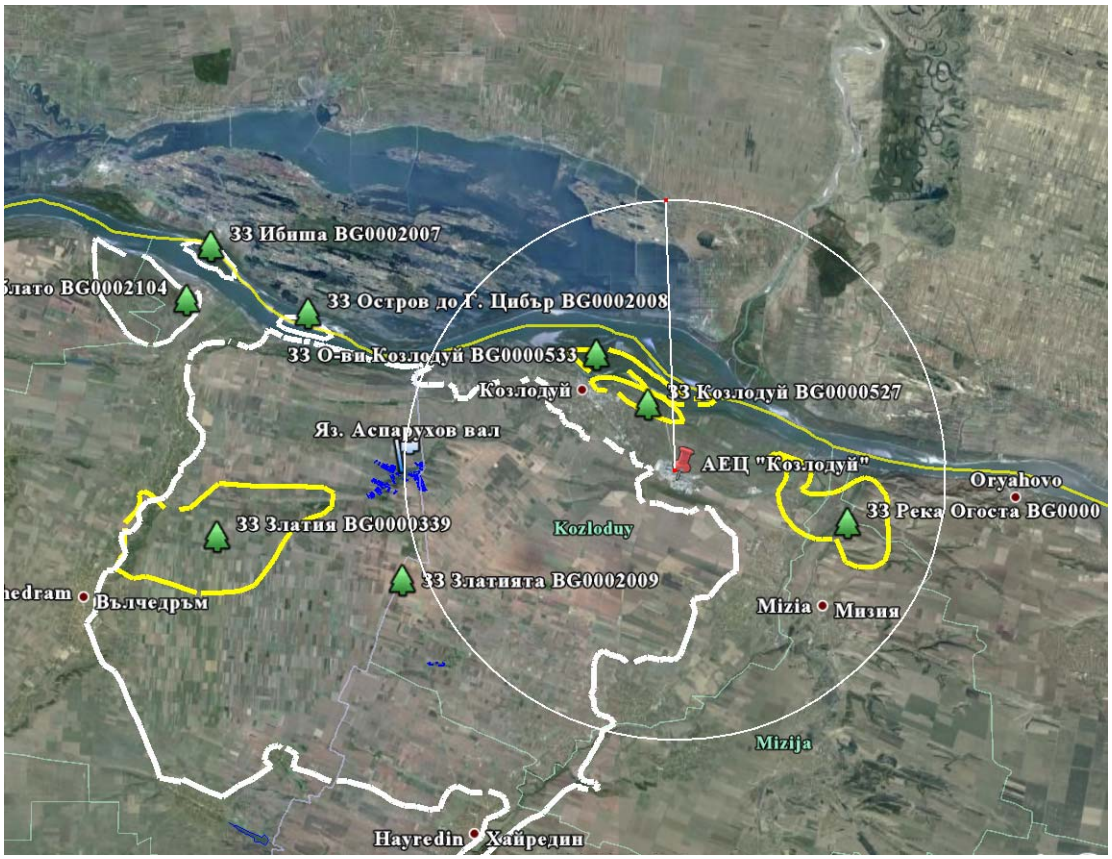


Fig. 3.8.2.4-1 Region of Kozloduy NPP together with the white-colour areas of Natura 2000 pursuant to the Bird directives and yellow-colour ones pursuant to the habitats directive; 12-km zone is marked with white circle.

From there it is seen that to the North from the protected area Zlatiata from both sides of the Danube River there are se4veral natural sites of high conservation value. They are based on large and rich of fish marsh-land next to the Romanian town Bustretsu, mouth of Zhiu and Tsibritsa rivers and several big Danube islands. Also here like alongside our Danube coastal area, the islands being not easily accessible for the humans are used by the birds for nesting and the wide wet zones on the left bank are used for feeding. This is the reason why the main food migrations of the birds from the nesting colonies of cormorants and herons are directed to the North of Danube. A small part of them fly to the South to the microdams located to the South of the Zlatiata as well as alongside the river bed of the Danube and adjacent islands. Most attractive birds in the investigated region are agricultural crops in the Zlatiata and wed areas on both banks of the Danube River.

3.9 Cultural heritage

Availability of architectural, hystorical and archaeological monuments. Current condition

In the Republic of Bulgaria National institute for protection of the immovable cultural values (NIPICV) (successor of the National Institute for cultural monuments – NICM, Sofia, 1000, 16 Doundukov Blvd., tel/fax 987 48 01) based on the currently existing LOW FOR CULTURAL HERITAGE – (LCH) (accepted by the 40th Parliament on 26 February 2009, promulgated in SG, # 19 from 13 March 2009 and entered into force from 10 April 2009 except Article 114, Para 2. and Para 126,

effective from 10 April 2010 replacing the previous one that has been effective for 40 years – since 1969 Law for cultural monuments and museums) is "State Cultural Institute of National Importance in the field of protection of immovable cultural heritage" (Article 18). .

According to the LCH [70], Article 58, and Para 1 "Declaration of sites that could be determined as immovable cultural values is made by the NIPNCV on the grounds of preliminary evaluation of their valuable scientific value and public importance".

Determination of the scientific and cultural value of the immovable site, its preliminary classification as well as the temporary modes of its protection is made with a declaration act issued by the Director of NIPNCV (Article 58, Para 2).

When the complex evaluation determines that the declared immovable sites have qualities of immovable cultural values, a proposal is submitted to the Minister of Culture by the director of NIPICV for their final classification, categorization and protection regimes (Article 64, Para 1).

A letter was sent to the Director of the National Institute for Protection of Immovable Cultural Values (NIPICV) by the investor (Employer) – and based on the ground of the ordinance for provisions and procedure for execution of the environmental impact assessment of the investment proposals (SG, issue 25 from 2003, amended and supplemented SG, N 3 3 from 2006) [76] a notification was made that a procedure for implementation of the investment proposal was started.

Investment proposal foresees "Decommissioning of units 1 to 4 of Kozloduy NPP.

Investigations made in the REGISTER of NIPICV showed that on the site of the investment proposal (site of Kozloduy NPP) there are no immovable cultural values and within the closest adjacent territories – 30 km area around the power plant there are some sites having the status of immovable cultural monuments.

Cultural historical monuments are numerous and various - from the antiquity, Middle Ages, from the period of fight for national and religious liberty etc.

Most important sites and attractions that could be subject to attention as touristic sites and attractions could be split in the following groops: 1. Cultural and historical monuments of antiquity and Middle Ages; 2. Religious monuments; 3. Interest ethnographic peculiarities.

Situation by November 2009 is as follows: in 30 – km scope around the power plant in 26 populated areas there are 148 sites of cultural and historical heritage of different ages that are split in types as follows:

- Archaeological reserve – 1 site;
- Archaeological monuments – 56 sites;
- Architectural-construction monuments – 58 sites;
- Architectural-art monuments – 1 site
- Historical monuments – 24 sites;
- Art monuments – 8 sites
- Depending of their importance instant (category) they are separated as follows:

- Of national importance – 22 sites;
- Of local importance 121 sites;
- For information only – 5 sites;
- Written-off – 3 sites.

In the territorial scope they are separated as follows:

0-**3 km area around Kozloduy NPP"**

There are no populated areas and cultural and historical monuments.

3-5 km area around Kozloduy NPP "Kozloduy - 2 populated areas with 8 sites totally.

- town of Kozloduy – municipality of Kozloduy, Vratsa district – 4 sites (List of the single sites on the territories, having the status of immovable cultural monuments are shown in Table 1-1 in Appendix. 11.3.4).
- v. Hurlets – municipality of Kozloduy, Vratsa district – 4 sites (List of the single sites on the territories, having the status of immovable cultural monuments are shown in Table 2 Appendix 11.3.4).

5-**8 km area around Kozloduy NPP - 2 populated areas with 5 sites totally**.

- town of Mizia – municipality of Mizia, Vratsa district – 3 sites (LISTS of the single sites on the territories, having the status of immovable cultural monuments are shown in Table 3).– Appendix 11.3.4).
- v. Lipnitsa – municipality of Mizia, Vratsa district – 2 sites (LISTS of the single sites on the territories, having the status of immovable cultural monuments are shown in Table -4 Appendix 11.3.4).

8-**12 km area around Kozloduy NPP - 1 populated area with 5 sites**

- v. Butan – municipality of Kozloduy, Vratsa district – 5 sites (List of the single sites on the territories, having the status of immovable cultural monuments are shown in Table 5 Appendix 11.3.4).

12-15 km area around Kozloduy NPP - 5 populated areas with 56 sites totally

- town of Town of Oryahovo – Oryahovo municipality, district of Vratsa – 42 sites (LISTS of the single sites and territories, having the status of immovable cultural monuments are shown in Table 6 Appendix 11.3.4).
- v. Ostrov – Oryahovo municipality, district of Vratsa – 3 sites (LISTS of the single sites and territories, having the status of immovable cultural monuments are shown in Table 7 Appendix 11.3.4).
- Dolni Vadin– Oryahovo municipality, district of Vratsa – 1 site (List of the single sites and territories, having the status of immovable cultural monuments are shown in Table 8- Appendix 11.3.4).).
- v. Krushovitsa – Oryahovo municipality, district of Vratsa – 7 sites (LISTS of the single sites and territories, having the status of immovable cultural monuments are shown in Table 9 Appendix 11.3.4).
- v. Sofroniievo – municipality of Mizia, Vratsa district – 3 sites (List of the single sites on the territories, having the status of immovable cultural monuments are shown in Table 10 - Appendix 11.3.4).

15-20 km area around Kozloduy NPP-4 populated areas with 15 sites totally

- v. Leskovets – Oryahovo municipality, district of Vratsa – 1 site (LISTS of the single sites and territories, having the status of immovable cultural monuments are shown in Table 11 - Appendix 11.3.4).

- Selanovtsi – Oryahovo municipality, district of Vratsa – 4 sites (LISTS of the single sites and territories, having the status of immovable cultural monuments are shown in Table 12). Appendix 11.3.4.
- town of Town of Hayredin – Oryahovo municipality, district of Vratsa – 7 sites (List of the single sites and territories, having the status of immovable cultural monuments are shown in Table 13 Appendix 11.3.4).
- v. Botevo – Oryahovo municipality, district of Vratsa – 3 sites (List of the single sites and territories, having the status of immovable cultural monuments are shown in Table 14 Appendix 11.3.4).

20-25 km area around Kozloduy NPP - 6 populated areas with 28 sites totally

- v. Galitche – Byala slatina municipality, district of Vratsa – 4 sites (Lists of the single sites and territories, having the status of immovable cultural monuments are shown in Table 15 Appendix 11.3.4).
- v. Altemir– Byala slatina municipality, district of Vratsa – 7 sites (Lists of the single sites and territories, having the status of immovable cultural monuments are shown in Table 16 Appendix 11.3.4).
- v. Mihalkovo – Oryahovo municipality, district of Vratsa – 7 sites (LISTS of the single sites and territories, having the status of immovable cultural monuments are shown in Table 17 Appendix 11.3.4).
- v Manastirishte – Hairedin municipality, district of Vratsa – 1 site (Lists of the single sites and territories, having the status of immovable cultural monuments are shown in Table 18 Appendix 11.3.4).
- Gorni Tsibur – Vulchedrum municipality, district of Montana– 5 sites (Lists of the single sites and territories, having the status of immovable cultural monuments are shown in Table 19 Appendix 11.3.4).
- v. Dolni Tsibur – Vulchedrum municipality, district of Montana– 4 sites (Lists of the single sites and territories, having the status of immovable cultural monuments are shown in Table 20 Appendix 11.3.4).

25-30 km area around Kozloduy NPP - 9 populated areas with 31 sites totally

- v. Burdarski Geran– Byala Slatina municipality, district of Vratsa – 1 site (Lists of the single sites and territories, having the status of immovable cultural monuments are shown in Table 21 Appendix 11.3.4).
- v. Turnava– Byala Slatina municipality, district of Vratsa – 3 sites (LISTS of the single sites and territories, having the status of immovable cultural monuments are shown in Table 22 Appendix 11.3.4).
- v. Dobrolevo – Borovan municipality, district of Vratsa – 1 site (LISTS of the single sites and territories, having the status of immovable cultural monuments are shown in Table 23 - Appendix 11.3.4).
- v. Furen – Krivodol municipality, district of Vratsa – 3 sites (LISTS of the single sites and territories, having the status of immovable cultural monuments are shown in Table 24 Appendix 11.3.4).
- v. Beli brod – Boitchinovtsi municipality, district of Montana– 5 sites (Lists of the single sites and territories, having the status of immovable cultural monuments are shown in Table 25 Appendix 11.3.4).
- v. Septemvriitsi (village Gorna Gnoenitsa) – Vulchedrum municipality, district of Montana– 1 site (Lists of the single sites and territories, having the status of immovable cultural monuments are shown in Table 26 Appendix 11.3.4).

- town of Vulchedrum – Vulchedrum municipality, district of Montana– 12 sites (Lists of the single sites and territories, having the status of immovable cultural monuments are shown in Table 27 Appendix 11.3.4).
- v. Razgrad – Vulchedrum municipality, district of Montana– 3 sites (Lists of the single sites and territories, having the status of immovable cultural monuments are shown in Table 28 Appendix 11.3.4).
- v. Stanevo – Lom municipality, district of Montana– 2 sites (Lists of the single sites and territories, having the status of immovable cultural monuments are shown in Table 29 Appendix 11.3.4

Detailed description of the sites of cultural and historical heritage in populated areas and categories of the monuments in the investigated territorial range (30-km area around the Kozloduy NPP) is presented in the listed tables in Chapter 11. (Appendices to Chapter 3)

Detailed description of the cultural heritage of the territory of Romania in the 30 km zone around the Kozloduy NPP as presented by the Romanian side is listed in the Reference [175.176 and 177]. The nearest area to Kozloduy NPP is the County Dolj with altogether 699 historical monuments. The city with the highest concentration is Craiova with 314 historical monuments. The distance to KNPP is about 65 km. In the 30 km area around Kozloduy NPP 31 historical monuments are situated, described in the table below.

Table 3.9.1-1 Historical monuments in the Romanian area (30 km around KNPP)

Code LMI	Name	Location	Address,	Dating
DJ-I-s-B-	Archeological	v. Listeava,	“La Livezi”	
DJ-I-m-B-	Establishment	v. Listeava,	“La Livezi”	Sec X
DJ-I-m-B-	Necropolis	v. Listeava,	“La Livezi”	Hallstatt
DJ-I-s-B-	Archeological	DJ-II-m-B-8360	Village Nedeia,	Bronze
DJ-I-m-B-	Establishment	Village Nedeia,	“Grindul cu oale”	Hallstatt
DJ-I-m-B-	Establishment	Village Nedeia,	“Grindul cu oale”	Bronze
DJ-I-s-B-7908	Roman camps Plosca	Village Plosca, comuna Bistret	8,2 km from the Village Plosca	
DJ-I-m-B-7908 01	Roman camps Plosca	Village Plosca, comuna Bistret		Epoca Romana
DJ-I-m-B-7908 02	Castru de Piatra	Village Plosca, comuna Bistret		Epoca Romana
DJ-I-s-B-7916	Establishment	v. Valea Stanciului	« La Vracea »	Sec.I p. Chr.
DJ-II-m-B-	“Sf. Gheorghe”	town Bechet		1870
DJ-II-m-B-	“Sf.	church		1826
DJ-II-m-B-	“Sf. Gheorghe”	town of Dabuleni		
DJ-II-m-B-	“Sf. Dumitru”	v. Gighera,		1848
DJ-II-m-B-	“Cuvioasa	v. Goicea, comuna		1856
DJ-II-m-B-	Church	v. Horezu Poenari,		1852

DJ-II-m-B-	Church Sf.	v. Macesu de Jos,		1833
DJ-II-m-B-	Church "Sf.	v. Macesu de Sus,		1825
DJ-II-m-B-	"Adormirea	v. Ostroveni,		1796
DJ-II-m-B-	Church "Sf.	v. Ostroveni,		1792
DJ-II-m-B-	Church "Sf.	v. Ostroveni,		1793
DJ-II-m-B-08338	Church "Sf. Nicolae"	v. Piscu Sadovei, comuna Sadova		1844
DJ-II-a-B-08360	Monastery Sadova	Village Sadova, comuna Sadova		sec. XVII
DJ-II-m-B-8360 01	Church "Sf. Nicolae"	Village Sadova, comuna Sadova		XV- XVI в.
DJ-II-m-B-8360 02	Bolnita "Intrarea in Biserica"	Village Sadova, comuna Sadova		
DJ-II-m-B-8360 03	ruine	Village Sadova, comuna Sadova		sec. XIX
DJ-II-m-B-8360 04	Tower Bell	Village Sadova, comuna Sadova		sec. XVII
DJ-II-m-B-8360 05	ruine	Village Sadova, comuna Sadova		sec. XVII
DJ-II-m-B-08394	"Sf. Voievoczi"	village Valea Stanciului, comuna Valea Stanciului		1792
DJ-II-m-B-08395	Church "Sf. Dumitru"	village Valea Stanciului, comuna Valea Stanciului	Fostul Village Tuguresti	sec. XVII
DJ-II-m-B-08396	Church "Sf. Nicolae"	village Valea Stanciului, comuna Valea Stanciului	Fostul Village Barza	1822

Conclusions:

1. When investigating the availability and condition of the cultural monuments some Dossier of NIPICM are used (National Documentary Archive), providing information for the registered cultural monuments (cultural values) – declared and nominated as well as their categorization.
2. All discovered archaeological sites, constructions and memorial places and adjacent ornamental and art decoration on the territory and aquatic of the Republic of Bulgaria *status of immovable cultural monuments - immovable cultural values*;
3. All newly discovered and undiscovered by the current moment archaeological cultural monuments on the territory of the country are declared as cultural monuments with ***preliminary category "national importance"*** – letter N 545 of NICM with the Ministry of Culture from 27 February 2001.

4. According to Decree N 1711 of the Council of Ministry 22 October 1962 all settlement and funeral mounds and defensive banks in Bulgaria are announced as cultural monuments of national importance – i.e. they have ***a status of the cultural monuments of the category "national importance";***
5. All memorial signs risen in view of the participation of Bulgaria in the wars from 1885, 1912-1913, 1915-1918, 1944-1945 years are ***declared as historical cultural monuments*** – letter N 4349 of NICM with the Ministry of Culture from 4 December 1992.
6. In view of the possibility some unregistered archaeological cultural monuments to be available up to the moment next to territory of the site we recommend the investor contact an expert-archaeologist for more information.
7. Based on data provided by the Romanian side concerning the cultural and historical heritage and taking into account that the decommissioning activities will take place within the borders of KNPP site, the conclusion can be made that transboundary impacts are not expected.

3.10 Health Status of the Population

Analysis of the personnel and population health risk will be made on the ground of the potential risks for the activities carried out during the different stages of the decommissioning process of Units 1-4 of KNPP.

Health and Demographic Status of the Population

1. Potentially affected population

Kozloduy NPP is situated in the North-West country region next to the Bulgarian Danube bank on the territory of the Municipality of Kozloduy Municipality of Below the capable for working age

- Kozloduy – 14445 residents;
- Village of Hurlets – 2289 residents;
- Village of Butan – 3088 residents;
- Village of Glojene – 2889 residents
- Village of Kriva bara - 471 residents.
- 30 km area also includes entirely four more municipalities, namely:
- Town of Oryahovo - 12936 residents;
- Mizia town - 7882 residents;
- Vulchedrum town -10986 residents;
- Village of Hairedin 5658 residents.

Residents of these municipalities are about 60000 people. Besides, within the restricted 30 km also 12 small villages are included that are situated on the Romanian river bank of the municipalities of Lom and municipality of Byala Slatina.

Demographic development of municipality of municipality Kozloduy compared with the total data for the country about the municipalityof Vratsa is presented on fig. 3.10.-1.

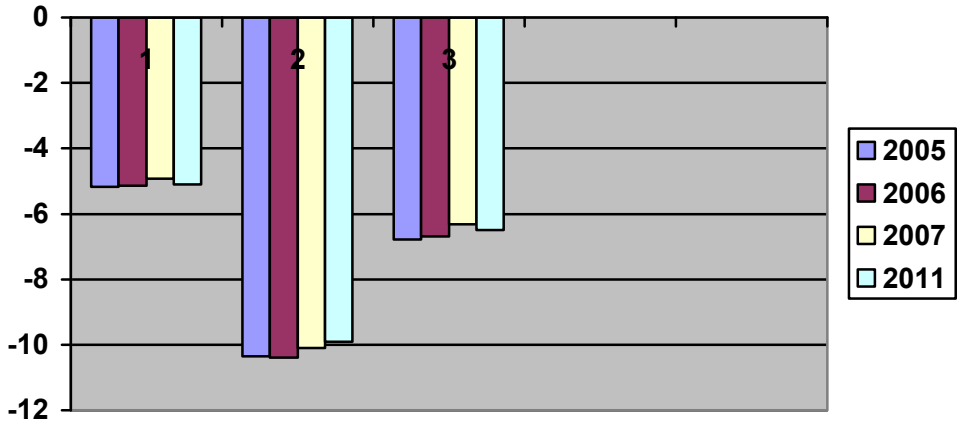


Fig. 3.10-1 Dynamic of the population growth in: 1- Whole country; 2 - Municipality Vratsa; 3 - Kozloduy Municipality.

The graph demonstrates considerably worse condition of the population growth in the municipality of Vratsa comparing with the average data for the country. Demographic processes of the municipality of Kozloduy are considerably better than the ones in the district but they are worse than the total country data. During the last years there is an ongoing process of reduction of the negative population growth that is well expressed

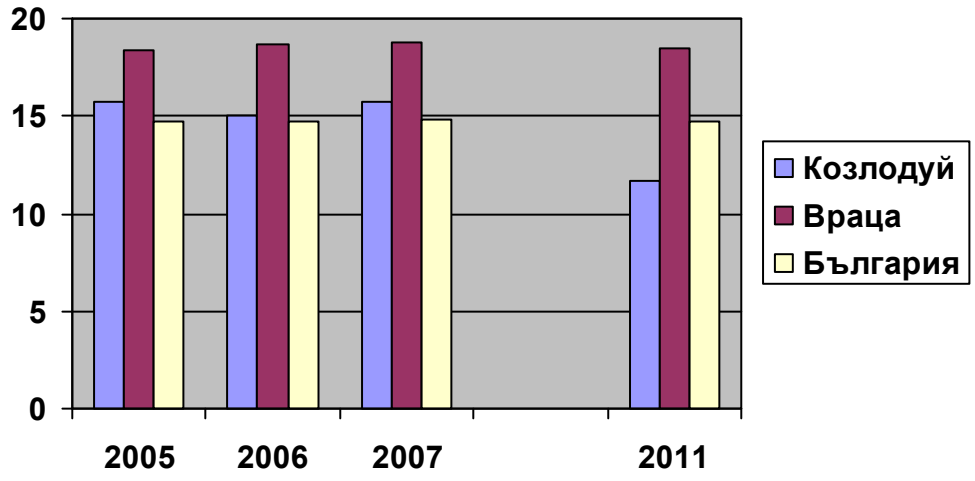
in view of the population of the municipality. Better growth of the population of the municipality of Kozloduy is related with the positive mechanical growth of the town of Kozloduy after the construction of NPP - from 10498 residents in 1975 the growth is to 14445 in 2007.
Age structure of the population in the North-West region of the country is more unfavourable comparing with the average data for the country. On table 3.10-1 data about the population within 30 km area of KNPP.

Table 3.10-1 Age structure of the population within 30 km area of KNPP.

Municipality	Population	Below the capable for working age		For the District of Vratsa		Above the capable for working age	
		Number	%	Number	%	Number	%
Kozloduy	24 244	4 954	20%	14,560	60%	4 730	20%
Mizia	9107	1 369	15%	4 605	51%	3 133	34%
Oryahovo	14 495	2 200	15%	7 362	51%	4 933	34%
Hayredin	6 565	920	14%	2 706	41%	2 939	45%
Vulchedrum	12 573	1959	16%	5 542	44%	5 072	40%
Total							

Notes: Data are for 2002.

Data provided in Table 3.10.-1 show that except in the Municipality of Kozloduy the number of the population below the capable for working age is less the one above the capable for working age and the able-bodied citizens are 50 or below 50%. The only exception is the municipality of Kozloduy
Considerable reduction of the demographic resource and advanced in age population could be also explained with higher death-rate and partially in the minicipality of Vratsa Fig. 3.10-2 demonstrates higher frequency (per 1000 people) of the death-rate of Vratsa District. Data abouth the municipality of Kozloduy are more favourable.



Legend:
Козлодуй - Kozloduy
Враца - Vratsa
България - Bulgaria
Figure 3.10-2 Dynamic of the processes of the death-rate among the population of the municipality of Kozloduy, District of Vratsa and Bulgaria.

NSI data shows a constant trend of higher death-rate among the population of the district of V ratsa comparing with the average data for the country. Higher death-rate in the area is mainly a result of the death-rate caused by diseases of the bodies related to the blood circulation (see table 3.10-2.). The higher death-rate caused by cardio-vascular diseases among this population comparing with the average data for the country is a result of its age structure - adult population is the main carrier of this class of diseases. In the annual report for 2011 the disease rate in the municipality of Vratsa it is shown that among the children population during the year the most frequent are the respiratory diseases. For the adult population the cardio-vascular diseases prevail.

Table 3.10-2 Total death rate and death rate for the country and Vratsa municipality during the period 2005-2011.

Year	**Total death-rate (per 100000 people)**		**Death-rate caused by the diseases of the blood-circulation bodies (per 100000)**	
	For the country	**for the municipality of Vratsa**	**For the country**	**for the municipality of Vratsa**
2005	1464.8	1826.1	968.1	1231.8
2006	1473.4	1851.0	978.5	1251.5
2007	1475.4	1866.3	971.0	1267.0
2009	1424.7	1837.4	940.1	1311.9
2011	14,73,2	1943.6	987.7	1216.4

Death causes based on which it is possible to manifest the scholastic effect of the ionizing radiation are the malignant diseases and congenital anomalies. Theoretically, the limit effects could impact on the disease frequency of the endocrine system, the blood vessels and the blood as well as on the nerves.

Table 3.10-3 Death-rate of malignant diseases and by the respiratory diseases for the country and Vratsa municipality for the period of 2005-2011.

Year	**Death-rate of malignant diseases (per 100000 people)**		**Death-rate caused by the diseases of the respiratory system (per 100000)**	
	For the country	**For the municipality Vratsa**	**For the country**	**For the municipality Vratsa**
2005	231.7	288.3	57.7	95.8
2006	230.0	258.4	54.3	89.2
2007	234.9	296.7	59.3	95.5
2009	224,1	239,6	54.8	71,6
2011	229,2	307,7	54.6	52,2

Table 3.10-4 Death caused by the blood diseases, death caused by the diseases of the endocrine system and death caused by the congenital anomalies 2005-2011.

Year	Death caused by the blood diseases	Death caused by the diseases of the endocrine system	Death caused by the congenital anomalies

	Country	Municipality of Vratsa	Country	Municipality of Vratsa	Country	Municipality of Vratsa
2005	2.0	0.5	25.6	12.8	3.2	3.3
2006	2.1	1.0	29.1	15.9	2.4	1.9
2007	2.3	0.5	28.3	13.2	2,2	1.5
2009	2.5	4.0	26.2	31.8	2.6	3.0
2011	2.0	1.6	22.3	49.5	1.4	1.5

Data shown in Table 3.10.3 and 3.10.-4 show that among the population Vratsa District there is a negligible increase of the death-rate caused by the malignant diseases. These negligible trends also could be related to the age structure of the population - lower death-rate caused by the congenital anomalies and lower percentage of the persons above the active age. These negligible trends also could be related to the age structure of the population - lower death-rate caused by the congenital anomalies and lower percentage of the persons above the active age. This is mostly valid in view of the death-rate caused by the diseases of the respiratory and endocrine system.

Table 3.10-5 Malignant diseases for country and district of Vratsa for a period 2005-2007.

Recorded malignant diseases (per 100000)	2005		2006		2007	
	Country	Municipality of Vratsa	Country	Municipality of Vratsa	Country	Municipality of Vratsa
Total	3069.9	3743.7	3229.0	3909.2	3330.7	4440.5
1. Digestive system. Large Intestine , PP175	441.9 168.4	522.5 166.4	472.7 182.5	577.0 182.7	498.7 196.5	677.1 215.4
2. Respiratory system, PP 75.4	201.3	254.6	209.1	252.6	217.6	305.5
3.Lacteal gland, PP 92	532.8	579.9	567.9	605.9	584.5	656.0
4.Lacteal glands of the females, PP 92	1038.3	1128.5	1093.1	1174.1	1124.8	1260.0
5. Female genitals , PP 23.8	937.2	1382.4	971.9	1259.6	981.3	1365.8
6. Male genitals , PP - HE	310.7	214.8	333.3	320.5	352.7	371.5
7.Urinary system diseases PP 49.4	167.7	150.8	126.5	115.2	195.1	246.6
8.Thyroid PP 32.1	49.0	51.7	49.1	54.5	52.8	62.2
9. Cerebrum	29.6	36.8	30.5	38.6	32.	37.2

Health status of population within 30 km zone of Kozloduy NPP in Romania

The 30 kilometer zone from the Romanian coast of the Danube includes 23 locations. Currently, the working population is around 110 000 people and is distributed mainly in the following economic activities:

- 38% are employed in industrial production;
- 15% are employed in trade and services;
- 10% are employed in the transport system;
- 8% in education;
- 5.7% work in the healthcare system.

In thus distribution presented no evidence of involvement in an environment of ionizing radiation can be found.

Ministry of Health, through the Radiation Laboratory of Hygiene and regional health center in Bucharest in cooperation with local institutions, carry out systematic monitoring of health status.

Below data provided by the Romanian side is presented.

Data on the monitoring carried out on 78323 residing within a 30 km zone of observation shows:

The distribution of population by age shows that the percentage of population over 60 years is much higher than the average data for the country.

In all the years of the observation period, mortality of the population in the surveillance zone is lower than the mortality data for the entire Romanian population.

Data related to illnesses from ionizing radiation show:

Throughout the period of solid cancer mortality in the surveillance zone is lower than the average data for the country;

The occurrence of illnesses of solid cancers in the surveillance zone is also lower compared with the data for the whole country;

Mortality from leukemia and lymphoma in the surveillance zone is rising after 2008. However, no data on the dynamics of this indicator in relation to the entire population of the country;

The incidence of illnesses of all types of leukemias and lymphomas, twelve years throughout the observation period, in terms of population in the area show a gradual increase. Since 2007, this increase is significantly. When comparing this frequency with the frequency in four regions around nuclear plants, the highest incidence of solid cancer and lymphomas are found in the area near Kozloduy. However these values do not exceed those established in respect of the entire population of Romania.

The results of the dynamics of total mortality rate and incidence of solid cancers in the surveillance zone are lower than the average data for the country. The increase in mortality and incidence of leukemias and lymphomas in recent years among the observed population can be associated with a large percentage of people over 60 years. This is confirmed by data from the ten-year radiological monitoring of atmospheric aerosols and deposited on the surface water of the gamma background (performed in SSMR four points - Turnu Severin, Beckett, and Craiova Zimnitsa) show values much lower than the norms.

Conclusions:

The health status of the population in 30 km zone around Kozloduy NPP in Romania is not different from that of the whole population.

Population in the monitored area includes 78323 people living in settlements within 30km radius around Kozloduy NPP. These settlements belong to the district Dolj
The distribution of population by age and aging shows the percentage of people aged over 60 is much larger than the general population of Romania. Systematic review of population health status began in 1999. Results from 12 years of monitoring the health status of the population are presented in the table below.

Table 3.10-6 health status in Romania

Year	Population	Number	employees	Number	**Solid cancer**	Distribution:
1999	88884	979	90.2		102.3 (157.3)	3.37 *
2000	87355	938	110.5		102.2 (181.4)	3.43 *
2001	89039	797.7	90.5		103.2 (224.1)	6.69
2002	81875	951.4	125.3	5.4	106.3 (227.6)	3.77
2003	80138	1066.6	130.9	0	177.3 (210.5)	5.60
2004	83950	1110.5	116.6		167.4 (226.6)	1.90
2005	84203			1,3	137 (218.9)	8.09
2006	82539	1031.1	149.4	0.76	235.7 (234.8)	7.13
2007	82277	955.9	115.4	0.74	208 (241.7)	13.41
2008	80129			3.3		
2009	79917	1141.9	104.2	5.12	224 (275.7)	17.1
2010	78323	1142	132.3	6.97	177.1	17.1

General mortality

The overall mortality of the population is lower than mortality in Romania over the considered period. The trend of change in mortality is the same as the national trend.

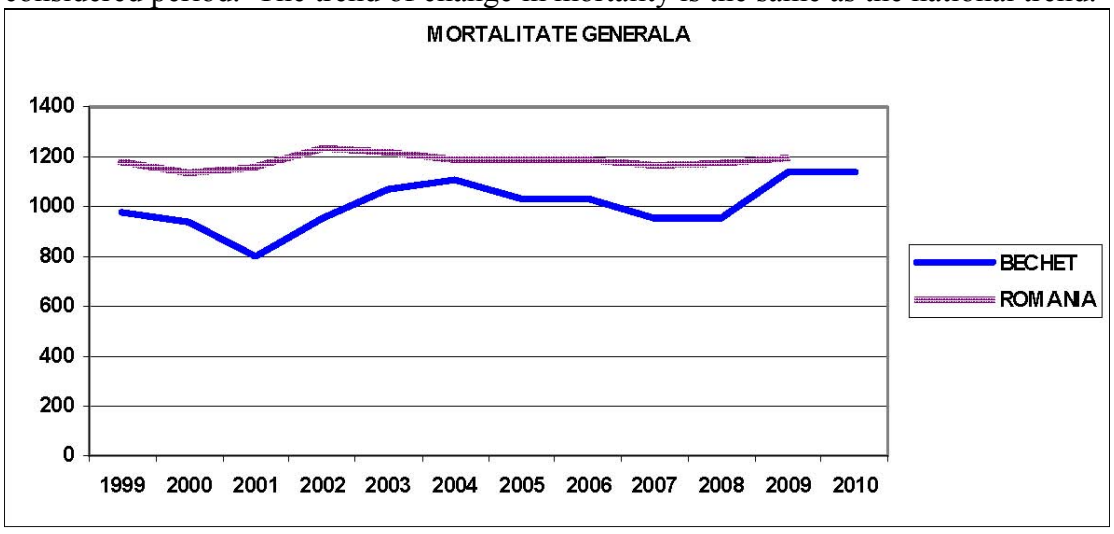


Fig. 3.10-3 General mortality for the area of Beckett for the period 1999- 2010.

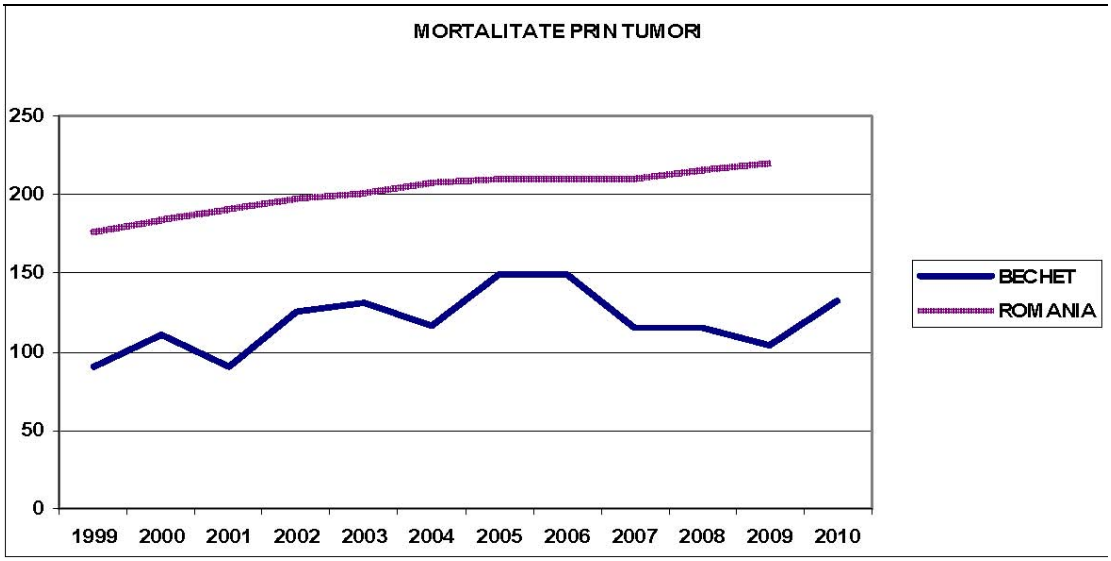


Fig. 3.10-4 cancer mortality for the area of Beckett for the period 1999 - 2010г.

Mortality from leukemia

Mortality from all types of leukemia is growing in the concerned interval from 1999 - 2010. There is currently no national data available for comparison.

Cases of cancer

While the incidence of cancer for Beckett area is slightly higher than observed in other areas, this rate does not exceed the value registered for the general population of Romania. Highest value was registered in 2006 and it is equal to that of the general population of Romania. There is a tendency that this value is increasing, which goes parallel to the trend of the general population of Romania.

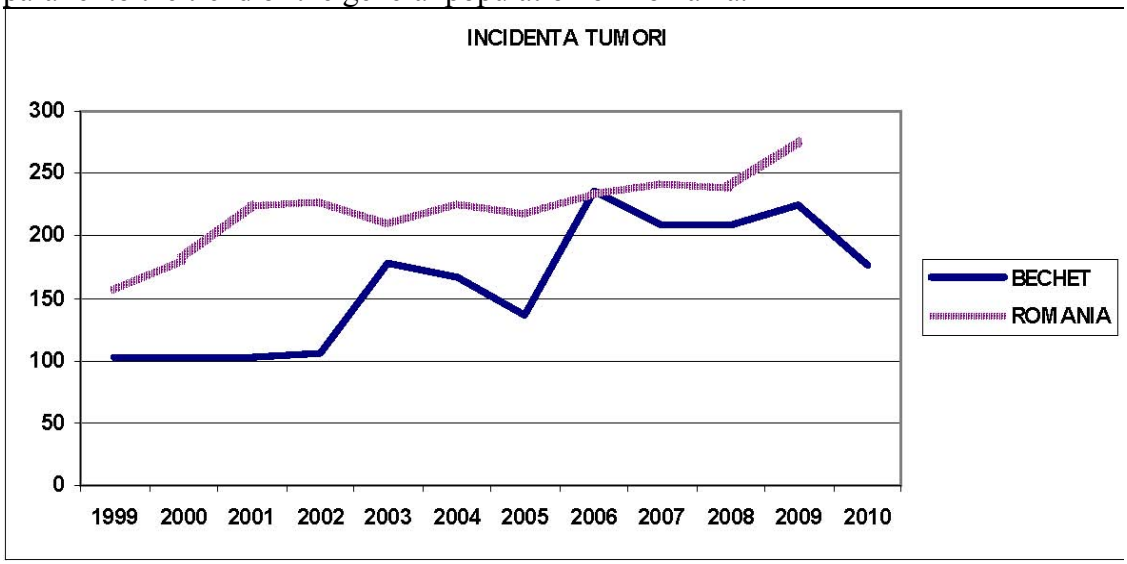


Fig. 3.10-5 Cases of cancer.

Cases of leukemia

The occurrence of disease from leukemia have tends to increase steadily over the period. Starting in 2007, in Beckett can be seen high values of this frequency compared with the values reported for other areasл

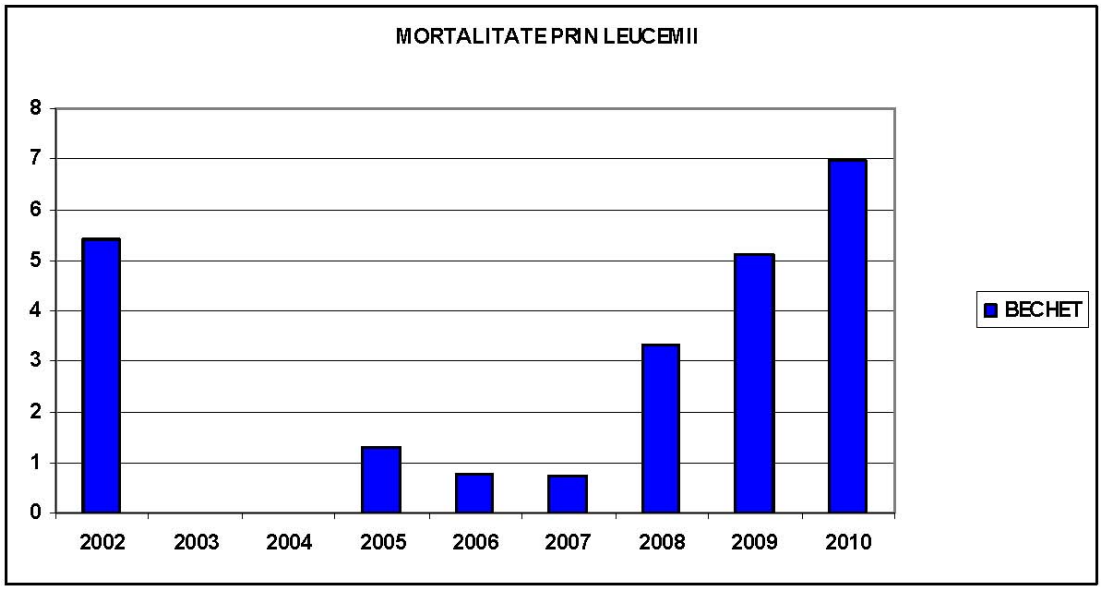


Fig. 3.10-6 Mortality from leukemia in the area Beckett, 2002 - 2010.

2. **Potentially affected workers and employees**

On the fenced site different power facilities are located as well as the entire complex of the auxiliary production activities. In order to guarantee the cleanness of the environment a precise input/output control at the Power plant is made. Work places are located on that site, i.e. they are within the area of the ionizing radiations. Depending on the place of the permanent work places the workers are separated in two categories:

- A Category includes workers, who work in the restricted area. They could receive annual effective zone **above 6 mSv**.
- B Category includes the rest staff, not included in A Category.

Depending on the work type and the rooms where the work places are located this staff is split in appropriate categories.

About 4600 persons were personnel of Kozloduy NPP in 2008, respectively at Units 1-4 the number of the personnel was 1485 persons. Since May 2010 at Units 1-4 their number was 869. Besides, on the site of the power plant there are different subcontracting companies operating so the number of the staff that is potentially exposed to the ionizing radiation within the different periods varies within wide range.

Pursuant to BNRP'2012 [16] the occupational effective dose rate limit is 100 mSv over 5 sequential years taking into account that the maximum effective dose rate per year does not exceed 50 mSv.

For the staff of the external organizations there is an administrative limit established for the annual individual effective dose 18 mSv.

In 2008 is only one assessed effective annual dose-rate caused by internal radiation equal to the level of registration 1 mSv, pursuant to Ordinance No 32 for the conditions and order for execution of the individual dosimetric control of the persons working with the radiation sources, prom., SG, issueb 91 from 15 November 2005.

During the last six years according to the Ordinance only individual annual dose-rates caused by an internal radiation exceeding 1mSv are recorded. Annual doses, lower than the recording level of 1mSv are accepted for the analysis purposes as equal to zero, which explains the sharp drop down of the collective dose rate after the implementation of the ordinance in November 2005.

In 2009 a control is executed of the level of the internal radiation of 1131 persons of the staff of Kozloduy NPP and of 2218 persons from outside organizations and there is no dose rate of internal radiation meterd above the level for registration 1 mSv, according to Ordinance 32.

In 2010 and 2011 totally 1047 people are controlled, respectively 914 people from the staff of Kozloduy NPP and 1924, respectively 1809 people from outside organizations and there is no dose of internal radiation metered above the level for registration of 1 mSv, according to ordinance 32. During the period 2009– 2011only single cases are detected when the activities are above the minimal detectable activity (MDA) – with sequence of the years with 52, 28 and 17 persons of the staff and with 5, 1 and 1 person of the outside organizations.

Collective effective dose in EP-1 in the last three years is mainly due to the collective effective dose rate of outside radiation calculated after measurement of the individual equivalent dose-rate Hp(10) with individual thermal luminescent dosimeters.

Collective effective dose rate for the staff of Kozloduy NPP and external organizations operating in EP-1 in 2008 reached 17% of the planned value of the indicator for 2008 and has a table trend of reduction during the last five years. These results are also repeated during the period 2009 -2011 [192] (see table 1 and 2 below).

Conclusions:

1. Analysis of the results of the independent expert assessment of NRRPC with the individual dosimetric control by film dosimeters of 50 workers of the risk quota of EP-1 and institutional operation and thermal luminescent dosimetric control show good coincident within the error range for the respective methods.
2. During the last 12 years in EP-1 there is no individual annual effective dose exceeding the annual limit for occupational radiation 50 mSv, as well as individual dose exceeding 100mSv for 5 continuous years pursuant to the Ordinance for the main radiation protection norms – MRPN'2012.[16].

Health risk for the workers in Kozloduy NPP is not a result only of the impact of the ionizing radiation. The unfavourable occupational conditions include also the infavourable microclimate (very often overheating), intensive noise, vibrations, electromagnetic fields and labour type. Different occupational groups are affected in different extent by different factors. When assessing the health condition of the staff we should consider both their total effect and their specific impact.

General health condition of the staff

The medical examination of the KNPP personnel is carried out every year according to the appropriate schedule in KNPP office "Occupational medical care". General health condition of the workers and employees of Kozloduy NPP totally for the workers and employees of A and B categories, reports on the Analyses of the Disease Rate with Temporary Disability (DRTD) as well as on the results of the periodically preventative medical examinations. Table 3.10-7 shows main indicators of DRTD for a period 2009- 2011

NPP "Kozloduy" is surrounded by a fence and there are different power capacities and support activities for the whole complex to ensure the cleanliness of the environment is built precise input / output control. This site is the entire working staff of the Head Office and the staff of other organizations. Depending on the workplace personnel are exposed to ionizing radiation (category A) and conventionally factors of work environment.

The staff of the external organizations was introduced administrative border of annual individual effective dose 18 mSv. Annual limit for occupational exposure is 20 mSv, as cumulative individual dose for 5 consecutive years may not exceed 100 mSv, according ONRZ'2012.

Analysis of "occupational exposure" given to us by the Kozloduy NPP shows that in 2011 only one year estimated annual individual effective dose from internal exposure equal to the level of registration 1 mSv, according to Ordinance № 32 on procedures for conducting individual monitoring of persons working with sources of ionizing radiation, publ., SG. 91 of 15.11.2005. Over the last three years under the Ordinance shall be registered only individual annual doses from internal exposure greater than 1 mSv. Annual doses below the level of 1 mSv for registration shall be adopted for the analysis to be zero, which explains the sharp drop of the collective dose after implementation of the Ordinance in November 2005.

In conclusion we can say that the health risk from effects of ionizing radiation is well controlled and limited.
Besides ionizing radiation, including adverse conditions are unfavorable microclimate (mostly overheating), intense noise, general vibrations, electromagnetic fields, the nature of work and shift work, various professional groups may be exposed to one or more adverse factors of work environment and employment. The headquarter of years has developed a streamlined system for continuous health monitoring. Analysis of morbidity with temporary disability (MTD) of all workers of category A and B are presented in Table 3.10-7.

Table 3.10-7 Indicators of DRTD for a period 2009-2011 in Kozloduy NPP

Year	Number of employees	% sick people	Frequency of the cases	Missed labour days	Frequency Labour losses	% of often and long-stay sick people
2009	4674	37.9	49.91	28017	599.42	4.12
2010	4484	26.58	42.46	26727	596.05	3.05
2011	4251	33.33	56.65	28747	676.24	4.58

Indicators of DRTD reflect mostly the temporary illnesses causing reduction of workability. In great extent their frequency is affected by the epidemiological situation (availability of infection diseases during the year). This could explain the differences of the number of sicked people during the year. Nevertheless, the frequency of the cases during the three years fluctuates within the range of low and average values that are more often announced for the country. Within these values is also the indicator of frequency of the labour misses. DRTD structure for 2009 and 2011 is shown in Table 3.10.-8.

Table 3.10-8 DRTD structure for 2009-2011 in Kozloduy NPP

illness	2009	2010	2011
1. Respiratory diseases generally			
1. Acute Catarrh of the upper respiratory tract	5.91	6.189	9.36
2. Pneumonia	0.64	1.09	0.75
3. Other respiratory diseases	4.66	4.15	5.08
2. Eye diseases	0.45	0.45	0.33
3. Ear diseases	0.8	0.80	1.43
4. Diseases of the Peripheral Nervous System	4.2	3.2	3.92
5. Diseases of the Central Nervous System including neuroses	0.10	0.60	0.49

6. Diseases of the blood donation – generall **1. .Hypertonia** **2. Chronic Ischaemic Heart Disease** **3. Other Cardiovascular Diseases**	 **1.6** **0.60** **0.24**	 **1.70** **0.36** **0.45**	 **1.34** **0.56** **0.49**
7. Gastric and duodenum ulcer.	**0.30**	**0.07**	**0.14**
8. Gastritis, enteritis, colitis.	**2.46**	**2.12**	**0.14**
9. Malignant neoplasms	**0.45**	**0.40**	**0.61**
10. Non-malignant neoplasms	**0.71**	**0.7**	**0.99**
11. Diseases of the genitourinary system	**2.35**	**2.20**	**2.70**
12. Skin diseases	**1.19**	**0.71**	**1.12**
13. Diseases of the osteo-muscular system.	**3.79**	**4.79**	**2.44**
14. Household accidents	**2.97**	**2.77**	**3.,19**
15. Occupational accidents	**0.06**	**0.16**	**0.05**

Structure of the DRTD generally repeats the average data for the country - infections of the upper respiratory tract and sharp desieses of the respiratory system are at the first place. There is no increased frequency detected of diseases that could be caused by the radiation factor such as blood diseases, blood organ diseases, and malignant diseases.

During the last three years only one occupational disease and several occupational accidents are registeredq and a few of the household incidents.

Almost the whole staff of Kozloduy NPP is subject to periodical preventive medical examinations. Table 3.10.-9 shows the relative share of the persons with chronic and sharp diseases (instant sickness) and newly discovered diseases.

The data in the table show that the number of workers with newly diagnosed disease is a relatively small percentage of the number of workers. Not calculated on the number of clinically healthy persons, but morbidity (one person can have more than one disease), it can be assumed that they are about 60 - 70%.

The structure of the disease during regular checkups to find out:

- First Frequency hypertension - 14.57%,. The first place of hypertension was found in prophylactic examinations in all studies of organized groups of workers. Frequency of 14.5% could be regarded as moderate.
- Second, are diseases of the auditory nerve - 3.15%. this is a relatively high frequency and can assume that is closely related to the fact that a significant number of workers are exposed to high noise levels.
- Thirdly are discopathies with frequency 1.6%.
- Other groups of diseases with an incidence of about 1%.

Table 3.10-9 Comparison of the standard of MTD in nosological groups "Frequency"

idex	Frequency of the cases "frequency"			
Nosological unit	**2009 г.**	**2010 г.**	**2011 г.**	**Standard**
1. Acute Catarrh of the upper respiratory tract	5.91	6.18	9.36	21.6
2. Pneumonia	0.64	1.09	0.75	1.1
3. Other respiratory diseases	4.66	4.15	5.08	0.9
4. Eye diseases	0.45	0.45	0.33	1.8
5. Ear diseases	0.98	0.80	1.43	3.4
6. Diseases of the Peripheral Nervous System	4.2	3.2	3.92	3.4
7. Diseases of the Central Nervous System including neuroses	0.1	0.6	0.49	2.6
8. Hypertonia	1.16	1.7	1.34	2.5
9. Chronic Ischaemic Heart Disease	0.6	0.36	0.56	0.8
10. Other Cardiovascular Diseases	0.24	0.45	0.49	1.9
11. Gastric and duodenum ulcer .	0.3	0.07	0.14	2.7
12. Gastritis, enteritis, colitis.	2.46	2.12	2.66	5.6
13. Malignant neoplasms	0.45	0.40	0.61	0.9
14. Non-malignant neoplasms	0.71	0.67	0.99	1.5
15. Diseases of urinogenital system	**2.35**	2.20	2.70	3.4
16. Diseases of female genitals	1.22	0.85	1.15	4.9
17. Skin diseases	1.19	0.71	1.12	2.9
18. Diseases of bone and muscular system	3.79	4.79	2.44	4.0
19. Household accidents	2.97	2.77	3.19	5.9
20. Occupational accidents	0.06	0.16	0.05	2.2

Table 3.10-10 Comparison of the standard of MTD in nosological groups "Influence;"

idex	Frequency of the days "influence;"			
Nosological unit	**2009 г.**	**2010 г.**	**2011 г.**	**еталон**
1. Acute Catarrh of the upper respiratory tract	27.33	24.55	41.04	71,7
2. Pneumonia	12.52	19.18	12.53	20,9
3. Other respiratory diseases	36.41	34.30	44.06	31,7
4. Eye diseases	9.07	6.36	3.29	7,1
5. Ear diseases	5.80	9.95	8.40	28,4
6. Diseases of the Peripheral Nervous System	8.03	35.05	39.02	28,9

7. Diseases of the Central Nervous System including neuroses	4.4	5.07	6.96	21,6
8. Hypertonia	4.54	4.62	6.47	24,7
9. Chronic Ischaemic Heart Disease	15.38	14.07	17.34	16,7
10. Other Cardiovascular Diseases	4.17	12.53	8.16	22,5
11. Gastric and duodenum ulcer .	4.28	3.67	1.76	28,9
12. Gastritis, enteritis, colitis.	10.8	11.47	10.68	26,3
13. Malignant neoplasms	26.51	29.50	55.89	20,4
14. Non-malignant neoplasms	24.69	33.34	29.00	34,2
15. Diseases of urinogenital system	**22.3**	17.3	27.07	21,5
16. Diseases of female genitals	14.68	9.99	12.11	61,1
17. Skin diseases	**11.7**	11.8	12.58	21,5
18. Diseases of bone and muscular system	54.19	23.78	84.89	39,6
19. Household accidents	91.61	94.58	83.32	75,5
20. Occupational accidents	13.5	6.56	3.98	49,3

Occupational diseases and accidents at work

Occupational diseases are not registered.

Table 3.10-11 presents data on occupational accidents and lost work days for 2009-2011

Table 3.10-11 Accidents at work and lost work days for 2009-2011

Year	Number of employees	Death accidents	total number of accidents.	Missed labor days	working days lost per 1 employee	number of rec. accidents
2009	4674	-	3	300	6.41	
2010	4484	-	7	294	6.55	
2011	4251	-	4	222	5.22	

Conclusion

The results of system health monitoring of workers from the NPP "Kozloduy" show that in many ways the results are better than the average for other organized labor groups. Based on this we can assume that the employees of the plant were in good health.

Приложение 1

Табл. 1. Колективна ефективна доза [manmSv] външно облъчване в КЗ 1 на „АЕЦ Козлодуй", 2009 ÷ 2011 г.

	Брой контр.	Колективна доза [manmSv] по дозови диапазони										Колективна ефект. доза	Средна инд. доза	Макс. инд. доза
		<0.10 mSv	0.10 - 0.20 mSv		0.21 - 0.50 mSv		0.51 - 1.00 mSv		1.01 - 2.00 mSv		2.01 - 5.00 mSv			
	лица	брой	брой	доза	брой	доза	брой	доза	брой	доза	брой	доза	[man mSv]	[mSv]	[mSv]
Персонал на АЕЦ															
2009	809	620	65	8,20	43	15,35	55	39,58	22	29,98	6	15,06	108,17	0,13	2,80
2010	718	604	51	6,37	43	13,26	19	12,48	1	1,43	-	-	33,54	0,05	1,43
2011*	485	405	37	4,75	27	9,51	14	9,73	2	2,48	-	-	26,47	0,01	1,26
Външен персонал															
2009	271	232	23	2,92	12	3,25	3	20,4	1	1,02	-	-	9,23	0,03	1,02
2010	255	213	15	2,27	20	5,88	5	3,13	-	-	-	-	11,28	0,04	0,75
2011*	189	178	7	0,96	2	0,64	2	1,05	-	-	-	-	2,65	0,01	0,54

* - Информацията е за $PO_{3,4}$ собственост на „АЕЦ Козлодуй" ЕАД

Табл. 2. Вътрешно облъчване на лица с разрешение на достъп в КЗ 1 на „АЕЦ Козлодуй", 2009 ÷ 2011 г.

	Брой контролирани лица	Брой измервания	С активност над МДА (брой)
Персонал на АЕЦ			
2009	1131	1477	52
2010	1047	1302	28
2011*	914	1131	17
Външен персонал**			
2009	2218	2597	5
2010	1924	2310	1
2011	1809	2088	1

* - Информацията е за $PO_{3,4}$ собственост на „АЕЦ Козлодуй" ЕАД

** - Външният персонал работи в КЗ 1 ($PO_{3,4}$) и КЗ 2 ($PO_{5,6}$) на „АЕЦ Козлодуй" ЕАД

3.11 Hazardous energy sources

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

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

3.11.1 Ionizing radiation

Mostly, the ionizing radiation is a result of the nuclear interacting and fission of the natural and artificial radiouniclides. These radiations influence on the live organisms by their ionizing component.

Combination of the secondary ultra rays, the radiation of the natural radionuclides located at the atmosphere as well as the waters and foods in the human body is determined as a natural radiation background. Typical for the ionizing radiations are alpha, beta, gamma, neutron and x-ray.

As a primary identification of the impact by radionuclides the measurement of gamma radiation is considered. This is possible due to the existing cause-effect connection. It is between the dose rate of the gamma radiation and specific activity of the radiating gamma radiounuclides in a certain substance.

Natural radiation gamma background is specific for every region at least due to two reasons:

- Different content and migrations of gamma radiating radionuclide in the biosphere;
- Various anthropogenic activities with radionuclide.

Nevertheless the natural radiation gamma background is anthropogenic impacted by considerable outside nuclear influences such as nuclear explosions, nuclear accidents etc., for the assessment purposes, we shall continue to consider it natural.

It is good to remember that in many countries in the world such as India, Iran, France etc. there are some regions where the gamma radiation background has quite higher values comparing with the ones measured in the Republic of Bulgaria, so it is not the one who has a hazardous impact on the life of organisms, but these are its drastic changes.

Due to this fact the norm for the radiation gamma background is not determined, but average value is accepted for a certain region and for our country this is 0.10μSv/h.

Measurement of the radiation gamma background is an important factor for determination of the radiation load of the population. The conditions of execution of the radioecological monitoring of Kozloduy NPP in 2009, 2010 and 2011 are presented in [190].

3.11.1.1 Radioecological monitoring

For the purposes of localization of the radiation impact of the nuclear power plant on the environment and live organisms and for conduction of the respective actions three zones of different radii are detached: radiation protection area – 2 km, controlled area – 12 km and monitored area – 100 km around Kozloduy NPP, which currently has assigned with new definitions in compliance with the updated legislation. Also, in

these areas a radiation monitoring has been made by the institution and control authorities (EEA, NCRBRP etc.).
In-house radiation monitoring of the environment is stipulated in a long-term program of Kozloduy NPP that is established in compliance with the regulations, good international practice, experience of RM Department and it is coordinated with MoEW, MH and NRA as well. Analyses are made of the air, soils, waters and bottom deposits, vegetation and also a radiation gamma background is measured.
In the monitored zone there are 36 points for the ground ecological system and 7 points for the water ecological system. There are three types of stations and they are described in details in Chapter 1 of this report.
Stations of the above types are located in the area of the industrial site in 12km area and in 100km monitored area around Kozloduy NPP. In the above areas samples from the drinking water, food products and fodders are taken (analyzed). On the industrial site the gamma background radiation, gamma radiation, soil, groundwater, atmosphere precipitates, and vegetation are controlled. (see fig. 4.1.9-2 Radiation monitoring stations on the industrial site). During the environmental radiological monitoring are applied some methods such as gamma spectrometry, low background radiometry, radiochemistry, liquid scintillation spectrometry etc.
In order to execute an objective assessment a verification of the results of the industrial monitoring with the results of the monitoring of EEA – MoEW and NCRBRP – MH etc. has to be performed.
For determination of the parameters of the higher atmospheric layers (at 25km) and in order to determine the migration degree of the harmful substances, including the radionuclide an Automatic System for Aerosol Probing (ASAP) is used.
Within the frameworks of the National Environmental Monitoring System, the EEA also executed environmental radiological monitoring on the territory of the whole country while maintaining the information database. System provides in time and plausible information on the condition of the environmental elements and factors impacted on it on the grounds of which some analyses, assessments and forecasts are made in order to justify the activities for environmental protection against harmful impacts. Indicators used for the control monitoring are as follows : gamma background radiation, content of natural and anthropogenic radionuclides in soils, sediments, waste products, specific total alpha and beta activity, content of uranium, radium and tritium contents in surface and groundwater, increase of radon over the dumping piles next to them and content of radionuclides in the atmospheric air.
Since 1997 the Republic of Bulgaria operates the National Automatic System for Continuous Monitoring of the gamma-background radiation (RaMo) for the purpose of on-line monitoring the background radiation in Bulgaria.This state regulated system works in compliance with the obligations for safe use of nuclear energy for peaceful purposes, environmental radiation monitoring as well as for mutual information in case of accidents in nuclear facilities or cross-border transfers. The system consists of 26 Local Monitoring Stations (LMS) for gamma background radiation covering the entire territory of the country.
AISERC and RaMo systems are connected and function as Unified National Radiation Monitoring System.
In emergency situations the field measurements, samplings and tests are made by the mobile laboratory and the dose rate of the gamma radiation is measured in motion and in the control points and determined the activity of ^{137}Cs, ^{134}Cs in aerosols, activity of

^{131}I in the lower atmosphere, content of ^{137}Cs, ^{134}Cs and ^{131}I in samples from contaminated surfaces.

In Romania, the National Environmental Radioactivity Surveillance Network (NERSN) insures the radioactivity monitoring of the influence area of Kozloduy NPP– Bulgaria, through 4 laboratories, called Surveillance Stations for Radioactivity Monitoring (SSRM) located in Bechet, Craiova, Drobeta, Turnu Severin and Zimnicea, and also 13 automatic stations 11 in Dolj county, Mehedinti county and Teleorman county).

It is appropriate to note that each party has conducted radiological monitoring in areas around Kozloduy NPP independently without coordination of the programs.

3.11.1.2 Gamma radiation on the industrial site of Kozloduy NPP

Gamma radiations from gamma radiating radioactive sources form the radiation gamma background in certain region. Gamma radiation is measured on site by the Site Monitoring Sector in compliance with the Radiation monitoring program on KNPP site during the operation UB.MP.PM.099/03 [150]. Points are selected to be located next to the potential radioactivity sources and to be in conformity with possible radioactive pollutions from the power plant operations on grounds, surfaces and others with gamma emitting radionuclide. Gamma radiations and the radiation gamma background are measured as an equivalent dose rate in measured unit (Sv/h). Program objectives are related to the non-proliferation of the radioactive contaminations and to avoid exceeding of the dose rate above certain limits. For this purpose **control border and permissible borders** are implemented for certain zones of the site.

The scope of the monitoring defined in the above mentioned program is based on the current Bulgarian laws, regulations, and guidelines in the field of radiation protection and present experience of the Site Monitoring Division. The scope of the Kozloduy NPP industrial site control is given in Table 1 of the Program. In case of recorded exceeding of the control or permissible limits additional investigations and measurements are performed to identify the source of ionizing radiation and radioactive contamination reason. In case of radioactive contamination it shall be determined, if the source is fixed or movable. In case of control limit exceeding appropriate measurements according ALARA principle are applied. In all cases of exceeding of the permissible limits correction measurements ensure a minimum level lower than the permissible thresholds.

Values of the gamma radiations measured in the region of the Access Control Points are close to the values of the natural radiation background that has been varied from 0.06 to 0.09μ Sv/h. **Control limi**t for this region is 0.2 μSv/h, and **the permissibility is** 0.3 μSv/h.

The control of the radiation status of the surface, ground and waste waters in the monitored area is done by sampling and sample analysis.

3.11.1.3 Gamma radiation in the control points on the territory of NPP

Measurements are made at 1 m altitude above the ground with **control limit** 0.50μSv/h and **permissibility** 1.0 μSv/h.

Equivalent dose rate of gamma radiation on the industrial site of Units 1–4

Data from the measurements are shown in the tables to the Summarized reports on the radiation monitoring on the industrial site of Kozloduy NPP in 2006, 2007 and 2008. [189].

Measurements are made at 31 points 1m above the ground. At 28 points the values of the measurements have varied from 0.04 to 0.26 μSv/h. In three points 1M, 2M and 3M the measured values varied from 0.22 to 2.00 μSv/h and they have exceeded the control and permissible limits. These higher values are caused by gamma emitting radionuclides in AB 1 and radiation contaminated earths disposed in Mogilata.

Equivalent dose rate of gamma radiation on the industrial site of Units 5–6

Data from the measurements are shown in Tables to the Summarized reports on the radiation monitoring on the industrial site of Kozloduy NPP in 2009, 2010 and 2008. [189]. Measurements are made at 34 points 1m above the ground. Recorded values for the equivalent dose rate of the gamma radiation varied from 0.06 to 0.18 μSv/h and they have not exceeded the values of the natural radiation gamma background. Under the scaffold bridges connecting AB-3 with MB of Units 5 and 6 and with SERAW Kozloduy treatment plant also no values exceeding the natural radiation gamma background has been recorded.

Gamma radiation in the points at the entrance to the transportation corridors to the control room

Measurements are made at the points of 10 cm above the ground with control limit 0.50μSv/h and permissible limit 1.0 μSv/h.

Equivalent dose rate of gamma emission in the region at the entrance to the transport corridor 1 of the Control room of Units 1 and 2

Data from the measurements are shown in Tables to the Summarized reports on the radiation monitoring on the industrial site of Kozloduy NPP in 2009, 2010 and 2011. [189].

Measurements are made in 8 lines at 4 points at 10 cm above the ground. Recorded values for the equivalent dose rate of the gamma radiation varied from 0.10 to 0.48 μSv/h and they have not exceeded the values of the control limits in the Control Room. Reduction of the measured activities is recorded. Higher values are caused by old contaminations fixed in the asphalt covering and by gamma emissions penetrating from the MB-1.

Equivalent dose rate of gamma emission in the region at the entrance to the transport corridor 2 of the Control room of Units 3 and 4

Data from the measurements are shown in Tables to the Summarized reports on the radiation monitoring on the industrial site of Kozloduy NPP in 2009, 2010 and 2011. [189].

Measurements are made in 8 lines at 4 points at 10 cm above the ground. Recorded values for the equivalent dose rate of the gamma radiation varied from 0.08 to 0.46 μSv/h and they have not exceeded the values of the control limits in the Control Room. Reduction of the measured activities is recorded. Higher values are a result of gamma emissions penetrating from RB-2.

3.11.1.4 Gamma emission on sites for RAW temporary storage

On these sites an additional radiation control has been made in compliance with the Program for radiation control of the environment of workshop for treatment, conditioning and storage of RAW of Kozloduy NPP.

Equivalent dose rate of gamma emission on the site for temporary storage of containers with RAW (BB Cube type Northern from the RAW storage facility next to the Outdoor Switchyard)

Data from the measurements are shown in the Tables of the Summarized reports on the radiation monitoring on the industrial site of Kozloduy NPP in 2009, 2010 and 2011. [189].
Measurements are made once per month at 9 points 100 cm above the ground. Recorded values for the equivalent dose rate of the gamma emission have varied from 0.08 to 13,20 μSv/h and they have not exceeded the maximal permissible value of 100 Sv/h Gamma emissions and their variations during the measurements are in compliance with the quantities and activities of RAW stored on the site.

Equivalent dose rate of gamma emission at the site (Southern from the RAW Storage facility) for temporary storage of railway containers with RAW of Ist category

Data from the measurements are shown in Tables to the Summarized reports on the radiation monitoring on the industrial site of Kozloduy NPP in 2009, 2010 and 2011. [189].
Measurements are made once per month at 12 points 100 cm above the ground. Recorded values for the equivalent dose rate of the gamma emission have varied from 0.07 to 4,20 μSv/h and they have not exceeded the maximal permissible value of 100 Sv/h Gamma emissions and their variations during the measurements are in compliance with the quantities and activities of RAW stored on the site.

3.11.1.5 Radiation control of the region Southern from AB-1

Equivalent dose rate of gamma emission in the region of Mogila Southern from AB- 1

Data from the measurements are shown in Tables to the Summarized reports on the radiation monitoring on the industrial site of Kozloduy NPP in 2009, 2010 and 2011. [189].
Measurements are made twice per year in 3 lines at 8 points at 10 cm above the ground. Recorded values for the equivalent dose rate of the gamma emission have varied from 0.34 to 5 μSv/h and at points 1d, 1e, 1f, 1g, and 1 they have exceeded the maximal permissible value of 2.4 Sv/h These exceeds and their variations are caused by penetration of gamma emissions from AB-1 and the radioactively contaminated earths after penetration of radioactive contaminated waters from AB, which are disposed in Mogilata.

3.11.1.6 Radiation gamma background

Equivalent dose rate of the gamma emission (radiation background) has been measured and is currently measured by dosimetric devices and equipment that are regulated and their calibration is controlled. Measurement and determination of gamma emission of longer duration is made also by thermal luminescent dosimeters (TLD). Measurement units for equivalent dose rate are Sv/h, μSv/h. Gamma background radiation (gamma emission) in this case is assessed based on the measurements, analyses and summaries made by Kozloduy NPP, MH, BAS and automatic continuous control systems during the years 2009, 2010 and 2011 and also the plant condition during the selected period has been taken into consideration. Attention is paid to the measurements made on the industrial site of Kozloduy NPP in the detached areas and close populated areas.
Radiation gamma background on the territory of the Republic of Bulgaria is controlled by:

- National automated system for permanent control of gamma-radiation background /BUL RaMo/. With its 26 Local monitoring stations (LMS) it records the radiation gamma background on the territory of the entire country.
- EEA-MEW by the points on the territory of the entire country make measurements with movable and stationary dosimetric devices where also the existence of artificial radionuclides is monitored in the environmental components;
- NCRBRP-MH and National Institute of Meteorology and Hydrology – Bulgarian Academy of Science (NIMH-BAS).

Analysis and the assessment of the presented information in the reports on radiation environmental monitoring in Kozloduy NPP, the National Automated Continuous Control System of the gamma background radiation and of the other measurements show that during the above years on the territory of the Republic of Bulgaria:

- no unusual changes (increasing) of the values of the radiation gamma background have been recorded;
- radiation gamma background in the controlled points has been varied within the limits of the typical natural gamma background for the respective point (region);
- no considerable impact of Kozloduy NPP on the natural radiation background has been recorded;

the radiation gamma background in 100 km area of Kozloduy varied for:
- 2009 – in the interval of 0.07-0.15μSv/h
- 2010 – in the interval of 0.07-0.15μSv/h
- 2011 – in the interval of 0.05-0.15μSv/h

Analysis and evaluation of information submitted by the competent supervisory authorities of Romania shows that over the years is no significant impact of Kozloduy NPP on the natural gamma background, characteristic of the territory of Romania was registered.

Measured average of these automatic stations (SSRM), gamma background in the portion of 100 (30) kilometer area of NPP "Kozloduy" has reached:

- 2009 minimum average of 0,094 μSv / h and maximum average 0,114 μSv /h;
- 2010 minimum average of 0,090 μSv / h and maximum average 0.120 μSv /h;
- 2011 minimum average of 0,094 μSv / h and maximum average 0.110 μSv /h;

Measured values of the gamma background are much less the established upper limit (standard) of 0,250μSv/h according to decree 1978/2010 of the Romanian government.

Gamma background radiation in certain areas beyond the industrial site of Kozloduy NPP

Gamma background radiation in the areas determined beyond the site is measured and controlled in compliance with the existing methodology approved by the industrial laboratory for environmental radiological monitoring:

- at 10 control points alongside the fence with TLDs for longer periods of time/three months/;
- at 8 control stations of the AISERC located in 3 km Radiation Protection Area, operating in continuous mode;
- at 22 control points of 100km areas for monitoring by thermal luminescent dosimeters (TLD) for longer periods of time /up to three months/;

- at 123 control points of 100km area for monitoring by dosimetric instruments;

Values of the gamma background radiation measured by movable dosimetric instruments in all control points of "A" and "B" types and in the monitored populated areas of 100 km monitored area for:

- 2009 – within the range of 0.07-0.15μSv/h
- 2010 – within the range of 0.06-0.10μSv/h
- 2011 – within the range of 0.05-0.15μSv/h

They do not differ considerably from the values of the radiation background accepted as natural for the region, which values vary for:

- 2009 – within the range of 0.08-0.15μSv/h
- 2010 – within the range of 0.04-0.15μSv/h
- 2011 – within the range of 0.05-0.15μSv/h

For the same periods of time and at 32 control points by recording with thermal luminescent dosimeters values of the gamma background radiation are determined as rate of the equivalent dose. Control points are located alongside the KNPP fence (10pcs) and the monitored area (22pcs). Values of this gamma background varied for:

- 2009 – in the interval of 0.083 0.15μSv/h
- 2010 – in the interval of 0.072 0.14μSv/h
- 2011 – in the interval of 0.079 -0.15μSv/h

They do not differ considerably from the values of the radiation background accepted as natural for the region.

Gamma background radiation on the industrial site of Kozloduy NPP

Radiation gamma background on the site is measured and controlled in compliance with the methodology approved by the industrial laboratory of the Site monitoring sector:

- at 30 control points of the site and RAW Storage and SNFSF with thermal luminescent dosimeters (TLD) for longer periods of time /three months/;
- in the region of disposal facility for non-radioactive domestic and production waste (DFNRDPW) once per week;
- in the region of drainage channels (Sanitary Sewage System, Main Drainage Channel) twice per year;
- at 2 base stations of the AISERC operating in continuous mode;
- if needed, at certain monitored points;

Values of the measurements at every three months of gamma background radiation and the equivalent dose rate in 20 control points around the complex of SW RAW-kozloduy vary for:

- 2009 – within the range of 0.094-0.87μSv/h with average value 0.17 μSv/h
- 2010 – within the range of 076-0.24μSv/h with average value 0.12 μSv/h
- 2011 – within the range of 091-0.18μSv/h with average value 0.12 μSv/h

Bigger value of 0.87 μSv/h is measured in IV quarter 2006. At point N18 of the loop around SW RAW_Kozloduy, because then the bigger quantity of solid and liquid RAW are disposed there stored in special BB Cubes.

Values of the measurements at every three months of a radiation gamma background and the equivalent dose rate at 10 Control points around the complex of RAW Storage vary for:

- 2009 – within the range of 0.085-0.16μSv/h

- 2010 – within the range of 0.076-0.15μSv/h
- 2011 – within the range of 0.083-0.15μSv/h

Values of the measurements at every six months of gamma background radiation and the equivalent dose rate in 23 control points over the easement of the drainage channels and water in them vary for:

- 2009 – within the range of 0.051-0.079μSv/h
- 2010 – within the range of 0.052-0.21μSv/h
- 2011 – within the range of 0.055-0.22μSv/h

Fluctuating radioactivity of the waste water and precipitates causes the differences of the measured values.

Values of the weekly measurements of gamma background radiation as the equivalent dose rate at control points above the DFNRDPW vary for:

- 2009 – within the range of 0.057-0.013μSv/h for 5153.5 m³ disposed waste
- 2010 – within the range of 0.057-0.083μSv/h for 4422 m³ disposed waste
- 2011 – within the range of 058-0.079 μSv/h for 4836.6 m³ disposed waste

Review of the tables for gamma background radiation on the Kozloduy NPP industrial facility beyond the controlled area shows that at the points of smaller values it is considerable constant for the periods of measurements and is fluctuating in the values and time at some points of measured higher values.

3.11.2 Non-ionizing radiations

3.11.2.1 Sources of non-ionizing radiations

Non-ionizing radiation is distributed by the electrical magnetic fields transferring energy, which is not in a condition to cause ionizing of the atoms and molecules of the substances, i.e. removal or adding of negative changed particles - electrons. Electromagnetic field as a form of the existence of the matter is a combination of electrical and magnetic fields that could be converted one into another. It is distributed as electrical magnetic waves of **length - λ, frequency - γ** and **energy - E** . Connection between these values is:

$\lambda = c / f$

and

$E = h \gamma$

Where:

- **c** is the **velocity** of the light in vacuum ≈ **300000 km/s**
- **h** of the Plank constant ≈ 4.13567μeV/GHz

For the electromagnetic waves as well as for the rest ones the following phenomena are typical: interference, refraction, reflection, refraction, interrelation with the substances. When their energy interrelates in the most cases it is transformed into heat causing also changes in the live organisms. Changes are increased together with the increase of the wave frequency and the energy respectively.

Electromagnetic spectrum, (fig 3.11.2.1-1) is the range of all possible electromagnetic emissions. It covers all possible frequencies considering that the radio waves, infrared emission, visual light and partially ultraviolet emission do not ionize the atoms and molecules.

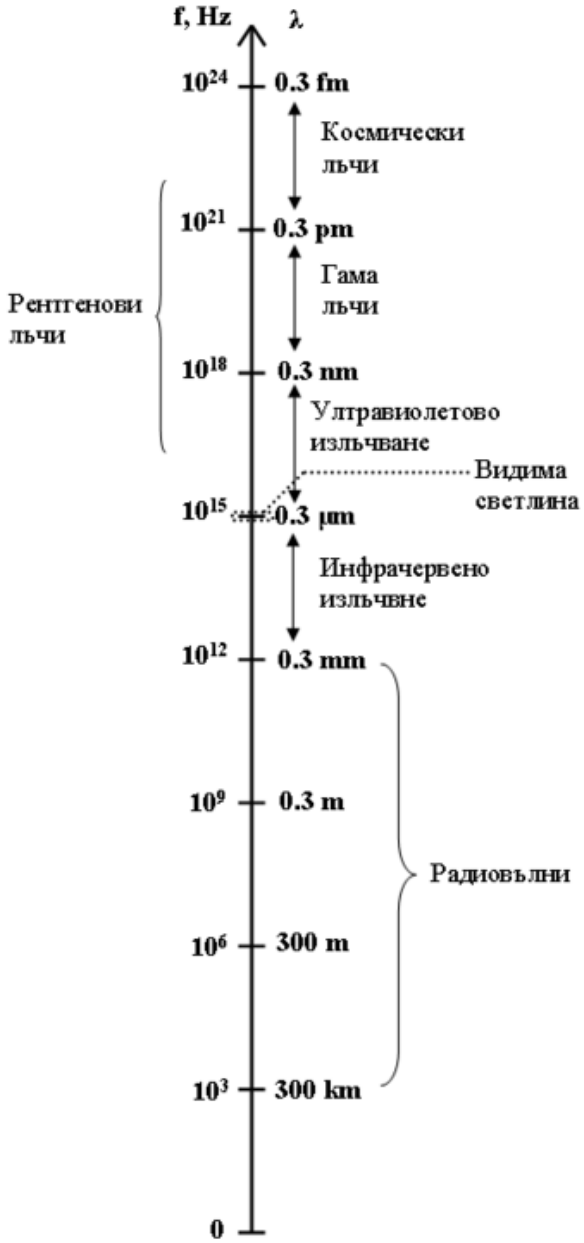


Fig 3.11.2.1-1 Electromagnetic spectrum

In the region of the currently operating Kozloduy NPP there are sources of electromagnetic fields, electro-motive force (EMF) low-and high-frequency emitting from 0 Hz to 30 GHz.

Impact by the high frequency sources on the environment is regulated by the requirements of Ordinance 9/1991 for limit permissible levels of electrical magnetic fields in populated territories and determination of hygiene protected areas around the emitting sites. Promulgated SG issue 35/1991 amended 8/2002;

Impact by the low frequency sources of up to 300Hz frequency on the environment is regulated pursuant to the requirements of Ordinance 7/1992 for the hygiene requirements of health protection of the populated environment promulgated in SG issue 46/1992.

Considerable values of low frequent EMF (electrical magnetic fields) of frequency up to 300 Hz are formed around the operating:

- Substations, HV electric power lines, electrical motors and other electrical machines;
- - generators, transformers, switchyards and switchgears as well as around the bus bars of the circuit breakers.

Other sources of the electrical magnetic environment of frequency up to 300 kHz are:

- Video monitors;
- Automated control systems and electricity generation systems;
- Video displays.

EMF sources of radio frequencies and higher frequencies used in Kozloduy NPP are:

- Security systems;
- Mobile connection systems including the mobile communication systems base stations etc.;
- Emergency annunciation systems including transmitters, mobile systems etc.

All sources of EMFs, allowing operation of Kozloduy NPP are regulated by the appropriate permissions to use. Effects of EMFs, which are emitted from sources on the environment are constant, non-cumulative, limited to the regulations and imposed by the regulations and do not affect the territory of the Republic of Romania.

3.11.3 Noise

Noise, according to the Environmental Noise Protection Act, is an unwanted or harmful external sound caused by human activity, inclusive of the noise emitted by motor, railway, water or air transport vehicles, by **industrial plants or facilities,** including the industrial activity categories according to Appendix 4 to Art. 117, para. 1 of the Environmental Protection Act and emitted by local noise sources as well.

This vibration starts from the sound source and is distributed as consequent concentration and dissolution of the material particles called sound wave. This vibration starts from the sound source and is distributed as consequent concentration and dissolution of the material particles called sound wave.

Physical values typical for the sound (noise) are as follows: sound pressure, sound power, sound rate, length of the sound wave, frequency. In order to assess the risk of the noise considering the exposition an **equivalent noise level– Leq is implemented.**

Typical for the distribution of the sound waves are the phenomena interference, diffraction, refraction, reflection etc.

With electrical and heat production in Kozloduy NPP the noise as physical factor occurs mostly in the work environment but it is also distributed in the environment.

As far as in this case the noise sources as well as the objects and subjects of considerable impact are located in the component of the atmosphere air, the analyses and assessments will be valid only for that component.

Sources of considerable noise in the environment established by the measurements from the power plant are: steam ejector machines, turbine generators, steam collectors, feedwater and condensate pumps etc.internal transport, aspiration systems, ventilation systems, pneumatic and transportation systems, air blown compressors etc.In many cases the main reasons for the high noise levels in the environment are the structure features of the machines and equipment (high revolutions, considerable velocity of fluid motion, resonance phenomena) as well as the big noise conductivity of the buildings, foundations, equipment etc.

Generated noise is constant with low and average velocity, daily mixed from time to time with pulse one.
At the borders on the site of NPP, which is an industrial area in accordance with Ordinance № 6 on indicators of environmental noise (SG br.58/2006g.) the equivalent noise levels should not exceed 70 dB (A) during daytime and evening (for production and storage areas and zones), and in places of influence (residential areas and zones) - 55 dB (A) daytime, 50 dB (A) in the evening and 45 dB (A) at night.
Noise impact of power plant on the environment has assessed in accordance with the regulations, and within the limits of the operational area and in places of influence.
Measurements of noise levels and accompanying definitions are made for the purpose of EIA according to the "Methodology for determining the total sound power emitted into the environment from industrial plant and determining the level of noise at the impact" of the MoEW, after it has been found it can be applied. Interpretation of results has been carried out in accordance with the requirements of Regulation N 6 26.06.2006. indicators for environmental noise, taking into account the degree of discomfort in different parts of the day, limit values of indicators of environmental noise, methods of assessing the performance levels of noise and harmful effects of noise on health.
For definitions and measurements (protocols for their own measurements NN 618, 621 from 13December.2010.) two measuring circuits are chosen:

- A first loop with 30 measuring points comprises electricity production-1 (EP-1), including reactors 1-4 and adjoining facilities significant sources of noise;
- A second loop with 30 measuring points comprises electricity production -2 (EP-2), including reactors 5 and 6 and adjoining facilities significant sources of noise.

During measurements in the area of electricity production-1 (EP-1) comprising Units of 1 to 4 the following major sources of environmental noise were in operation: EP-1, system for gas cleaning, systems for ventilation and conditioning, MCR, sprinkler pools, cooling transformers close to portal N 4 of main switchyard, intradepartmental transport. The noise of them except for interdepartmental transport is constant with low and medium frequency, round-the-clock.
The measured values of equivalent noise levels at measuring points located on a second loop and recorded in test report N 618/13.09.2010, during normal operation of Units 5 and 6 range from 47.4 dB (A) to 62.5 dB (A). Moreover in any measuring point of the contour does not exceed the limit of 70 dB (A) defined by the ordinance for production and storage areas and zones, which is also the boundaries of the operational area. In case the level of overall sound power of noise sources located in the loop and nearby is set at 113.7 dB (A).
During measurements in the area of electricity production-2 (EP-2) comprising Units 5 and 6, the following major sources of environmental noise were in operation: systems to maintain the status of the ceased EP-1, primary and auxiliary equipment of Units 5 and 6, during normal operation of electricity production, systems to purify water and gas, systems for ventilation and conditioning, MCR, sprinkler pools, cooling transformers, compressor station, pumping stations, intradepartmental transport. The noise of them is constantly low and middle frequency, diurnal, mixed occasionally with impulse one.

The measured values of equivalent noise levels at measuring points located on a second loop and recorded in test report N 621/13.09.2010, during normal operation of Units 5 and 6 range from 47.3 dB (A) to 66.6 dB (A). Moreover in any measuring point of the contour does not exceed the limit of 70 dB (A) defined by the ordinance for production and storage areas and zones, which is also the boundaries of the operational area. In case the level of overall sound power of noise sources located in the loop and close out of it is set at 119.1 dB(A).
The defined values of equivalent level of noise in the impact areas based of the indicated methodology are:
- For Kozloduy City from EP-1 43.6 dB(A), and from EP-2 , 46.8±2 dB(A);
- For the island Kopanitsa-Romania from EP-1 40.5 dB(A), from EP-2 - 39.5 dB(A);
-For Beckett City – Romania from EP-1 31.5 dB(A), from EP-2 27.9 dB(A);
- For Harlets village from EP-1, 41.7 dB(A), from EP-2 37.8 dB(A);
- For Glojene village EP-1, 39.7 dB (A), and EP-2 36.2 dB (A).
Only in the town of Kozloduy the equivalent noise levels of EP-2 exceeds the limit value of 45 dB (A) for night time, but given the error of ± 2 dB (A), it cannot certainly be argued that there is excess.
The impact of sound waves that are emitted from the noise sources located in NPP on the environment is limited and within the regulations imposed by the regulations of the Republic of Bulgaria.
Noise impact in this case and in accordance with the regulations on the territory of the Republic of Romania is defined as insignificant.

3.11.4 Vibrations

Vibration is a vibrating of material point or body towards one balanced position. Vibration could be simple, but in most cases it is complicated with a lot of components of different frequencies.
Generally, depending on their temporary characteristics the vibrations could be: **periodical**, **short-term**, **long-term.** Depending on the acting force they could be **forced** or **free**.
Vibrations are useful in some production processes while in other cases they are harmful and can cause wearing of components and industrial accidents. When vibrations are transmitted to the human organism they could harm it.
As for their immediate (local) impact on the machines and facility operators, the vibrations have been well studied and presented in the literature. Bulgarian and international standards and the respective sanitary codes have been implemented for such impact. Measurements are made of vibration rate, vibration acceleration, amplitude at different vibration frequencies.
The vibrations propagate similar to noise (sound) in the components of the environment at different speed as kinetic energy which in is eventually transformed into other types. Due to the lack of data about the measurements and vibrations generated by Kozloduy NPP or different machines and equipment the environmental condition could not be described in view of this factor and its impact on the specified impact places.

3.11.5 Thermal impact by Kozloduy NPP

See Chapter 1 Section 1.13 of this report.

3.11.6 Other harmful physical factors

Workers, involved in the dismantling facilities will be exposed to:
- Dust and metal aerosols;
- Asbestos;
- infrared and ultraviolet radiation.

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

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

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

3.12 Waste and hazardous substances

3.12.1 Conventional waste

3.12.1.1 Main types

Conventional (non-radioactive) waste are the ones, which radioactive pollution does not exceed the limits for decontrol pursuant to the currently effective regulations and internal documents and which are allowed to leave the site (protected area) of Kozloduy NPP in compliance with the requirements of the radiation protection.

On fig. 3.12.1-1 shown a block diagram of the method of investigating the radioactivity of the waste I and II-nd category and treatment as conventional waste

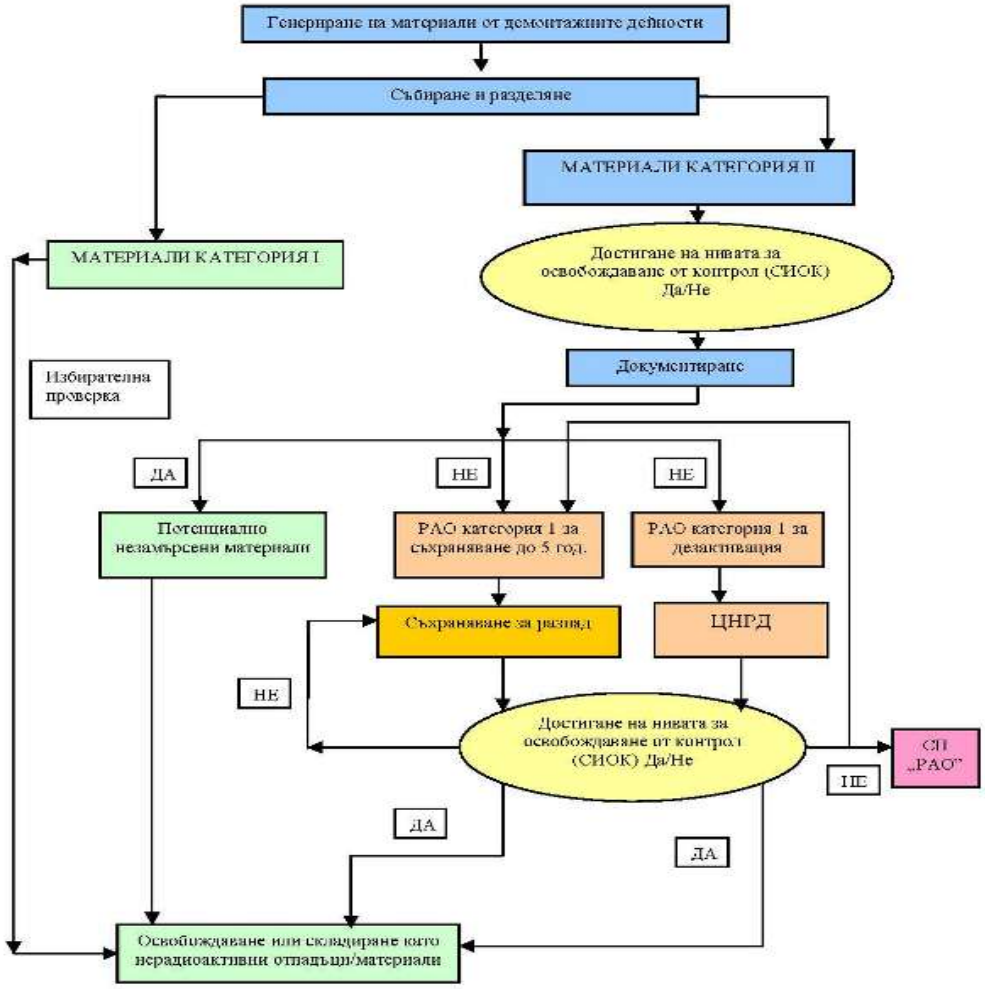


Fig. 3.12.1-1 Movement of streams of materials I and II-nd class and turning them into conventional waste

On fig. 3.12.1-2 shown a block diagram of the method of investigating the radioactivity of the waste from II and III-Grade and treatment as conventional waste.

The groups of non-radioactive wastes are assigned conventional waste including municipal, construction, industrial and hazardous waste. In the operation of the power

plant are formed except household and conditional waste, but also waste oil, ferrous and nonferrous metals, discarded electrical and electronic equipment, fluorescent and mercury lamps, batteries, asbestos waste, waste wood, paper and cardboard, leachate from landfills and more.
In compliance with the requirements of the Waste Management Law they are collected separately [123].

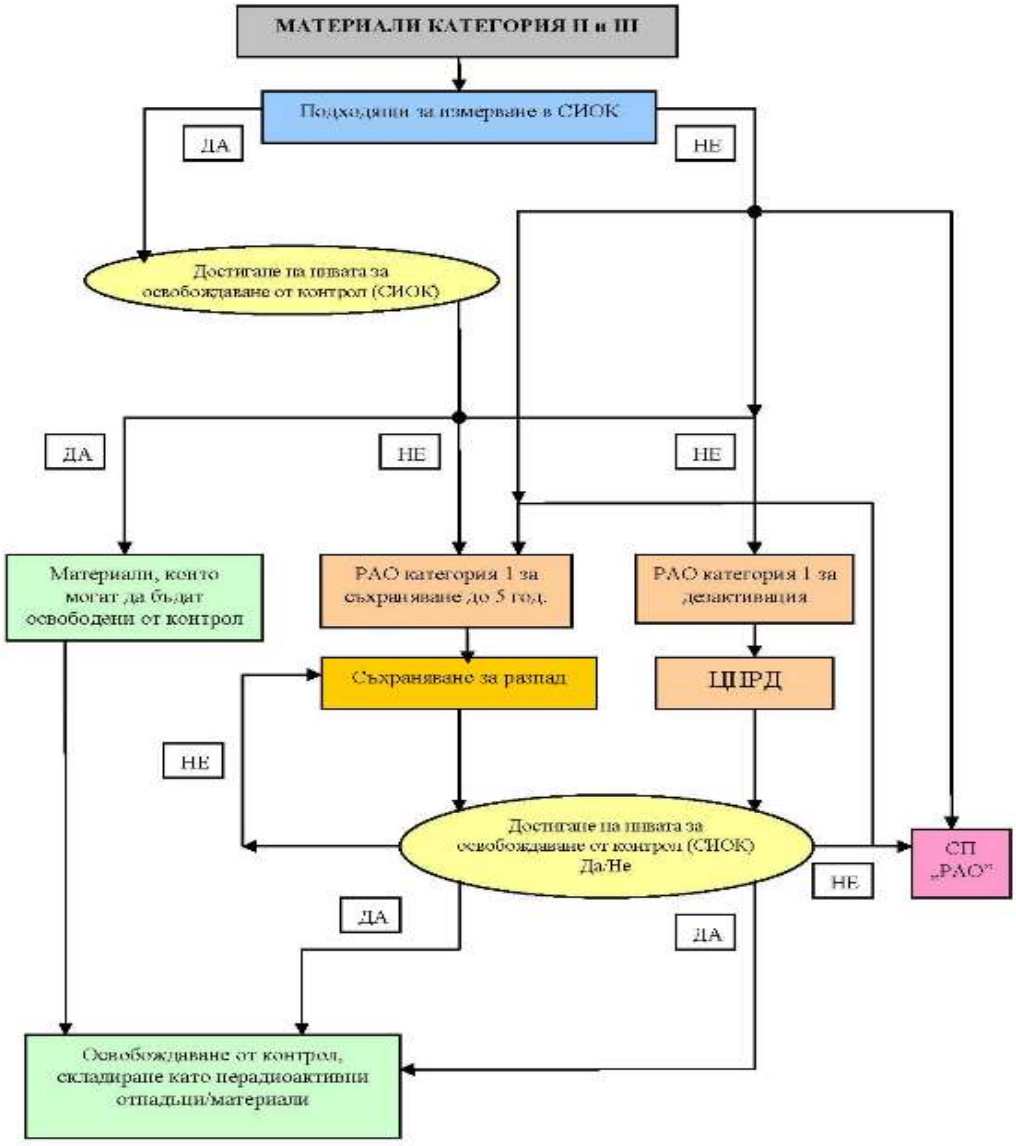


Fig. 3.12.1-2 Movement of streams of materials II and III-Grade and turning them into conventional waste

The conventional (non-radioactive) waste in Kozloduy NPP is managed pursuant to Conventional Waste Management Program in Kozloduy NPP [151] and Safety rules for management of conventional waste [164].
Wastes in Kozloduy NPP generated as a result of the production activity, activities of the auxiliary units and outside companies, working on the site under a contract, concluded with the Company as well as sorting out of goods and material values (GMV) are classified according to Ordinance 3 from 2004 for waste classification

[153]. List of waste generated in Kozloduy NPP EAD with indicated codes, is presented in Appendix 11.1.5-1. In table 3.12.1-1 the annual quantities are summarized.

Table 3.12.1-1 Annual quantities of the main groups of conventional waste from Kozloduy NPP.

N	Type of the waste	average annual quantity	Notes
1	Waste from parks and gardens	Appr. 25 t/a	including grass, leafs, branches; and soil and stones.
2	Mixed municipal waste	Appr. 1500 t/a	Also, in the same containers about 5 t/ small batteries, CTMs and photograph waste etc. are stored, for which no special requirements are established.
3	Volume waste	Information n/a	Equipment of offices and rooms
4	Construction waste	Appr. 175 t/a	Disposed
5	Infiltrate from the waste disposal facility	Appr. 1600 t/a	Periodically transferred to the neutralization pit of EP-2
6	From medical products	Appr. 1 t/a	Sorted out in 2005 and disposed
7	absorbents, filter materials, towels and protection clothes not containing hazardous substances	Appr. 12 t/a charcoal	Disposed once in RNHIW in 2001.
8	Sludge	appr.5150 t	Sludges of different origin disposed in RNHIW
9	Waste from grids and screens	Appr. 35 t/a	Disposed in RNHIW
10	Sorted out tires	internal -300 pcs. external-700 бр.	Annual delivery Temporary storage
11	Paper and carton	Appr. 9 t/a	Average sold in 2002 - 2004.
12	Wood waste	In 2001 г -17t; In 2002 -200t	Sold to outside persons and organizations
13	Cuts, shavings and of ferrous and non-ferrous metals	In 2003 -100t; In 2004 - 15 t	Sold to outside organizations
14	Waste from ferrous and non-ferrous metals	Ferrous metals - during the period 2001 – 2004 sold average 1800 t/a; Ferrous metals - during the period	In 2002 – max. sold 3300 t. In 2004 – max. sold 1000 t.

N	Type of the waste	average annual quantity	Notes
		2001 – 2004 sold average 400 t/a;	
15	sorted out electrical and electronic equipment; Components of sorted out equipment	Information n/a	
16	Waste of chemical substances and agents, incl.	appr.60 t appr.50 t	Organic and non-organic substances and agents, not containing hazardous substances; Organic and non-organic substances, containing hazardous substances;
17	Packing of chemical substances and agents.	Information n/a	
18	Spent greases and lubricants	Appr. 2 t/a	Collected separately
19	Spent solutions	< 0.1 t/y < 0.1 t/y.	From x-ray films Fixation solutions
20	Spent oils and oil-water emulsions	appr.320 t	Stored or unsold by the end of 2004.
21	Sludge from oil catchment pits	appr.10 t	Stored in
22	Gasoline, boiler and diesel fuel	Minimal waste are expected	In 2004 sold black oil is 1300 t
23	Absorbents, filter materials, towels and protection clothes contaminated with hazardous substances	Information n/a	Non-separate collect system is not applied.
24	Insulation materials, containing asbestos	In 2002 and 2005 disposed in RNHIW–average by 2t	
25	Diluents	Appr. 1 t/a	From laboratories and nitrogen-oxygen station
26	Fluorescent pipes and other waste containing mercury	Luminescent lamps – average 10 000 pcs/y; Mercury lamps– average 4 000 pcs/year; Sodium and other lamps – average 200 pcs/year.	Stored in reinforced containers.

N	Type of the waste	average annual quantity	Notes
27	Batteries and accumulators containing hazardous substances	Appr.60 -65 t/a	Sold during the period 2001 – 2004.

Table 3.12.1-2 Non-Radioactive waste generated in the "NPP Kozloduy" for the period 2007 - 2011

№	Name, description	Code according to Reg№ 3	Quanity, t				
			2007	2008	2009	2010	2011
Hazardous waste							
1	Non-chlorinated hydraulic oils, mineral based	13 01 10*	-	-	-	-	-
2	Non-chlorinated engine, lubricating and gear oils, mineral based	13 02 05*	13,10	-	26,60	-	7,8
3	Non-chlorinated insulating and heat transmission oils, mineral based	13 03 07*	-	-	4,60	23,14	24,8
4	Interceptor shafts (collector) sludges	13 05 03*	7,60	13,3	-	6	-
5	Oil from oil-water separators	13 05 06*	-	-	2,50	11,5	7,86
6	Gas, steam and diesel fuels	13 07 01*	-	-	-	-	-
7	Other emulsions	13 08 02*	-	-	-	-	-
8	Wastes not otherwise specified (waste greases and lubricants)	13 08 99*	-	-	-	-	-
9	Packaging containing residues of hazardous substances or contaminated by hazardous substances	15 01 10*	-	-	0,20	2,4	3,264
10	Absorbents, filter materials, wiping cloths and protective clothing contaminated by hazardous substances	15 02 02*	-	-	-	-	-
11	Decommissioned vehicles	16 01 04*	-	-	-	-	234,58
12	Oil filters from vehicles	16 01 07*	-	-	-	-	-
13	Antifreeze fluids containing hazardous substances	16 01 14*	-	-	-	-	-
14	Transformers and capacitors containing PCBs	16 02 09*	-	12,50	-	0,676	-
15	Discarded equipment containing hazardous components (3), other than those mentioned in 16 02 09 to 16 02 12	16 02 13*	-	-	2,10	3,2	4,302

№	Name, description	Code according to Reg№ 3	Quanity, t				
			2007	2008	2009	2010	2011
16	Inorganic waste containing hazardous substances	16 03 03*	-	0,50	0,032	-	-
17	Organic wastes containing hazardous substances	16 03 05*	-	0,40	-	-	-
18	Gases in pressure containers (including halons) containing hazardous substances	16 05 04*	-	-	-	-	-
19	Lead batteries	16 06 01*	-	-	104,7	20,650	47,469
20	Ni - Cd batteries	16 06 02*	-	-	0,30	1,46	1,9
21	Insulation asbestos-containing materials	17 06 01*	0,50	-	13,60	0,06	22,280
22	Construction asbestos-containing materials	17 06 05*	-	-	-	-	-
23	Sludges from physico-chemical treatment containing hazardous substances	19 02 05*	-	-	-	-	-
24	Solvents	20 01 13*	-	-	-	-	-
25	Photographic chemicals and preparations	20 01 17*	-	-	-	-	-
26	Fluorescent tubes and other mercury-containing waste	20 01 21*	1,40	1,40	0,40	3,5	4,29
Industrial waste							
27	Sawdust, shavings, cuttings, wood, particle board and veneer other than those mentioned in 03 01 04	03 01 05	5,40	0,90	6,40	5,2	7,8
28	Photographic films and paper containing silver or silver compounds	09 01 07	-	-	-	-	-
29	Photographic films and paper not containing silver or silver compounds	09 01 08	-	-	-	-	-
30	Filings and scrap of ferrous metals	12 01 01	-	-	6,90	6,2	8,08
31	Filings and scrap of non-ferrous metals	12 01 03	-	-	-	0,22	0,420
32	Paper and cardboard packaging	15 01 01	-	0,10	-	-	-
33	Plastic packaging	15 01 02	-	-	-	-	-
34	Metal packaging	15 01 04	-	-	-	-	-
35	Glass packaging	15 01 07	-	-	-	-	-

№	Name, description	Code according to Reg№ 3	Quanity, t				
			2007	2008	2009	2010	2011
36	Absorbents, filter materials, wiping cloths and protective clothing other than those mentioned in 15 02 02	15 02 03	3,30	3,50	1,50	-	-
37	Discarded tires	16 01 03	-	15,0	-	2,2	8,212
38	Discarded vehicles, containing neither liquids nor other hazardous components	16 01 06	-	-	-	-	-
39	Antifreeze fluids other than those mentioned in 16 01 14	16 01 15	-	-	-	-	-
40	Discarded equipment other than those mentioned in 16 02 09 to 16 02 13	16 02 14	-	7,80	18,2	64,2	54,739
41	Components removed from discarded equipment other than those mentioned in 16 02 15	16 02 16	-	-	8,78	71	41,322
42	Inorganic wastes other than those mentioned in 16 03 03	16 03 04	-	2,40	1,80	6,26	4,392
43	Organic wastes other than those mentioned in 16 03 05	16 03 06	-	0,60	5,20	-	-
44	Alkaline batteries (except 16 06 03)	16 06 04	-	-	-	-	0,099
45	Other batteries and accumulators	16 06 05	-	-	-	-	-
46	Sludges from physico-chemical treatment other than those mentioned in 19 02 05	19 02 06	5,0	-	-	-	-
47	Leachate from landfills other than those mentioned in 19 07 02	19 07 03	1234	1139	839	1365,5	1365,5
48	Waste from grills and screens	19 08 01	8,0	-	-	-	-
49	Sludge from wastewater from settlements	19 08 05	-	-	-	-	-
50	Wastes not otherwise specified	19 09 99	-	-	16,0	-	-
51	Ferrous metals	19 12 02	-	1186	1052,9	1314,2	1508,324

№	Name, description	Code according to Reg№ 3	Quanity, t				
			2007	2008	2009	2010	2011
52	Non-ferrous metals	19 12 03	-	16,70	143,28	66,955	81,155
53	Sharp tools	18 01 01	-	-	-	-	-
54	Waste, the collection and the disposal of which is subject to special requirements in order to prevent infection	18 01 04	-	-	-	-	-
Construction waste							
55	Concrete	17 01 01	15,0	4,3	4,0	3,0	4,0
56	Dredging soil other than those mentioned in 17 05 05	17 05 06	-	-	-	-	-
57	Insulation materials other than those mentioned in 17 06 01 and 17 06 03	17 06 04	73,0	131,0	79,0	99,9	265,16
58	Mixed waste from construction and demolition, other than those mentioned in 17 09 01 17 09 02 and 17 09 03	17 09 04	67,50	16,60	111,5	156,5	49,75
Municipal waste							
59	Paper and cardboard	20 01 01	74,2	31,30	19,1	6,855	65,03
60	Glass	20 01 02	-	-	-	-	-
61	Medicines other than those mentioned in 20 01 31	20 01 32	0,20	0,20	0,20	-	-
62	Wood other than those mentioned in 20 01 37	20 01 38	-	90,39	56,91	131,2	168,1
63	Plastics	20 01 39	-	6,80	0,30	-	-
64	Other fractions not otherwise specified (sludge cleaning cold channel)	20 01 99	-	-	-	-	-
65	Biodegradable waste	20 02 01	28,6	40,0	43,50	44,3	36,9
66	Soil and stones	20 02 02	2,0	13,0	2,0	-	-
67	Mixed municipal waste	20 03 01	1114,0	1238,9	881	899	957,35
68	Waste from sewage cleaning	20 03 06	16,0	-	-	-	-

Hazardous waste - hazardous waste to belong: fluorescent and mercury lamps, batteries generated as hazardous waste systems, emergency power lighting, control and other systems Auto fleet in the replacement of exhausted batteries. Packages involving chemical substances and mixtures - a majority of the chemicals are supplied in NPP "Kozloduy" EAD with tanks. When the amount of chemicals is less, they are in drums, cans, glass containers and the like. Waste oil is formed from the cleaning of oily wastewater into the local sewage treatment facilities within the NPP "Kozloduy". They collected in 5 t tank and transported by an external company. The total quantity of oil retained in treatment facilities is about 60 t. Sludge mudtight - with annual 10-m^3.

Industrial waste - the largest share of industrial waste in the NPP "Kozloduy" have metal waste (old worn machine parts, worn steel ropes, etc.) They are not related to direct production activities, and are formed in the repair of the equipment at sites. Besides scrap in the repair of brass pieces of equipment are formed brass waste. Ferrous and non-ferrous metals will be formed in the dismantling of systems, equipment and components for the scrapping of all equipment or parts of equipment.

This waste is the largest and predominant throughout the decommissioning. The first step will be carried out dismantling systems, equipment and components in IB, starting with those that are not radiation-contaminated. After commissioning of TSNRD can begin the dismantling of systems, equipment and components that are radioactive contamination. They will be transported to TSNRD, where they will perform their fragmentation and decontamination. It is expected that all contaminated ferrous metals from the IB will be successfully disarmed and released from control. Since TSNRD will be a facility to remove the insulation of cables, it is expected that the metal conductors of all wires and cables to be removed from all items will be successfully exempted. It is also believed that the majority of stainless steel and a significant part of carbon steel by the AO and AB will also be decontaminated to levels of clearance.

Construction waste is generated depending on the volume of repair. The amount varies around 200 m3 per annum. Sheet as at present be disposed dredging spoil and concrete waste DNBPO, which will continue in stages of decommissioning. Not expected to generate significant amounts of large concrete waste from decommissioning activities as demolition is not intended and provides only eliminate some fundamentals of equipment and removal of buildings to be used for other purposes.

Recommended in the management of construction waste generated during decommissioning of units 1-4 should be in line with the Regulation on management of construction waste and use of recycled building materials (SG, br.89/134.11 .2012) in accordance with the recommendation of the Ministry (letter ref. NoOVOS-289/09.01.2013 on), including the construction of other sites for RAW and RAM.

Household waste - are formed in all workplaces, administrative and industrial buildings, cafes, catering, and cleaning of the plant site from branches, leaves, etc. Given that a significant part of the period of removal of the units and the site staff will continue, with high probability it can be argued that household waste will also keep their species structure and its quantitative characteristics (volume, weight and rate of formation).

With the decommissioning of Units 1 to 4 of NPP "Kozloduy" expected quantities of generated construction, manufacturing and certain hazardous waste to increase, but

will generally be within the permitted limits for disposal of DNBPO and the remaining waste will be forwarded to the companies for further treatment through recovery. Firms must have a license under the Art. 35 of WMA.

3.12.2 Waste collection, transportation and treatment

Kozloduy NPP has a permit pursuant to Article 37 of the WML for collection, transportation, utilization and decontamination of the waste. The permit is issued by the RIEW-Vratsa, which executes control over the execution of the activities.
Schemes for treatment and transportation of conventional waste from Kozloduy NPP are described in Appendix 7 of [151]
One part of the waste is collected separately and for the other one there is no organization established yet. The later includes spent greases and lubrications, small batteries, sodium and other lamps with metal halogenides, packings of chemical substances and agents.
Subject to separate collection and treatment are:

- waste, which due to their specific characteristics and/or requirements of the regulations are determined as hazardous;
- production waste, hazardous and utilizible production waste are temporary stored at certain places on the site of the power plant and after that they are sold or transferred to licensed outside organizations for further treatment.

With decision 05-ДО-72-01 from 12 June 2008 of the RIEW, Vratsa for temporary storage of the waste before their disposal Site 1 in Kozloduy NPP is determined and the content and quantities of the waste before their disposal is regulated. It supplements the provisions of Decision 05-ДО-72-00 from 24 January 2006 and is in force until 31 December 2010, and the last amendment of the license is valid until 31.12. 2015
Table 3.12.2-1 shows the permitted waste quantities for temporary storage on Site 1 in groups as well as the quantities of a part of the production and hazardous waste until 2009 and the levels are coming years are similar to those.

Table 3.12.2-1 Quantities of waste for temporary storage on Site 1 in Kozloduy NPP.

Code	Type of the waste	Quantity of the waste, t
20.05.01	*Domestic waste*	1844.5
	Production waste, incl.:	11536.9
19.12.02	ferrous metals;	3000
19.12.03	non-ferrous metals	1200
16.01.03	end-of-life tires	15
19 07 03	infiltrate from waste disposal facilities different than the one specified in 19 07 02	1800
19.02.06	sludge from neutralization pits of EP-1	160
19.08.01	sludge from treatment complex of EP-2: - from grids; - from water treatment	60
19.08.05	waste, not mentioned anywhere (initial treatment CPS and cold channel)	
19.09.99	Paper and carton	1.5

20.01.01		5000 80
17.07.01	*Construction waste*	326
	Hazardous waste, incl.:	1030.4
20.01.21*	end-of-life luminescent materials and mercury lamps	4
13 01 10*	non-chloric hydraulic mineral oils	5
13.02.05*	non-chloric motor, lubbrication oils and gear mineral oils.	500
13.03.07.	non-chloric insulation and heat transmission mineral oils Sludge from oil catchment pits	200
13.05.03*	oil from oil-water separators Gasoline, boiler and diesel fuel Packing, containing waste of hazardous	10
13.05.06*	substances or contaminated hazardous waste	50
13.07.01*	absorbents, filter materials (including oil	0.5
15.01.10*	filters, non mentioned anywhere), towels and protection clothes, contaminated with hazardous materials.	25
15.02.02*	non-organic waste containing hazardous substances	15
	organic waste, containing hazardous substances lead accumulator batteries	
16.03.03*	nickel-cadmium batteries	3
16.03.05*	Insulation materials, containing asbestos construction materials, containing asbestos	15
16.06.01*	sludge from neutralizing pits, containing hazardous substances	60
16.06.02*		80
17.06.01*		20
17.07.05*		25
19.02.05*		50

Waste transportation is carried out with own specialized and universal transportation means or with other machines of the outside companies working on site under contract.

In compliance with the normative requirements and based on the internal company documents in the protected area of Kozloduy NPP radiation control is executed in the place of generation and collection of the waste. Containers with municipal and non-utilized small production waste are subject to daily dosimetric control.

Storage Department (table 3.12.2-3) accepts for temporary storage ferrous and non-ferrous metals, including cuts and shavings, tires, accumulators, en-of-life electrical

and electronic equipment and components, wood and oversize waste. This waste is sent for utilization by recycling, which is in accordance with the new Waste Management Act (SG. 53 on 13.07.2012). Storage facilities are designed as storages for temporary waste storage due to which there are significant discrepancies of Ordinance 7 from 24 August 2004 and Appendix N 2 of the Ordinance for waste treatment and transportation of production and hazardous waste.

Waste chemical substances and products are stored at the places of their generation.

Considerable quantity of waste chemicals is stored in storage facility - storage 104. The include paints, varnishes, substances with unknown content etc. In storage 001 there are packages of hazardous chemical substances, plastic and glass waste, equipment, components of the equipment etc.

Waste oils and oil-water emulsions are collected in suitable vessels and are stored at the places of their generation and in the oils torage facilities of EP-1 and EP-2.

Solutions of developing solvent and water base activator and fixation solutions are collected separately and stored in the unit, where they are generated - Test center "Diagnostic and Control"

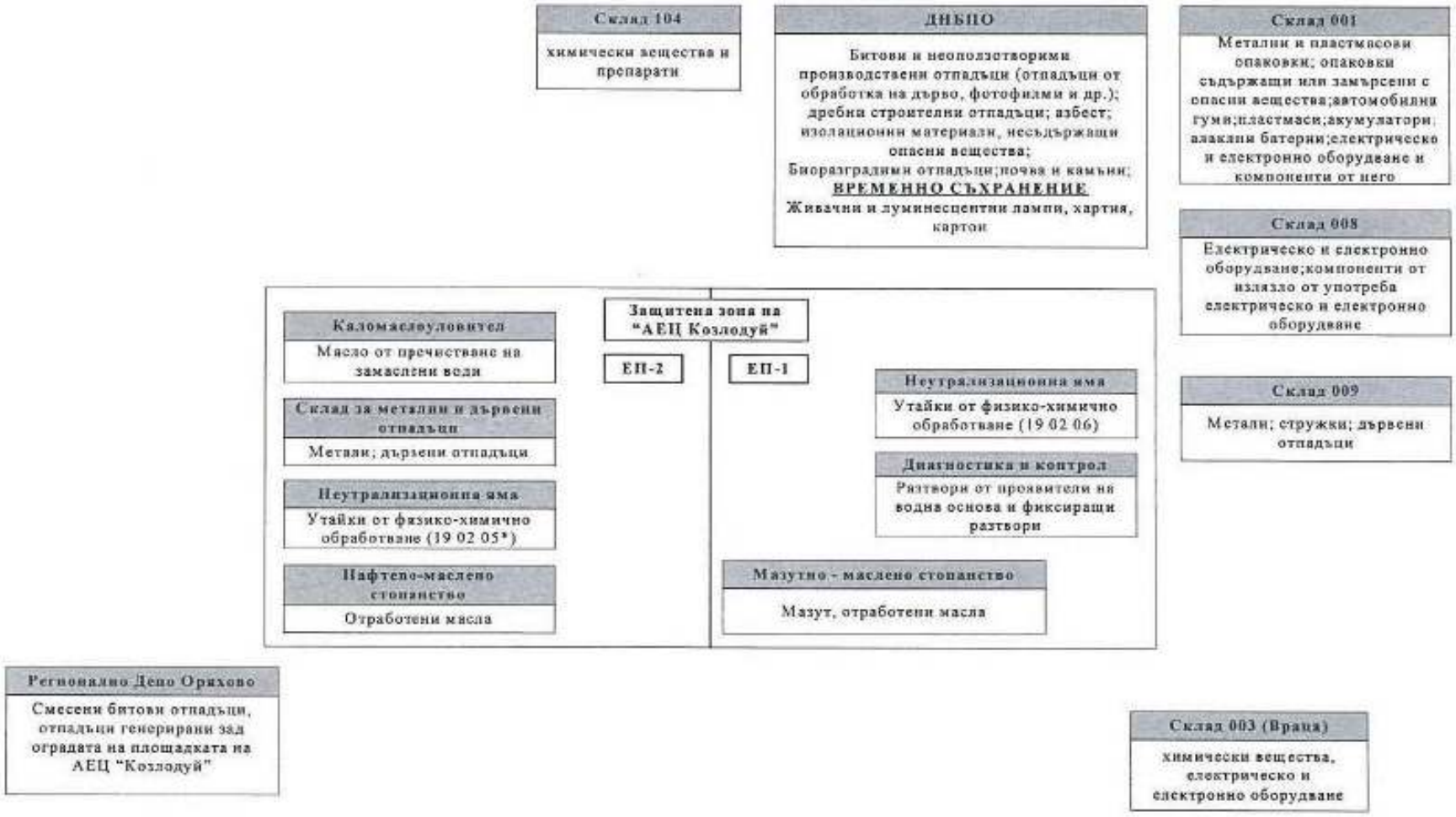


Fig 3.12.2-1 Scheme of locations for waste treatment within the NPP "Kozloduy"

Table 3.12.2-2 Locations (sites) for temporary storage of waste

Waste	Code	Temporary storage
Ferrous metals and non-ferrous metals	19 12 02, 19 12 03	Storage 009, site in EP-2
ferrous metal and non-ferrous metal filings and turnings	12 01 01, 12 01 03	Storage 009
wood other than that mentioned in 20 01 37	20 01 38	Storage 009, site in EP-2
discarded equipment other than those mentioned in 16 02 09 to 16 02 13	16 02 14	Storage 008
components removed from discarded equipment other than those mentioned in 16 02 15	16 02 16	Storage 008
discarded equipment containing hazardous components(2) other than those mentioned in 16 02 09 to 16 02 12	16 02 13 *	Storage 008
hazardous components removed from discarded equipment	16 02 15*	Storage 008
lead batteries	16 06 01*	Storage 001
Ni – Cd batteries	10 06 02*	Storage 001
alkaline batteries (except 16 06 03)	16 06 04	Storage 001
bulky waste	20 03 07	Storage 001 and“association”
end-of-life tyres	16 01 03	Storage 001

end-of-life luminescent materials and mercury lamps	20 01 21*	DNBAO
Paper and carton	15 01 01, 20 01 01	DNBPO
Waste chemicals	16 03 03*, 16 03 04, 16 03 05*, 16 03 06	In place of generating
Waste oils and oil/water emulsions	13 01 10*, 13 02 05*, 13 03 07*, 13 07 01*, 13 08 02*	In place of generating, oil holdings of EP-1 and EP-2
water-based developer and activator solutions, fixer solutions	09 01 01*, 09 01 04*	"Diagnostic and Control"

In the Department 'Supply and warehousing" are separate storages for temporary storage of ferrous and nonferrous metals, incl. filings and clippings, tires, batteries, discarded electrical and electronic equipment and components, wood and bulky waste.
In storage 001 is separate temporarily six individual cells for temporary storage of lead acid and Ni - Cd batteries and alkaline batteries. According to the Regulation on the placing on the market of batteries specified in section 10.9 of the Decision for Waste Management of "NPP Kozloduy", uncontrolled release and / or disposal of spent batteries is prohibited as prohibited uncontrolled disassembly and / or spillage of the electrolyte thereof.
In the same storage temporarily stored metal and plastic containers of hazardous substances.
Significant amount of waste chemicals is located in ‘Supply and warehousing" department storagees - 106 (NPP" Kozloduy ") and 003 (in Vratsa).
Among them there are paints, varnishes, substances with unknown contents, etc.
Storages are not designed as storages for temporary storage of waste, so that there are significant deviations from the requirements of Regulation 7 [24].
In 2002 was elaborated *„Program for implementation of system for separate collection and utilization of paper and carton”*. Also, the storage facility accepts for temporary storage waste paper and carton. There the documents, which have to be destroyed, are cut before transfer for utilization. In 2008 the Disposal facility accepted appr. 30 t waste paper and appr. 16 t are sold.
Based on the assessment of the existing condition during the elaboration of Program for Management of conventional waste in Kozloduy NPP and taking into account the degree of importance of the problems Action plan (2006-2010) is elaborated and implemented, which is a part of the program for control of conventional waste [151].

3.12.3 Waste disposal

Since the beginning of 2001 Kozloduy NPP has its own Repository for conventional municipal and industrial waste (RCMIW), which fully complies with the current requirements. In the RCMIW conventional municipal, unused industrial and small construction waste are disposed. Construction and operation of the Repository is designed in two stages and their total area for disposal in above 11 dca. Design capacity of the facility is 45 000 m^3, and the operation period is 9 years for the first stage and 15 years for the second one.

The Repository is appr. 3.7 km far Southern from the midstream of Danube River against its 693 km. To the East from the area are located the raw water channels of Kozloduy NPP and at West the High voltage power supply lines are located and from its Southern side the limestone facility, RAW Repository and Switchyard are located.

Figure 3.12.3-1 shows annual amounts of the conventional wastes, storied at the Repository in the period 2001-2011.

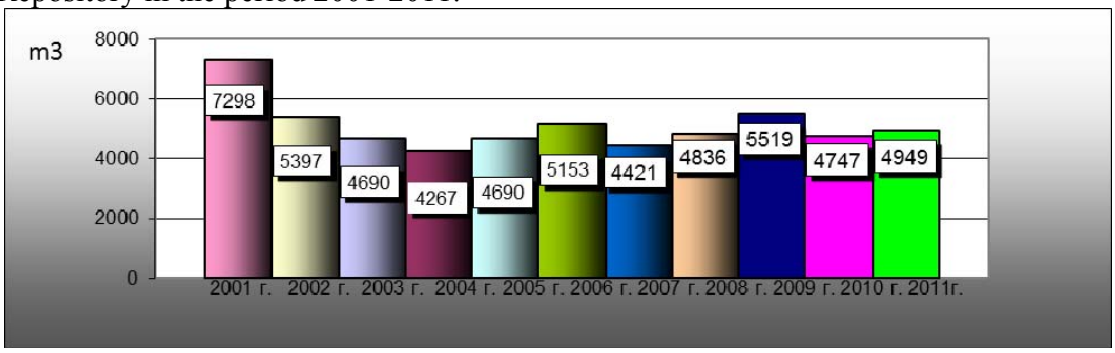


Figure 3.12.3-1Annual amounts of the conventional wastes, storied at the Repository in the period 2001-2008.

Table 3.12.3-1 indicated volume of damped waste by type by the end of 2010, the trend is to reduce quantity of damped waste, which is a good measure to extend the life of the dam.

Table 3.12.3-1 Volume of the waste disposed for 2002-2010

year	Dometic, m^3	Constructional and recoverable waste from manufacturing, m^3	Waste from parks and gardens, m^3	Total, m^3
2002	4703,3	439,5	254,0	5396,8
2003	1008,0	429,0	253,0	4690,0
2004	3814,0	390,0	63,0	4267,0
2005	3431,5	47,5	434,0	3913,0
2006	4059,0	675,5	419,0	5053,5
2007	3772,0	247,0	290,0	4422,0
2008	4038,0	372,6	426,0	4836,6
2009	4402,0	674,0	433,0	5509,0
2010	3585,5	716,3	443,0	4744,8

Source: Annual report of Kozloduy NPP, Radiological monitoring, 2002-2010

During the last two years after the shut down of the generation of Units 1-4 the total quantity of the disposed waste remains relatively unchanged. Average 85% of the

disposed wastes are municipal, 8.4% are not used industrial and construction waste and 6.6 % - waste from parks and gardens. For eleven years operation are filled 85% of Stage I.
If during the dismantling and removal of equipment when new wastes are classified, they should be characterized in accordance with the Guide for basic characterization of waste and applying the criteria for acceptance of waste at different classes of dams, MEW, Sofia, 2011 , if appropriate, if the waste does not meet class depot should be made and pre-treatment of waste prior to disposal in accordance with the Guide for the pre-treatment of waste prior to disposal, MEW, Sofia, 2005
As a result of the prevailing quantity of municipal waste and higher compacting ration the repository is filled slower than it is foreseen by the project. For eight years of operation 64% of the volume of the waste body is constructed. The remained capacity of Stage I of the Repository is 5940 m^3 or 36%. After the re-elaboration of the design of the Repository aiming to comply with the new requirements the second stage of the Repository will be prepared.
With the same Decision 05-ДО-72-01 from 12 June2008 it is permitted until 31.12.2015 to dispose in the RCMIW and of the following hazardous waste (table 3,12.3-3).

Table 3.12.3-2 Composition and quantities of hazardous waste that is permitted disposal DNBPO

Code	Type of waste	quantity, t/y
15.02.02*	absorbents, filter materials (including oil filters not otherwise specified), wiping cloths, protective clothing contaminated by dangerous substances	3
17 06 01*	insulation materials containing asbestos	90
17 07 05*	construction materials containing asbestos	90

Table 3.12.3-3 content and quantities of hazardous waste permitted for disposal in RCMIW.

Relating to compliance with the legal requirements to protect the environment the Kozloduy NPP Program foresees construction of a chamber for hazardous waste in the Repository of Kozloduy NPP for municipal and industrial waste until the construction of separate disposal facility for hazardous waste. Decision by the RIEW, Vratsa regulates the separate collection and temporary storage of the hazardous waste in specialized vessels on the territory of the power plant until the final solution of their treatment issue. End-of-use luminescent and mercury lamps are temporary stored in RCMIW in reinforced containers. In 2007 Nadin Komers EOOD received for further treatment 5.5 tons end-of-life luminescent and mercury lamps collected during the period 2005 – 2007. In 2008 the Disposal facility for temporary storage received 11 300 pcs luminescent lamps and 700 mercury lamps and together with the accumulated quantities of luminescent lamps by the end of 2008 it was increased up to 13 600 pcs and after that it was submitted to outside organizations holding the respective permits for safe treatment of the hazardous waste.

In the area of the Repository a monitoring is carried out according to the Programs for In House Radiation Control and Non-Radiation Monitoring of the Repository. The results of self-monitoring of Repository carried out under these programs are recorded in accounting records (records) listed below in Table 3.1.12-3.

Table 3.1.12-3 Reporting documents for monitoring of the RCMIW

Document	Storage term	Place for storage	Responsible staff
Reporting book for depot	5 y	central archive	Cheef department
References for radiation monitoring of incoming waste	permanent	central archive	Cheef department
Repoting book asbestos containing wastes	30 y	central archive	Cheef department
Transport maps for asbestos containing wastes	5 y	central archive	Cheef department
Protocols for sampling and testing of asbestos containing wastes	30 y	central archive	Cheef Department “Quality
Protocols for sampling and testing of domestic, industrial and construction waste going to landfills (health environmental forensics)	5 y	central archive	Cheef Department “Quality
Monthly report for results of operation of depot	3 y	Department “Quality”	Cheef Department “Quality
Annual report for results of operation of depot	permanent	central archive	Cheef Department “Quality
Metheorological data book	-	Group“Depot”	Cheef department
Protocols from draw water and measurmet of the evel of undergroundwater	6 y	central archive	Cheef Department “Quality
Protokols for sampling of surface waterq underground water and aste water	6 y	central archive	Cheef Department “Quality
Protocols from testing of underground water	6 y	central archive	Cheef Department “Quality
Protocols from testing of waste water	6 y	central archive	Cheef Department “Quality
Annual report for results of the self monitoring of depot	permanent	central archive	Cheef Department “Quality

Results of self-monitoring of the depot are summarized in annual reports to be submitted to the Executive Environment Agency (EEA) and Regional Inspectorate - Vratsa

3.12.4 Removal of asbestos insulation and flammable materials in operational units' condition ("E")

In compliance with the decommissioning schedule [36], the safe storage preparation of units 1 and 2 commences upon enforcement of the decommissioning permit. Quality Assurance program for Stage 1 of the decommissioning of units 1-4 of Kozloduy NPP EAD firstly includes the activities for removal of asbestos, inflammable materials and conventional waste. Nevertheless the permit for decommissioning is still not issued, in order to reduce the potential hazards from the equipments the activities for elimination of these materials in Units 1 and 2 are already terminated.

Flammable materials include the transformer oils ann oils from turbine generators. In each unit 120t oil are stored. The total quantity of the pols from units 1-4 is assessed as 453t.

The elimination of the oils from reactors 1 and 2, which total quantity is assessed as 215t is made in compliance with program П.Т-07А/Б. The program optimizes the measures for collection, temporary storage, transportation of the spent oils and their submission for disposal according the Ordinance for treatment and transportation of spent oils and oil products [174] and their respective adaptation to the specific of the operation of Kozloduy NPP or utilization according to the Public Procurement Law.

The oils have to be drained till the end of 2009 and stored temporary in oil facility in separate tanks. In letter from 30 September 2009– input data for EIA [130], it is stated that by this date there are free capacities for temporary storage. For the rest oils in the facilities and pipelines of the oil systems of units 3 and 4, which is approximately 240t presently drainage is not foreseen.

After conversion of Units 1-4 in condition "E" the materials, containing asbestos, used for heat insulation, are in safe condition, (under tin, cement plaster or in places with limited access).

Presently in the EU the use of asbestos is forbidden pursuant to the EU legislation and in compliance with the national health and safety legislation (EU Directive 76/769/EEC). This material has to be removed carefully according to the approved procedure and using qualified contractors. It has to be considered that the work with asbestos in EU is subject to control and requirements, which are also included in the national laws as a result of the transponation into the national legislation of Directive 83/477/EEC and following amendments.

In compliance with the requirements of the Ordinance for prevention of the environment pollution with asbestos [40] and Ordinance for protection against risks for work with asbestos [41] updated detailed inventory is elaborated of the places in the RB and TH, where a heat insulation containing asbestos materials is available as well as estimation of the quantities of hazardous materials. It is foreseen to remove the heat insulation and other asbestos materials in the carrying civil structures and the roof panels, internal/external linnings on walls and lining panels, pipelines and tanks etc. during the operation license. It is foreseen the insulation (asbestos) to be performed before the pipeline dismantling and in this way it prevents the potential risk of inhalation or absorption of asbestos dust in case of cutting or crushing.

It is assessed that the total quantity of the heat insulation of asbestos rope for insulation of the pipelines of units 1 and 2 is 247,6 kg. The total quantity of the heat insulation materials, containing asbestos of thickness within the range of 30 from 120 mm in the pipelines and facilities in the Turbine Hall of secondary circuit and Units 1 and 2 is assessed as 89391 kg. After the removal of 17700 kg from turbines (SG-2 and SG-4) before 2001, the approximate remains are 72 t. Analogical asbestos quantity will be eliminated from the facilities in the turbine Hall of the secondary circuit of Units 3 and 4.

When implementing the P NEST – 18AB.for safe dismantling in March 2009 another11825 kg of heat insulation materials, containing asbestos, have been removed from the Turbine Hall, Secondary circuit of Units 1 and 2, which are placed in polypropylene flexible tanks after marking and description.

Different methods for removal of asbestos are applied depending on the asbestos type. They could vary from the removal of the materials before the elimination of the asbestos (in case of uncovered synthetic fibers and asbestos rope, or uncovered corrugated asbestos material) until creation of completely ventilated closed room and the staff wears a respiratory device (covered with a tent heat insulation slab/cement roof slabs/wall panels/fire fighting/insulation pipes).

The work is carried out by qualified contractor according to the recommendations of the Updated Strategy for Decommissioning of Units 1-4 of Kozloduy NPP. This may be a group in Kozloduy NPP/Decommissioning or other commercial organization holding an official license for execution of this type of activity. It is needed the persons involved in the group to be specially equipped and trained to work in this area and to work in full compliance with the existing or forthcoming by-laws and to be able to work with asbestos within the framework of the Bulgarian energy strategy or other types of industries.

After execution of control of the radioactive pollution of the heat insulation the heated bags will be placed in closed metal barrel for temporary storage in the БВ-1 in the Control area. The rest non-polluted bags are placed at a place for temporary storage in the Turbine Hall, secondary circuit, elevation 00.00m to 1HC. The operation is executed according to permit N 1/08.05.2008 of the RIPCPH in the town of Vratsa

Transportation diagram is elaborated for the containers with the waste and for storage of the containers with waste. With Decision 05-ДО-72-01 from 12 June 2008 is arranged storage in RNHIW of the insulation and construction materials, containing asbestos 90 t/year of each type until 31 December 2010. Upon decommissioning, this practice will continue for newly generated waste. Authorization of DNBPO is amended, and the term is extended to 2015

Conclusions:

1. In the NPP "Kozloduy" is good management practice for conventional (non-radioactive) waste. Regulatory requirements are met for the classification of waste, separate collection of the majority of them, temporarily storing, transportation for recovery and disposal of waste unfit for recycling. Waste management is under "Program for radioactive waste management in NPP" Kozloduy "and" Rules to ensure the safety of radioactive waste. "
2. In the implementation phase of the project will be released radioactive waste and so far have been separated from the activities of the company. Quantities for disposal are within the authorization of DNBPO, which amended and in force until 31.12.2015

3. Existing storages for temporary storage of waste with insufficient capacity, so plans to build a site for temporary storage of waste prior to their recovery, including recycling.

3.12.5 Hazardous chemical products

For the purposes of the main productions on the site of Kozloduy NPP different raw materials and materials are stored, including chemical substances and products. The biggest quantities of industrial chemicals are the ones, used both for production of demineralized water and for maintenance of the water chemistry regime of I and II circuit.

The main raw materials used in Kozloduy NPP except the uranium dioxide used as nuclear fuel enriched with ^{235}U and placed as pellets in the zirconium fuel elements collected in the fuel assemblies include also:

- Industrial and laboratory chemicals: nitrogen acid, salt acid, sulphur acid, oxalic acid, sodium base, potassium base, ammonium water, sodium hypochloride, potassium permanganate, ferichloride, hydrate lime etc.
- Combustibles and lubricants materials; oils (transformer, compressor, turbine, machine etc.), greese and lubricants, diesel fuel, benzene;
- Grounds, paints, varnishes, glues and dissolvents.
- Yon exchange resins;
- Metals.

In chapter 11 Table 11.1.4-1 a reference is presented on the chemical substances and products used in Kozloduy NPP EAD [165]. It includes the main chemical substances and products, used annually by the company and in 2006 they are spent in quantities exceeding 300 kg. It includes also chemical reagents used only in Units 5 and 6 of EP-2 and they are not related to the decommissioning of units 1-4 from EP-1 and respectively they are not subject to Environmental Impact Assessment. Such are chemical substances, specified in positions 5, 12, 13, 14, 15, 19, 22 and 26 of Table 11.1.4-1.

On the site are established conditions for the safe storage of the necessary quantities of oil products - benzine, diesel fuel and oils as well as the necessary hydrogen amount for the electric generators cooling needs, which is produced in own electrolyze installations.

In application of the EPA requirements a classification was made at KNPP concerning the storage and use of chemical substances and the NPP is classified as “enterprise with high hazard potential”. In this regard in 2008 the company obtained operation permit for operation of such enterprise after submission of the needed documents. The competent authority for the supervision in this matter is Vratsa RIoEW.

The shut down of units 1-4 means reduction of the consumption of the industrial chemicals used for regulation of the water chemical regime of first and secondary circuit for regeneration of ion exchange resins as well as for the operations for treatment and decontamination due to termination of the operation of the units. The shut down of units 1-4 means also reduction of the quantity of anion and cation exchange resins used for water demineralization.

Detailed description of the designation, needed quantities and their reduction as a result of the final shut down of units 1 and 2 is carried out in [6]. In spite of some differences between units 1 and 2, on one part and units 3 and 4 – on the other part due to the uniform capacity of all four units, it is assumed that the reduction of chemicals upon shut down of units 3 and 4 is the same like for shutdown of units 1 and 2.

(1) NH_3: Ammonia is stored in one tank (25%weight) and is used as regulating agent in the primary and secondary circuit.

- Consumption: 6 t /year

After the final shut down of Units 3 and 4 the consumption of ammonia is reduced by 12 t /year.

(2) H_2SO_4: sulphur acid is stored in one tank of (8m³), 92% concentration and is used for regeneration of the cationic resins in the water treatment systems.

- Consumption: 30 t /year

After the final shut down of Units 3 and 4 the consumption of sulphur acid is reduced by 60 t /year.

(3) HCl: salt acid is stored in one four tanks of 35% concentration and is used for regeneration of the cationic resins in the water treatment systems.

- consumption 400 t /year.

After the final shut down of Units 3 and 4 the consumption of salt acid is reduced by 800 t /year.

(4) HNO_3: nitrogen acid is stored in one tank of (12m³), 42% concentration and is used for regeneration of the cationic resins in the water treatment systems 1, 2, 3 and 5.

- Consumption 10 t /year.

After the final shut down of Units 3 and 4 the consumption of nitrogen acid is reduced by 20 t /year.

(5) $N_2H_4.H_2O$ – hydrazine hydrate is used mainly for elimination of the oxygen by the coolant of the secondary circuit. Annual consumption is 5 t/year for units 1 and 2 (65% weight).

After the final shut down of Units 3 and 4 the consumption of hydrazine hydrate is reduced by 10 t /year.

(6) KOH: - potassium base is used for regeneration of the anionic resigns of WTS 1, 2 и 4, as improvement agent for pH of the first circuit ad well as for cleaning of the equipment and rooms. It is supplied in solid condition

- Consumption: 6t/y and for Units 3 and 4 the consumption of potassium base is reduced by 12 t /year.

(7) NaOH: - sodium base is stored in two tanks (32m³ each) (48%W) and is used for regeneration of the anionic resins in the water treatment systems.

- Consumption: 300 t /year

After the final shut down of Units 3 and 4 the consumption of sodium base is reduced by 600 t /year.

(8) $FeCl_3$: - ferrous chloride is stored in a tank of 32m^3 (35% weight.)..

- for both units the annual consumption is 80t. After the final shut down of Units 3 and 4 the consumption of ferychloride is reduced by 160 t /year.

(9) $Ca(OH)_2$: calcium dihydrooxide is stored in two vertical tanks of 40 m3 each. It is used for decarbonization of the demineralized water.

Consumption: during the operation of 2 units it is 230 t /year dry powder product.

After the final shut down of Units 3 and 4 the consumption of ferichloride is reduced by 430 t /year.

(10) Benzine (fuel for the trucs and cars): used in Kozloduy NPP, but stored in industrial petrol station beyond the territory of the Power plant.

(11) Diesel fuel: used periodically for testing of 12 diesel generators (DG), for units 1-4.

- Consumption: Each DG is tested once monthly during 3 hrs and once per year during 24 hrs. During the test the consumption is 0.4 t/h. This the consumption of diesel fuel for all four units is assessed as appr. 150t/y.

(12) Asbestos: - used as thermal insulating material sealed with cement matrix. Asbestos will be removed from the reactor room, turbine hall and auxiliary facilities before the stage of preparation for safe enclosure and it will be disposed in the existing Repository in Kozloduy NPP (RCMIW). At the moment of shut down of units 1 and 2 the asbestos quantities in EP-1 are assessed to 72 t. The same asbestos quantity will be for units 3 and 4.

Taking into account that the real decreasing of the production of the DW of EP-1, which is related to the shut down of units 1-4, during the period 2002– 2008 is increased by 90%, it could be assumed that the same is the ratio of reduction of the consumption of sulphur, salt and nitrogen acids, sodium base, used for the regeneration of the ion exchange filters, with which the water demineralization will be carried out as well as the demineralization of lime milk and ferichloride, used for coagulation of the salts extracted during the regeneration from sewage waters of the DW generation.

3.12.6 Generation of gaseous pollutants during the decommissioning process

Detailed description of the sources and properties and quantities of the gaseous pollutants, generated during the different stages of the decommissioning process of the units is presented in Chapter1 Section 1.10.

3.12.7 Generation of liquid RAW during the decommissioning process

Detailed description of the sources and properties and quantities of the liquid RAW generated during the different stages of the decommissioning process of the units is presented in Chapter1 Section 1.11.

3.12.8 Generation of solid RAW during the decommissioning process

Detailed description of the sources and properties and quantities of the solid RAW generated during the different stages of the decommissioning process of the units is presented in Chapter1 Section 1.12.

3.13 Social and economic condition

3.13.1 Geographic location of “Kozloduy” NPP

The site chosen for the deployment of the power plant has a favorable geographic location. It was built in the Northwestern Bulgaria, on the territory of Vratsa District, within the borders of municipality of Kozloduy and on the land of the town Kozloduy and the village Harlets. The location of the site of Kozloduy NPP, marked on the topographic map and the administrative map of the Republic of Bulgaria (issued 2008.) [100] shows that to the North in a straight line it is located around 120 km away from Sofia, 62 km away from the District centre – Vratsa, around 65 km away from the situated South-East District centre – Pleven and it is situated 57.2 km away from the South-West third District center – Montana. The closest towns to the site of the power plant are Lom, Byala Slatina, Oryahovo and Knezha and out of them only the town of Oryahovo is included in the range of 30 km area of Kozloduy NPP. The area of Kozloduy NPP on the Bulgarian side icludes entirely the territories of the Municipalities Kzloduy, Mizia, Hayredin and bigger or smaller parts of the municipalities Krivodol, Borovan, Byala Slatina, Oryahovo (wich are administratively related to the district of Vratsa) and the municipalities Lom, vulchedrum, Boitchinovtsi (Montana district). 30km area includes only a small part of the land of Knezha of the Knezha municipality included in the district of Pleven. For defining the total perimeter of the 30 km area to the perimeter of the three municipalities Kozloduy, Mizia and Hayredin according to the data from the National Cadastral Center EOOD, the area of the separate settlements has been added from performed planimetry on a map at a scale 1: 400 000 [103]. The so determined area is 1779.28 km^2, and the number of populated areas is 43 (table .13.13-1).

Table 3.13.1-1 Area of the municipalities within 30 km area of Kozloduy NPP.

Municipalities	Total area (sq.km,)	Populated areas within 30 km area of Kozloduy NPP	
		Area (sq. km)	Number of populated areas
Lom	323.9	23.06	1 (of 10 in the municipality)
Vulchedrum	431.5	407.81	10 (of 11 in the municipality)
Boytchinovtsi	308.3	66.06	2 (of 13 in the municipality)
Krivodol	326.8	19.15	1 (of 15 in the municipality)
Kozloduy	284.9	284.90	Whole municipality - 5 settlements
Hayredin	189.1	189.10	Whole municipality - 6 populated areas
Borovan	210.7	97.68	3 (of 5 in the municipality)
Mizia	209.3	209.30	Whole municipality - 6 populated areas
Oryahovo	326.5	281.42	5 (of 7 in the municipality)
Byala slatina	572.3	177.00	4 (of 15 in the municipality)
Knezha		23.8	0
Total	3183.3	1779.28	43

Source of information: National Cadastral Center EOOD until 31 December 2000, cited by NSI in the statistic guide “Regions, districts and municipalities in the Republic of Bulgaria”, 2004 and planimetration[107]. .

The examined 30-km zone includes not only Bulgarian territory but also it includes a part of the territory of neighboring Romania It is situated entirely in the Southern part of Dolj county. In its scope are 133 035 ha land occupying the lowland plains and parts of Romanatilor and Bailesti plains, formed in the low left bank of the Danube. These Danube side lands are drained by the left meandering tributaries of the Danube River, Jiu river, Jiet (Old Jiu) river and their smaller tributaries Baboaia river, Balasan river and river Giorosel . In the lower part of the southern lowland area a number of lakes and swamps were formed, the largest of them are lakes Bistret and Calugareni. Average altitude is appr. 70 m varying between 20 m in the most southern Danube side part and to the North it reachs 122,5 m. Depending on the categories of economic use and utilization the areas on the Romanian side are divided mostly as agricultural landsc106,976 ha and fores (forests, shrubs, forest nurseries, etc) - 9328 ha and water areas 10012ha (rivers, lakes and marshlands).

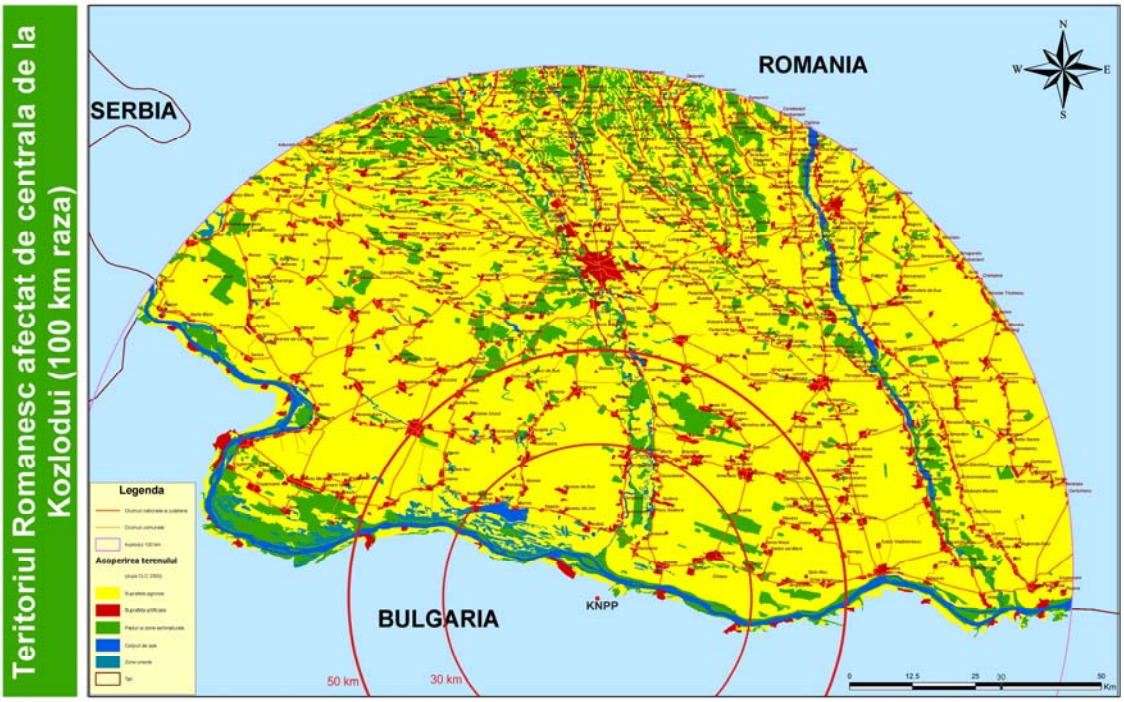


Fig.3.13.1-1 Map of Romanian territory around Kozloduy NPP

The area used for construction and functioning of the power plant is appr. 4km^2 and it is located against 694th km of the flow of the Danube River. The industrial site is located 3.7km southern from the river midstream and the state border with the Republic of Romania. To the North between the site of Kozloduy NPP and the river bed of the Danube the Kozloduy valley is situated.

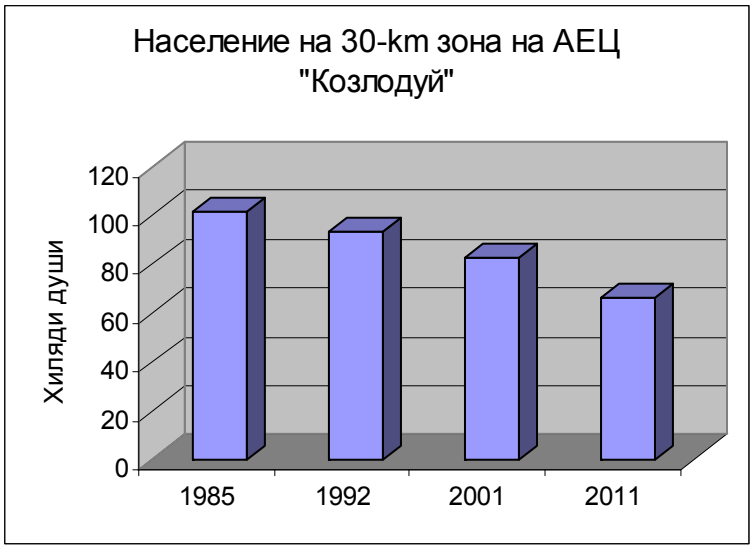
The selected site of the power plant is located in the northern part of the first overflowed terrace of the Danube River and is located 3,5 km South-Eastern from the town of Kozloduy and appr. 4 km North-West from the village of Hurlets.

3.13.2 Demographic and social and economic characteristic

Population dynamics

In the area within the 30km radius around Kozloduy NPP (Zone No 3 for Emergency lanning) 43 villages from 10 municipalities are included, which are falling into the borders of the administrative areas of Montana and Vratsa [102]. Entirely included in the area are the territories of the municipality Kozloduy, where the nuclear power plant is located as well as the neighboring municipalities Mizia and Hayderin. This area includes also parts with different areas coming under the jurisdiction of another seven municipalities - Lom, Valchedram, Boytchinovtsi (Montana district) and Krivodol, Borovan, Oryahovo, Byala Slatina (Vratsa district). Besides the populated areas on the territory of our country the 30-km zone includes sparsely-populated part of the territory of the Republic of Romania. Within this zone 23 populated areas are involved, including 2 cities - Dabuleni and Bechet. All they are a part of the big administrative-territorial district Dolj.

The comparison of the number of population only in the populated areas included in 30 km zone during the last four countings (1985, 1992, 2001 and 2011) and data from the current statistic for 2007. [105] show clear trend for reduction during this period– from 101.6 thousand people. (1985) of 66.0 thousand people (2011), i.e. for 25-year period the population of the area is reduced to 35.6 thousand people (fig. 3.13.2-1). The tendency of change in the number of population there does not differ in character from the tendency of change in the country and the districts, where this area is located. The comparison of the relative reduction of the population in 30 km area during the period 2001-2011 (-33.5%) is close to the average reduction for the areas of Vratsa (-34.9%) and Montana (-33.5%) and approximately twice bigger than the one for the country (-17.7%).



Legend&
Хиляди души - Thousands of people
Fig. 3.13.2-1 Population in 30km area of Kozloduy NPP
Source of information: NSI [106].

The highest number of population can be found in the municipality of Kozloduy (Table 3.13.2-1, Table 3.13.2-2), where area N 2 for emergency planning is completely involved. The analysis of the change in the number of the population by settlements (Table 3.13.2-2, Table 3.13.2-3) shows that until the census in 2001 [106] it increases

only in Kozloduy Town and in Dolni Tsibar Village. It could be definitely said that the increase of the number of population in Kozloduy Town through this period is related to the construction and operation of the nuclear power plant and to the activities connected with it. During the last few years slight reduction of the number of population is seen after continuous period of increase (Table 3.13.2-2, Table 3.13.2-3). The data of the last census of the population (by 1 February 2011) show that only in the village of Dolni Tsibur there is a slight trend for increasing of the number of population. Probably this is a result of its good geographical situation comparing with the village of Gorni Tsibur and close populated areas. In contrast to it the population of the town of Kozloduy comparing with the previous census (2001) is reduced by 1834 people. In the Kozloduy Town this reduction is also in a relation to the closing of the first four units of Kozloduy NPP. In the other 41 settlements is observed more or less expressed trend for reduction of the number of the population through the period 1985-2011.

Table 3.13.2-2 Number of the population into the 30 km area of NPP „Kozloduy” according to censuses of the population (people).

Municipality	Populated areas	1985	1992	2001	2011
Lom Municipality	1. village of Stanevo	1006	786	549	341
Vulchedrum Municipality	2. v. Botevo	180	127	107	65
	3. v. Buzovets	469	384	267	114
	4. town of Vulchedrum	6481	5732	4800	3662
	5. v. Gorni Tsibur	950	675	390	196
	6.v. Gorni Tsibur	1498	1535	1576	1586
	7. v. Zlatia	2070	1616	1289	870
	8. v. Ignatovo	532	443	358	262
	9. v. Mokresh	1768	1502	1150	803
	10. v. Razgrad	1638	1366	1092	686
	11. v. Septemvriytsi	1924	1746	1441	1149
Boitchinovtsi municipality	12. v. Beli brod	566	479	395	238
	13. v. Lehchevo	2948	2705	2370	1797
Krivodol municipality	14. v. Furen	609	579	409	251
Kozloduy municipality - whole	15. v. Butan	4019	3717	3343	2918
	16.v. Glozhene	3459	3294	3150	2748
	17. town of Kozloduy	12494	13662	14892	13058
	18. Kriva bara	713	663	554	397
	19 v. Hayderin	2821	2633	2428	2059
Hayredin municipality - whole	20 v. Botevo	225	194	105	81
	21 v. Burzina	598	491	399	251
	22 v. Manastirishte	1934	1755	1515	1067
	23 v. Mihaylovo	1720	1676	1378	1048
	24v. Rogozen	1877	1769	1463	1007
	25 v. Hayredin	2893	2532	2125	1547
Borovan municipality	26 v. Dobrolevo	1420	1307	1077	865

Municipality	Populated areas	1985	1992	2001	2011
	27 v. Malorad	2786	2593	2380	1883
	28 v. Sirakovo	414	396	330	225
Mizia municipality - whole	29 v. Voivodina	476	411	360	264
	30v. Krishovitsa	3050	2633	2193	1712
	31v. Lipnitsa	1421	1212	945	737
	32 town of. Mizia	5137	4596	4069	3252
	33 v. Saraevo	118	95	73	44
	34 v. Sofronievo	3138	2540	1965	1561
Oryahovo municipality	35 v. Galovo	690	535	409	277
	36 v. Leskovets	1230	1089	876	656
	37 town of Oryahovo	7326	6767	6107	5031
	38 v. Ostrov	2740	2433	2042	1480
	39 v. Selnovtsi	6104	5245	4623	3540
Byala Slatina Municipality	40 vilage of Altimir	1989	1900	1525	1179
	41 vilage of Burdarski gearn	1459	1292	1078	745
	42 village of Galiche	3327	2882	2406	1976
	43 v. Turnava	3370	3184	2875	2366
TOTAL		101587	93171	82878	65994

Source: Calculations by the author according to data of NSI [105, 106].

According to the data provided by experts from Romania 75150 people live in 19 populated areas within the Romanian part of the 30-km area. For 4 populated areas located within this area no data about their population have been submitted, but when considering the average population of the villages in this part of the country, probably the total number of population is about 80 thousand people (Table 3.13.2-2)

Table 3.13.2-2 Number of population in the 30-km zone of the Kozloduy NPP living on the territory of the Republic of Romania.

Settlement	Population (number of residents)
v. Ostroveni	5255
V .Gighera	3208
v. Valea Stanciului	5736
v. Călăraşi	6282
town of Bechet	3917
town of Dăbuleni	12819
v. Piscu Vechi	2713
v. Sadova	8489
v .Gângiova	2630
v. Măceşu de Jos	1433
v. Măceşu de Sus	1427
v. Bistreţ	4336

v.Goicea	2774
v. Bârca	4024
v. Vela	2033
v. Nedeia	1380
v. Sarata	2139
v. Listeava	1612
v. Horezu Poenari	2943

Source: Information received from Romanian part

For the whole Bulgarian part of the 30-km area the number of women is around 2 thousand people higher than the number of men out of the total number of the population in 2010. (Table 3.13.2-3). However it could be noticed that in some settlements the number of the population of male and female sex is almost even (Kozloduy, Lehchevo, Furen and others) but in some other settlements the number of women is higher (Valchedram, Mizia, Stanevo, Gorni Tsibur, Krushovitsa, Butan, Selanovtsi etc.).

Таблица 3.13.2-3 Number of the population in 30 km area of Kozloduy NPP (people, 2010)

Municipality	Populated areas	Total	Men	Women
Lom Municipality	1. village of Stanevo	405	193	212
Vulchedrum Municipality	2. v. Botevo	70	28	42
	3. v. Buzovets	153	69	84
	4. town of Vulchedrum	3696	1752	1944
	5. v. Gorni Tsibur	198	85	113
	6.v. Gorni Tsibur	1526	763	763
	7. v. Zlatia	859	410	449
	8. v. Ignatovo	287	133	154
	9. v. Mokresh	869	398	471
	10. v. Razgrad	795	384	411
	11. v. Septemvriytsi	1139	547	592
Boitchinovtsi municipality	12. v. Beli brod	228	107	121
	13. v. Lehchevo	1887	931	956
Krivodol municipality	14. v. Furen	326	166	160
Kozloduy municipality - whole	15. v. Butan	2917	1373	1544
	16.v. Glozhene	2781	1359	1422
	17. town of Kozloduy	13752	6832	6920
	18. Kriva bara	432	202	230
	19. v. Hayderin	2133	1052	1081
Hayredin municipality - whole	20. v. Botevo	75	34	41
	21. v. Burzina	277	135	142
	22. v. Manastirishte	1094	535	559
	23. v. Mihaylovo	1096	515	581
	24.v. Rogozen	1039	495	544

Municipality	Populated areas	Total	Men	Women
	25. v. Hayredin	1524	736	788
Borovan municipality	26. v. Dobrolevo	868	421	447
	27. v. Malorad	1930	947	983
	28. v. Sirakovo	281	131	150
Mizia municipality - whole	29.v. Voivodovo	254	117	137
	30. v. Krushovitsa	1599	786	813
	31. v. Lipnitsa	679	331	348
	32. town of Mizia	3289	1596	1693
	33. v. Saraevo	46	20	26
	34.v. Sofronievo	1434	687	747
Oryahovo municipality	35 v. Galovo	294	150	144
	36. v. Leskovets	665	313	352
	37. town of Oryahovo	5331	2535	2796
	38.v. Ostrov	1542	759	783
	39. v. Selanovtsi	3662	1765	1897
Byala Slatina Municipality	40. v. Altimir	1223	618	605
	41. v. Burdarski geran	775	385	390
	42. v. Galiche	1958	938	1020
	43.v. Turnava	2559	1236	1323
TOTAL		67947	32969	34978

Source of information: NSI [105, 106].

The analysis of the sex structure shows little differences between the relative share of men and women. In total for the whole area their percentage difference is 3,0 % (fig. 3.13.2-2). It is slightly higher in the villages, where the share of men is 48.4 % and of women - 51.6 %, than in the towns (men – 48.8 %, women – 51.2 %). This is related to the higher number of women over the working age in the villages.

Legend: мъже – male
жени -female

Fig. 3.13.2-2 Sex structure of the population in the 30-km area of Kozloduy NPP for 2010. (*Source of information: NSI*).

The similar is the proportion between men: women (48.4 : 51.6%), from the total number of the population in all municipalities, which are entirely or partially included in the 30 km area of Kozloduy NPP. The total number of population in these 10 municipalities in 2011 is over 139 000 people (Table 3.13.2-4).

For the rest of the 30-km zone around Kozloduy NPP, located on Romanian territory, gender structure of population is absolutely identical - 51.4 percents of the population are women - with the Bulgarian part of the area. Is this a coincidence? Rather, this and other demographic characteristics can be explained not only by territorial proximity of the two parts of the area, but by a number of common features of their socio-economic and demographic development. Identical are the characteristics of transformation during the last 20 years. The border is the Danube and instead a natural unifying factor axis and accelerated development rather divide these lands, etc.

The correct calculation of the average density of the population is difficult because of the different data about the areas of the municipalities and the separate settlements in the different sources of information. For calculation of the average density of municipalities information from the National Cadastral Center EOOD until 31 December 2000 is used, cited by NSI in the statistical guide “Regions, districts and municipalities in Republic of Bulgaria”, 2004 (about the area of the three municipalities Kozloduy, Mizia, Hayredin) and planimetration on the ground of map of the scale 1: 400 000 (the rest of the settlements)[103]. The total area of the 10 municipalities included entirely or partially in this area under the data of the National Cadastral Center EOOD is 3183.3 km^2. The average density of the population in these 10 municipalities is 43.6 people per km^2 (2010).

The average density of the population only on the territory of Bulgaria within in the 30 km area around Kozloduy NPP (38.2 people per km^2) in 2010 it is lower than the average for the areas, where it is located – Vratsa (53.5 people per km^2) and Montana (42.1 people per km^2), also than the average for the country (67.6 people per km^2). The

comparison between the municipalities entirely or partially included in the investigated area shows that the density of the population in the municipality of Kozloduy (77.3 people per km^2) is higher than the one of the respective municipalities and the country. Relatively low is the density of the population in Mizia Municipality (34.9 people per km^2) and Hayredin (27.0 people per km^2). In the municipalities partially included in the 30 km area the density of the population is between 23.4 people per km^2 (Valchedram) and 46.5 people per km^2 (Byala Slatina). It should be noted that Lom Municipality is differed by the highest index (91.4people per km^2), but in the investigated area is included only one village from it – village Stanevo, situated at the most Eastern part of the municipality.

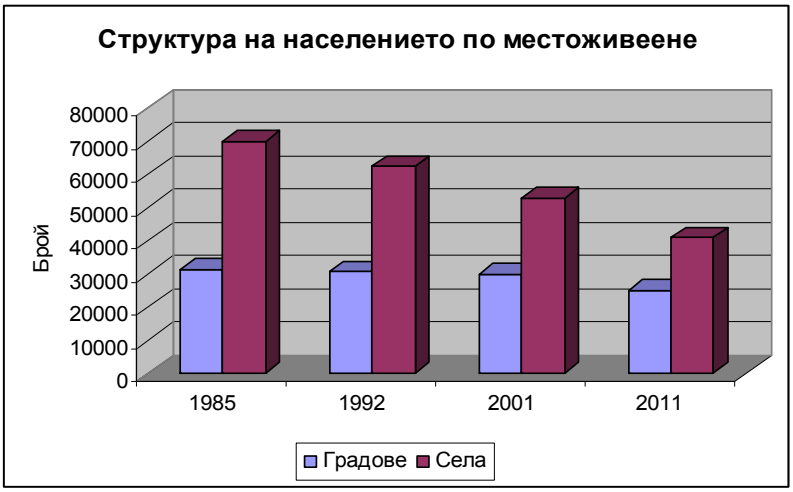
Table 3.13.2-4 Number of the population of the municipalities which is entirely or partially included in 30 km area of Kozloduy NPP (people, 2010)

Municipalities	Total	Men	Women
Kozloduy	22015	10818	11197
Mizia	7301	3537	3764
Hayredin	5105	2450	2655
Municipalities, entirely incuded in 30-km area	*34421*	*16805*	*17616*
Lom	29618	14094	15524
Vulchedrum	10116	4823	5293
Boytchinovtsi	9746	4812	4934
Krivodol	10276	4978	5298
Borovan	6029	2957	3072
Oryahovo	12069	5788	6281
Byala slatina	26616	12906	13710
Municipalities, partially included in 30km area	*104470*	*50358*	*54112*
Municipalities - total	138891	67163	71728

Source: Calculations by the author according to NSI data

The predominant part of the population in the 30 km area of Kozloduy NPP lives in the villages (fig. 3.13.2-4). During the period 1985-2011 the number of the town population was reduced – from 31.4 thousand people to 26.0 thousand people, but in the same time its relative share increased – from 30.9 % (1985) to 38.4 % (2011). The character of these changes is identical to the change of the number and share of the town population at national and district level. These data show considerably lower level of urbanization in the investigated territory in comparison to the average for the country - 72.75 % of the population of Bulgaria lives in the towns (2011).

In this respect, the structure of the population residing in the Romanian part of the 30-km zone is similar to Bulgarian - less pronounced urbanization process in comparison with that of a country with a predominantly peasant population. In Dolj the proportion of urban population is 53.7 percent, for the study area it is significantly lower - 22.3%.



Legend: брой- numbers;
Градове – Towns;
Села – Villages.
Fig. 3.13.2-3 Structure of the population by residence
Source of information: NSI

Reproduction of the population

Birth-rate, death-rate, natural population growth

The natural population growth in the investigated area is defined by the influence of the numerous multi-directional and diverse demographic and social-economical factors. The tendencies of its change are identical to the changes at district and national level. The number of the newly born and the birth rate decreases while the number of people who die and the mortality rate increases. In 2010 the number of the children born alive is over 2.6 times lower than the number of the dead, which defines the negative natural population growth (Table 3.13.2-5). The number of boys born is higher than girls, which is typical characteristic not only for the investigated area, but also for the whole country. Also, the number of men who died is higher than women. At separate settlements the number of born children is very low, especially in smaller villages and in six of the villages (Stanevo, Botevo, Saraevo, Galovo) not even one child was born during the respective year

Table 3.10.2-5 Number of the born and dead in the 30 km area of Kozloduy NPP (2010)

Municipalities	Populated areas	Born alive (people)			Dead (people)		
		Total	Boys	girls	Total	men	Women
Lom Municipality	1. village of Stanevo	0	0	0	13	6	7
Vulchedrum Municipality	2. v. Botevo	0	0	0	1	0	1
	3. v. Buzovets	1	0	1	9	6	3
	4. town of Vulchedrum	25	14	11	102	51	51
	5. v. Gorni Tsibur	1	1	0	6	3	3
	6.v. Gorni Tsibur	15	7	8	14	12	2
	7. v. Zlatia	3	1	2	32	14	18
	8. v. Ignatovo	2	0	2	5	4	1
	9. v. Mokresh	10	6	4	22	10	12

Municipalities	Populated areas	Born alive (people)			Dead (people)		
		Total	Boys	girls	Total	men	Women
	10. v. Razgrad	3	2	1	26	13	13
	11. v. Septemvriytsi	11	7	4	25	14	11
Boitchinovtsi municipality	12. v. Beli brod	0	0	0	10	6	4
	13. v. Lehchevo	20	11	9	52	25	27
Krivodol municipality	14. v. Furen	3	2	1	11	5	6
Kozloduy municipality - whole	15. v. Butan	42	16	26	47	22	25
	16.v. Glozhene	32	17	15	47	21	26
	17. town of Kozloduy	117	70	47	148	67	81
	18. Kriva bara	4	3	1	16	8	8
	19. v. Hayderin	25	19	6	37	16	21
Hayredin municipality - whole	20. v. Botevo	0	0	0	3	1	2
	21. v. Burzina	2	1	1	11	6	5
	22. v. Manastirishte	3	2	1	31	18	13
	23. с. Михайлово	8	4	4	34	19	15
	24.village of Rogozen	7	2	5	31	10	21
	v. Hayredin	6	3	3	81	39	42
Borovan municipality	26. v. Dobrolevo	12	8	4	34	24	10
	27. v. Malorad	20	8	12	56	30	26
	28. v. Sirakovo	1	0	1	11	5	6
Mizia municipality - whole	29.v. Voivodovo	2	1	1	6	3	3
	30. v. Krushovitsa	9	6	3	51	28	23
	31. v. Lipnitsa	3	3	0	31	11	20
	32. town of Mizia	13	9	4	56	25	31
	33. v. Saraevo	0	0	0	2	2	0
	34.v. Sofronievo	10	5	5	31	15	16
Oryahovo municipality	35 v. Galovo	0	0	0	9	4	5
	36. v. Leskovets	4	1	3	22	14	8
	37. town of Oryahovo	45	21	24	97	55	42
	38.v. Ostrov	15	9	6	37	19	18
	39. v. Selanovtsi	35	16	19	92	51	41
Byala Slatina Municipality	40. v. Altimir	13	7	6	33	17	16
	41. v. Burdarski geran	6	3	3	20	9	11
	42. v. Galiche	20	10	10	48	21	27
	43.v. Turnava	21	7	14	52	32	20
TOTAL		569	302	267	1502	761	741

Source: Calculations by the author according to data of NSI [105].

Similar is the situation both on the territory of the municipalities entirely included in the 30 km area and the municipalities partially included in that area (Table 3.1032-6). The

growth of the population in all these municipalities is negative. In 2010 the number of the population in the 10 municipalities is decreased only as a result of the natural population growth with 1923 people including over 976 men and almost 947 women.

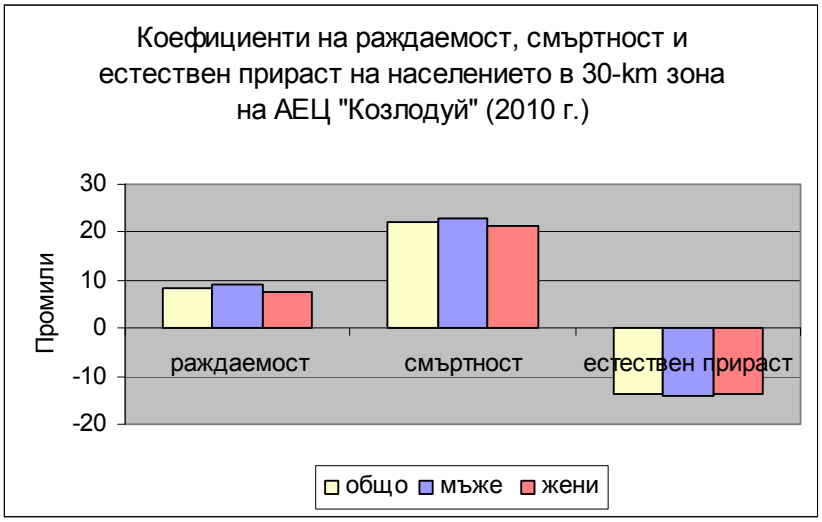
Table 3.13.2-6 Natural population growth of the municipalities entirely or partially included in the 30 km area of Kozloduy NPP (2010)

Municipalities	Natural growth (people)		
	Total	Men	Women
Kozloduy	-75	-9	-66
Mizia	-140	-60	-80
Hayredin	-165	-81	-84
Municipalities, entirely included in 30-km area	*-380*	*-150*	*-230*
Borovan	-120	-54	-66
Byala slatina	-269	-156	-113
Oryahovo	-183	-108	-75
Krivodol	-228	-116	-112
Boytchinovtsi	-242	-113	-129
Vulchedrum	-182	-92	-90
Lom	-319	-187	-132
Municipalities, partially included in 30-km area	*-1543*	*-826*	*-717*
Municipalities-total	-1923	-976	-947

Source: Calculations by the author according to data of NSI [105, 106].

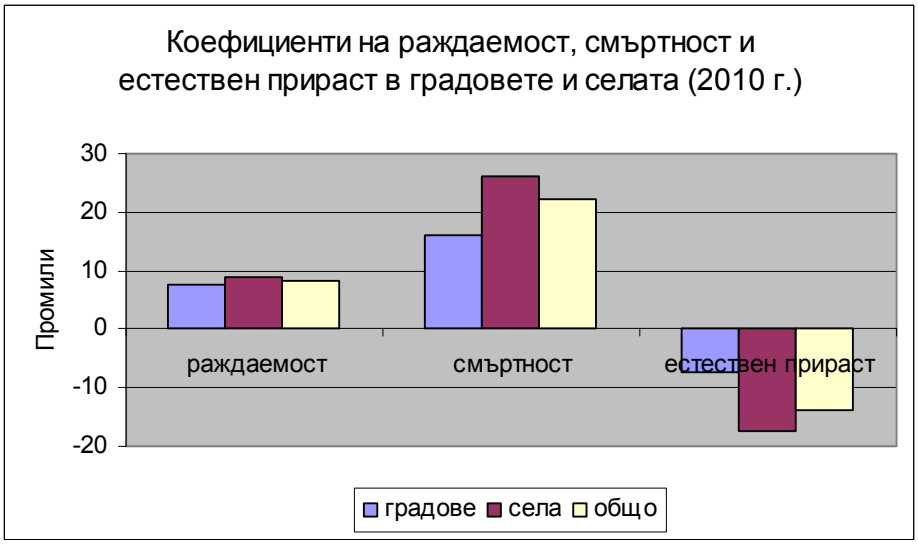
Analysis of the natural population growth rate in the 30 km area shows the low values of the coefficients of birth (totally – 8.4 ‰) and the high values of the coefficients of death (totally – 22.1 ‰) (fig. 3.13.2-4). As a result the natural population growth is negative, besides that with considerable value (-134.7 ‰).

The birth rate among the men is higher (9,2 ‰) than that among the women (7.6 ‰). Contrary is the situation referring to the mortality rate, which for men is 23,1 ‰ and for women it is 3 per thousandths lower (21.2 ‰). As a result the natural population the growth of men (-13.9 ‰) is more unfavorable than the one of women (-13.6 ‰).



Legend:
Промили – Promiles;
Раждаемост – Birth;
Смъртност – Mortality;
Естествен прираст – Population growth
Fig. 3.13.2-4 Birth, mortality and natural population growth in 30km area of KNPP (2010)
Source of information: NSI

The comparison of the natural population growth in the towns and villages shows the considerably more unfavorable situation in the village settlements (fig. 3.13.2-5). While the values of the coefficients of birth are comparatively close (villages – 8.8 ‰, towns – 7.7 ‰), there are considerable differences in the values of the coefficients of death (villages – 26.2 ‰, towns – 15.5 ‰). As a result of that the natural population growth in the villages (-17.4 ‰) is over 2.5 times more unfavorable than the one in the towns (-7.8 ‰)



Legend:
Промили – Promiles;
Раждаемост – Birth;
Смъртност – Mortality;
Естествен прираст – Population growth
Fig. 3.13.2-5 Birth, mortality and natural growth in the towns and villages (2010)
Source of information: NSI

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The analysis of the natural population growth in the separate settlements of the 30 km area of Kozloduy NPP shows the considerable differences between them (Table 3.13.2-7). Except in the village of Dolni Tsibur in all of the 42 settlements the natural population growth is negative. This is a consequence of the specific of the social and economic and demographic development of the North-Western region as a whole, of the worsen age structure of the population, its aging, reduction of the contingent of women in fertile age, lower birth rate, higher dead rate of the population etc. In many of the villages the mortality rate is very high and in some villages they are much over the average for the investigated territory (in 17 villages more than twice over the average value for the investigated territory (in 13 villages it is twice bigger than the average ratio of the natural population growth rate for the 30-km area). The biggest negative values pf the natural growth are in the villages Buzovets, (-52.3‰), Hayredin (-49.2‰), Beli brod (-43.8‰), Lipnitsa (-41.2‰)etc.. Negative are the values of the natural growth and for the towns in the investigated territory, which varies from -2.3‰for the town of Kozloduy -20,8‰ for the town of Vulchedrum. The particularly high negative values of the natural population growth rate at a significant part of these settlements show the presence of demographic crisis in them, which is typical for the northwestern part of the country

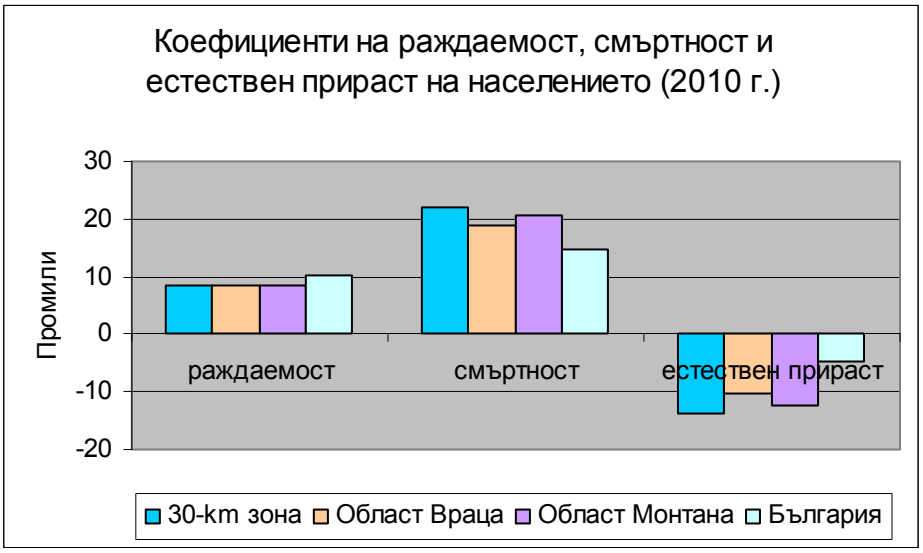
Table 3.13.2-7 Natural population growth rate in the municipalities entirely located in 30-km area of Kozloduy NPP (2010 .)

Municipalities	Populated areas	Natural growth (people)			Ratios of		
		Total	Men	Women	Live born (‰)	Deads (%)	Natural growth (‰)
Lom Municipality	1. village of Stanevo	-13	-6	-7	0	32.1	-32.1
Vulchedrum Municipality	2. v. Botevo	-1	0	-1	0	14.3	-14.3
	3. v. Buzovets	-8	-6	-2	6.5	58.8	-52.3
	4. town of Vulchedrum	-77	-37	-40	6.8	27.6	-20.8
	5. v. Gorni Tsibur	-5	-2	-3	5	30.3	-25.3
	6.v. Gorni Tsibur	1	-5	6	9.8	9.2	0.6
	7. v. Zlatia	-29	-13	-16	3.5	37.3	-33.8
	8. v. Ignatovo	-3	-4	1	7	17.4	-10.4
	9. v. Mokresh	-12	-4	-8	11.5	25.3	-13.8
	10. v. Razgrad	-23	-11	-12	3.8	32.7	-28.9
	11. v. Septemvriytsi	-14	-7	-7	9.6	21.9	-12.3
Boitchinovtsi municipality	12. v. Beli brod	-10	-6	-4	0	43.8	-43.8
	13. v. Lehchevo	-32	-14	-18	10.6	27.6	-17
Krivodol municipality	14. v. Furen	-8	-3	-5	9.2	33.7	-24.5
Kozloduy municipality - whole	15. v. Butan	-5	-6	1	14.4	16.1	-1.7
	16.v. Glozhene	-15	-4	-11	11.5	16.9	-5.4
	17. town of Kozloduy	-31	3	-34	8.5	10.8	-2.3
	18. v.e Kriva bara	-12	-5	-7	9.2	37	-27.8
	19. v. Hurlets	-12	3	-15	11.7	17.3	-5.6
Hayredin	20. v. Botevo	-3	-1	-2	0	40	-40

Municipalities municipality - whole	Populated areas	Natural growth (people)			Ratios of		
		Total	Men	Women	Live born (‰)	Deads (%)	Natural growth (‰)
	21. v. Burzina	-9	-5	-4	7.2	39.7	-32.5
	22. v. Manastirishte	-28	-16	-12	2.7	28.3	-25.6
	23. v. Mihaylovo	-26	-15	-11	7.8	33.1	-25.3
	24.village of Rogozen	-24	-8	-16	6.7	29.8	-23.1
	25. v. Hayredin	-75	-36	-39	3.9	53.1	-49.2
Borovan municipality	26. v. Dobrolevo	-22	-16	-6	13.8	39.2	-25.4
	27. v. Malorad	-36	-22	-14	10.4	29	-18.6
	28. v. Sirakovo	-10	-5	-5	3.6	39.1	-35.5
Mizia municipality - whole	29.v. Voivodovo	-4	-2	-2	7.9	23.6	-15.7
	30. v. Krushovitsa	-42	-22	-20	5.6	31.9	-26.3
	31. v. Lipnitsa	-28	-8	-20	4.4	45.6	-41.2
	32. town of Mizia	-43	-16	-27	4	17	-13
	33. v. Saraevo	-2	-2	0	0	43.5	-43.5
	34.v. Sofronievo	-21	-10	-11	7	21.6	-14.6
Oryahovo municipality	35 v. Galovo	-9	-4	-5	0	30.6	-30.6
	36. v. Leskovets	-18	-13	-5	6	33.1	-27.1
	37. town of Oryahovo	-52	-34	-18	8.4	18.2	-9.8
	38.v. Ostrov	-22	-10	-12	9.7	24	-14.3
	39. v. Selanovtsi	-57	-35	-22	9.6	25.1	-15.5
Byala Slatina Municipality	40. v. Altimir	-20	-10	-10	10.6	27	-16.4
	41. v. Burdarski geran	-14	-6	-8	7.7	25.8	-18.1
	42. v. Galiche	-28	-11	-17	10.2	24.5	-14.3
	43.v. Turnava	-31	-25	-6	8.2	20.3	-12.1
TOTAL		-933	-459	-474	8.4	22.1	-13.7

Source: Calculations of the author on data of NSI .

The seriousness of the demographic situation in 30 km area is confirmed by the comparison of the birth ratio, dead ratio and natural growth in 30 km area of the nuclear power plant in the areas of Vratsa and Montana and for the whole country (fig. 3.13.2-6). Birth ration of the population in 30-km area is the same like the one for both administrative areas (Vratsa –8.4‰, Montana –8.3 ‰) and it is lower than the one for the country (10.1 ‰). death ratio is higher than in the other territorial units - by 1,4 ‰ than in Montana, by 3.3 ‰ than in Vratsa, by 7.4‰ than in the country. The ratio of the natural growth in 30km area (-13.7‰) is 1.1-1.3 times higher than the ratios in the districts where they are located (Vratsa – minus 10.4 ‰, Montana – minus 12.3‰) and appr. 3 times higher than in the country (minus 4.6 ‰).



Legend:

Промили – Promiles;
Раждаемост – Birth;
Смъртност – Mortality;
Естествен прираст – Population growth
30-km зона – 30 km zone;
Област Враца - Vratsa District;
Област Монтана – Montana District;
България - Bulgaria

Fig. 3.13.2-6 Birth, mortality and natural growth rates
Source of information: NSI

The specification of the information only for the municipalities entirely included in the 30 km area shows that the most favorable demographic situation among them is in the municipality of Kozloduy (table 3.1032-7). With most unfavorable values (-32.3‰) differs the municipality of Hayredin which is the smallest among these municipalities by the number of its population. Along with rendering an account of other influencing factors there should be noticed also the influence of the age structure of the population (Table 3.13.2-8).

Table 3.13.2-8 Natural population growth rate in the municipalities entirely located in 30-km area of Kozloduy NPP (‰, 2010)

Municipality	Birth rate	Dead rate	Natural growth rate
Municipality of Kozloduy	10.0	13.4	-3.4
Municipality of Mizia	5.1	24.3	-19.2
Municipality of Hayredin	5.1	37.4	-32.3
30km зона	8.4	22.1	-13.7

Source: Calculations by the author according to NSI data

Despite the scarce data on the demographic situation in the Romanian part of the territory concerned it may be judged that a similar demographic processes going on - low fertility, high mortality of the population, poor age structure, declining contingent of women in fertile age, decreasing reproductive and etc. The country's average birth rate is 10.0 ‰, in Dolj (Dolj) this index decreased to 8.9 ‰. In rural areas it reaches only 8.2 ‰. The overall mortality of the population of Romania is 11.7 ‰ and it is less than the indicator for Bulgaria. The situation for the natural growth of the population is average value of the natural growth of the Romanian population from -1.7‰, for Dolj

county the natural growth is already -4.8 ‰, and in the villages from the region it is -10.4‰ (table 3.13.2-9).

Table 3.13.2-9 EThe nature movement of population in Romania and in an area Dolj (2007)

	Live born (‰)	Deads (‰)	Totally for the country
Total for the country	10.0	11.7	-1.7
Общо Dolj	8.9	13.7	-4.8
30-km area	9.8	9.7	0.1
Dolj -град	9.4	9.4	0
Calculations of the author on data of NSI [105, 106].	10.2	14.2	-4.0
Dolj-village	8.2	18.6	-10.4

Source:Romanian Statistical Yearbook, 2 , Population, 2007.

0 to 14-year-olds accounted less than 14% of the population in the 2011 Census were appr. 14% of the population in 30km area (3.13.2-10).Contrary to this, the relative share of the population over 60 years is very high at 31.5%. The activities on the construction and operation of the NPP have been a reason for attracting young population in the town of Kolzoduy and for formation of very favorable age structure of the population of the town. Since the town of Kozloduy is the biggest settlement in the municipality this has influenced also the age structure of the population in the whole municipality. Highly deformed is the age structure of the population in the other two municipalities, especially in the municipality Hayredin, where the process of aging of the population is strongly expressed.

Table 3.13.2-10 Age structure of the population of the municipalities entirely located in the 30-km area of Kozloduy NPP (%, census 2011) [106]

Municipality	0-14 years	15-59 years	Over 60 years
Municipality of Kozloduy town of Kozloduy	15.9 15.1	63.9 68.0	20.2 16.8
Municipality of Mizia	12.4	53.1	34.4
Municipality of Hayredin	10.5	47.0	42.6
30-km area	14.2	54.3	31.5

Source: Calculations by the author according to NSI data

The comparison of the age structure of the population in the 30-km area to the age structure of the population in the municipalities Vratsa and Montana and the average for the country shows the more progressed process of aging of the population in it and the worsening of the age structure (Table 3.13.2-11). The higher relative share of the population at the age groups 0-14 in the town of Kozloduy and Kozloduy municipality and relatively lower share of the population of the age group 15-59 in comparison with the previously mentioned regions and the country impacted the opportunities for formation of work force in the 30-km area. The considerably higher share of the elderly population is an evidence for the necessity of adequate development of the social system on that territory. Particularly higher is the relative share of the women older than 60 years (over 1/3 of the number of women are at age over 60).

Table 3.13.2-11 Age structure of the population (%, census 2011) [106]

	0-14 years	15-59 years	Over 60 years
30km зона	14.2	54.3	31.5
Municipality of Vratsa	13.4	57.6	29.0
Municipality of Montana	12.8	55.1	32.1
Bulgaria	13.3	60.9	25.8

Source: Source: Calculations of the author on data of NSI [106].

Presence of deepening negative demographic processes is shown for the Romanian territory within the range of the 30-km zone around Kozloduy NPP. The data suggest the distribution of population by age group for the district Dolj (Dolj). Since we have no details in this respect about the investigated part of the zone of influence, it will be referred to the data field, accepting them as valid and study area. Of the total population of the area (712178 people) in the under working age (from 0 to 19 years) were 14.47%. Working age is 68.56% of the population. In the over working age group (over 65) are 17.0%. From the presented data it is shown that the proportion of under working age population is very small compared with that of the working population. This means that in the future there will be no balance required for normal development of the demographic study area and the demographic situation will continue to get worse. Mechanical population growth

For defining the size and significance of the mechanical growth only the internal migrating movements are taken into consideration, because of the absence of data for the number of the emigrants from these settlements and possible immigration. At the time of the construction of the nuclear power plant and the production and service units related to it, Kozloduy NPP as a national site attracts considerable number of workers and specialists.

Upon the commissioning of the plant, the specialists working at the plant were settled in the town of Kozloduy. After the shutdown of part of the units some of the specialists quit their jobs. The number of the people migrating from the town is increasing. Nowadays as a whole in the 30-km area the number of the people settling (1442 people, 20107) is lower than the number of the emigrants (1826 people) (Table 3.13.2-12) The balance of the migration is negative as in the three municipalities located in this area and also in the municipalities which are partially included in it.

Table 3.13.2-12 Number of the settled and emigrated from the 30-km area of Kozloduy NPP (2010)

Municipalities	Populated areas	Settled			Emigrated		
		Total	Men	Women	Total	Men	Women
Lom Municipality	1. village of Stanevo	66	40	26	12	8	4
Vulchedrum Municipality	2. v. Botevo	0	0	0	6	3	3
	3. v. Buzovets	5	1	4	5	3	2
	4. town of Vulchedrum	75	29	46	119	53	66
	5. v. Gorni Tsibur	8	2	6	10	9	1
	6.v. Gorni Tsibur	28	14	14	47	18	29
	7. v. Zlatia	28	13	15	26	14	12

Municipalities	Populated areas	Settled			Emigrated		
		Total	Men	Women	Total	Men	Women
	8. v. Ignatovo	7	3	4	12	8	4
	9. v. Mokresh	27	15	12	35	16	19
	10. v. Razgrad	19	8	11	40	16	24
	11. v. Septemvriytsi	37	19	18	35	18	17
Boitchinovtsi municipality	12. v. Beli brod	0	0	0	9	4	5
	13. v. Lehchevo	38	15	23	41	15	26
Krivodol municipality	14. v. Furen	4	1	3	5	3	2
Kozloduy municipality - whole	15. v. Butan	53	26	27	65	21	44
	16.v. Glozhene	57	25	32	57	33	24
	17. town of Kozloduy	263	113	150	414	198	216
	18. Kriva bara	6	3	3	9	4	5
	19. v. Hurlets	36	14	22	49	23	26
Hayredin municipality - whole	20. v. Botevo	2	1	1	2	1	1
	21. v. Burzina	5	2	3	12	3	9
	22. v. Manastirishte	13	7	6	47	21	26
	23. v. Mihaylovo	33	14	19	32	15	17
	24.village of Rogozen	27	10	17	36	17	19
	25. v. Hayredin	61	22	39	45	22	23
Borovan municipality	26. v. Dobrolevo	9	4	5	17	8	9
	27. v. Malorad	86	39	47	46	22	24
	28. v. Sirakovo	10	6	4	5	3	2
Mizia municipality - whole	29.v. Voivodovo	4	2	2	7	2	5
	30. v. Krushovitsa	24	14	10	36	18	18
	31. v. Lipnitsa	30	12	18	13	7	6
	32. town of Mizia	55	26	29	77	28	49
	33. v. Saraevo	0	0	0	0	0	0
	34.v. Sofronievo	15	6	9	20	11	9
Oryahovo municipality	35 v. Galovo	11	5	6	7	3	4
	36. v. Leskovets	11	6	5	18	9	9
	37. town of Oryahovo	95	43	52	112	42	70
	38.v. Ostrov	28	13	15	44	20	24
	39. v. Selanovtsi	62	31	31	66	35	31
Byala Slatina Municipality	40. v. Altimir	28	13	15	37	13	24
	41. v. Burdarski geran	17	11	6	30	15	15
	42. v. Galiche	25	10	15	56	26	30
	43.v. Turnava	34	11	23	65	29	36
TOTAL		1442	649	793	1826	837	989

Source of information: NSI

The mechanical growth of the population in 2007 is -384 people and the number of the men and women of it is almost equal (Table 3.10.2-13). In all towns negative migratory balance is observed. Differing from the near future with typical positive mechanical growth the data about 2010 show that the number of the emigrated people exceeds the number of settled ones in the town of Kozloduy (151 people) out of which the men are 85 and the women are 66 (table 3.13.2-13). Second is the village of Vulchedrum. The towns Mizia and Oryahovo have smaller negative values comparing with the above two towns. The number of the men who migrated (321 men) is higher than the number of the women who migrated (401 women). Undoubtedly, the emigration of the population from the investigated territory is a result of the shut down of units 1-4 of Kozloduy NPP, as well as of the reduction of the work places in the power plant and restricted options for finding of new work in other activities and productions. Less are the villages where due to different reasons there is a positive balance (Sirakovo, Stanevo, Furen, Hayredin, Malorad etc.). In the predominant part of the villages the number of the population is reducing also because of the weak mechanical exodus

Table 3.13.2-13 Mechanical growth of the population in the 30-km area of Kozloduy NPP (2010)

Municipalities	Populated areas	Mechanical growth		
		Total	Men	Women
Lom Municipality	1. village of Stanevo	54	32	22
Vulchedrum Municipality	2. v. Botevo	-6	-3	-3
	3. v. Buzovets	0	-2	2
	4. town of Vulchedrum	-44	-24	-20
	5. v. Gorni Tsibur	-2	-7	5
	6.v. Gorni Tsibur	-19	-4	-15
	7. v. Zlatia	2	-1	3
	8. v. Ignatovo	-5	-5	0
	9. v. Mokresh	-8	-1	-7
	10. v. Razgrad	-21	-8	-13
	11. v. Septemvriytsi	2	1	1
Boitchinovtsi municipality	12. v. Beli brod	-9	-4	-5
	13. v. Lehchevo	-3	0	-3
Krivodol municipality	14. v. Furen	-1	-2	1
Kozloduy municipality - whole	15. v. Butan	-12	5	-17
	16.v. Glozhene	0	-8	8
	17. town of Kozloduy	-151	-85	-66
	18. c. Kriva bara	-3	-1	-2
	19. v. Hurlets	-13	-9	-4
Hayredin municipality - whole	20. v. Botevo	0	0	0
	21. v. Burzina	-7	-1	-6
	22. v. Manastirishte	-34	-14	-20
	23. v. Mihaylovo	1	-1	2
	24.village of Rogozen	-9	-7	-2

Municipalities	Populated areas	Mechanical growth		
		Total	Men	Women
	25. v. Hayredin	16	0	16
Borovan municipality	26. v. Dobrolevo	-8	-4	-4
	27. v. Malorad	40	17	23
	28. v. Sirakovo	5	3	2
Mizia municipality - whole	29.v. Voivodovo	-3	0	-3
	30. v. Krushovitsa	-12	-4	-8
	31. v. Lipnitsa	17	5	12
	32. town of Mizia	-22	-2	-20
	33. v. Saraevo	0	0	0
	34.v. Sofronievo	-5	-5	0
Oryahovo municipality	35 v. Galovo	4	2	2
	36. v. Leskovets	-7	-3	-4
	37. town of Oryahovo	-17	1	-18
	38.v. Ostrov	-16	-7	-9
	39. v. Selanovtsi	-4	-4	0
Byala Slatina Municipality	40. v. Altimir	-9	0	-9
	41. v. Burdarski geran	-13	-4	-9
	42, v. Galiche	-31	-16	-15
	43.v. Turnava	-31	-18	-13
TOTAL		-384	-188	-196

Source of information: NSI

Populated areas

In the 30-km area of Kozloduy NPP 43 settlements are included – 4 towns (Kozloduy, Valchedram, Mizia, and Oryahovo) and 39 villages. According to the applied classification of the towns in the country only Kozloduy is included to the group of the small towns (from 10 to 30 thousand people). The other three towns are included to the group of the very small towns (to 10 thousand people). According to the development of the economy and the character of the employment of the population it could be said that Kozloduy, Mizia and Oryahovo have mixed functions, which are defined by the industry, the services, the transport and others. Lower is the meaning of the agricultural activities. The town of Valchedram has mainly agricultural character. All of the four towns have administrative functions as centres of municipalities.

The small (200-1000 people) and medium (1000-2000 people) villages predominate on the territory of the 30-km area. In accordance with Regulation N 5 from 1995 on the classification of the villages this is a total of 29 out of 39 villages. Sixteen of the villages are in the group of the small villages and 13 – in the group of the average ones. Five villages have over 2000 people population in 2011 and could be referred to the group of the big villages (Selanovtsi, Butan, Glozhene, Tarnava, Harlets, Galiche, Lehchevo, and Malorad). Only 5 villages have below 200 residents and they are in the group of the very small villages - saraevo, Botevo (Vulchedrum municipality), Botevo (Hayredin municipality), Buzovets and Gorni Tsibur. The villages have agricultural functions.

Only one of them – Hayredin village has administrative functions as a centre of a municipality.

The Romanian part of the territory falling within the 30-km zone of influence around Kozloduy NPP includes in total 23 settlements, 2 cities (Dabuleni and Bechet) and 21 villages. In 2009 the number of inhabitants of the town Dabuleni (by information on the Romanian side) is 12819, and the second city - Bechet has 3917 inhabitants. The village with the lowest population is the village Nedeia – 1 380 people and with the one with the highest number is the village Sadova -8 489 people. Like the Bulgarian villages in the Danube valley, and Romanian villages in this part of the territory of Romania, are located at great distances from one another, which means that their lands are large, the density of the urban network is smaller and thirdly, that the number of inhabitants is also greater than the hilly and mountainous lands, both Bulgaria and Romania.

Economical activity of the population. Economy

The development of the social-economical and demographic processes during the last two decades exerts negative influence on the dynamic of the number of the working force, of the employed and unemployed in the villages included in the 30 km area of Kozloduy NPP and also in the whole country. The reduction of the working force is determined by the unfavorable processes of the development of the population, by dropping out of the labor efficiency age, a higher number of the population and entering of smaller quotas, by the migrations from this territory towards other parts of the country or towards other countries, etc. A typical character of the working force is the high relative share of the people who have high school and university degrees, with a specific qualification, concentrated in the Kozloduy municipality. Strong influence on the number of the people employed had also the economical changes at the separate settlements, the reduction of the number of the working places, especially in the 90’s as a result of closing different companies and the changes in the agriculture and other. T

According to the census data in 2011 the group of the economically active population in the investigated territory includes 24105 people or 42.6% of the population from 15 and older (table. 3.13.2-14). The number and the share of economically not active people (32520 people) are very high (57.4%). The number of the economically active people is higher than the number of economically non-active people only in the towns of Kozloduy and Mizia, where there are constructed industrial enterprises - Kozloduy NPP, some other enterprises, organizations, institutions and companies for service activities etc., which offer better options for employment comparing with the other populated areas. In some villages the proportion between thes two groups is more favourable - village of Glozhene, village of Hurlets, village of Galovo, which are next to Kozloduy NPP and a part of their population is employed in the electricity production and related activities. In the most part of the settlements the number of economically not active persons is several times higher than the economically active ones - e.g. v. Malorad and Gorni Tsibur, Septemvryitsi, Krushovitsa, zlatia etc. In some of the villages the employed persons are smaller part of the group of the economically active persons - v. Mokresh, v. Razgrad, v. Butan, v. Glozhene etc. In the most of the shown expamples the populated areas are more distant from the town of Kozloduy and there are not enterprises and companies offering sufficient number of work places, their potential for development of production and service activities is limited. Besides, the bigger part of the population in the above settlements and in the other ones, including the registered unemployed people and especially from the economically non-active population is with

very low educational background. This means that thiscategory of people is without special knowledge, professional skills, experience and qualification and they could not meet the current business requirements. Actually, this is completely valid for big number of populated areas in the rest part of the country, mostly for some of the border territories of North-West Bulgaria and other areas suffering now and which will continue suffering this problem.

Table 3.13.2-14 Population of 15 and older in populated areas and depending on its economic activity 1 February 2011.

Municipalities	Populated areas	Total	Economically active			Economically non-active
			Total	Employed	Unemployed	
Lom Municipality	1. village of Stanevo	327	130	101	29	197
Vulchedrum Municipality	2. v. Botevo	64	9	9	-	55
	3. v. Buzovets	107	16	..	..	91
	4. town of Vulchedrum	3229	1312	1000	312	1917
	5. v. Gorni Tsibur	192	49	34	15	143
	6.v. Gorni Tsibur	1175	552	273	279	623
	7. v. Zlatia	791	249	168	81	542
	8. v. Ignatovo	226	74	44	30	152
	9. v. Mokresh	678	259	113	146	419
	10. v. Razgrad	615	198	100	98	417
	11. v. Septemvriytsi	960	208	173	35	752
Boitchinovtsi municipality	12. v. Beli brod	223	67	35	32	156
	13. v. Lehchevo	1509	503	371	132	1006
Krivodol municipality	14. v. Furen	232	35	20	15	197
Kozloduy municipality - whole	15. v. Butan	2354	1054	658	396	1300
	16.v. Glozhene	2291	1099	676	423	1192
	17. town of Kozloduy	11082	7088	6377	711	3994
	18. с. Крива бара	331	86	69	17	245
	19. v. Hurlets	1748	889	651	238	859
Hayredin municipality - whocle	20. v. Botevo	81	14	14	-	67
	21. v. Burzina	215	82	38	44	133
	22. v. Manastirishte	974	317	259	58	657
	23. v. Mihaylovo	901	210	166	44	691
	24.village of Rogozen	913	252	162	90	661

Municipalities	Populated areas	Total	Economically active			Economically non-active
			Total	Employed	Unemployed	
	25. v. Hayredin	1394	446	369	77	948
Borovan municipality	26. v. Dobrolevo	721	285	152	133	436
	27. v. Malorad	1581	338	243	95	1243
	28. v. Sirakovo	203	61	40	21	142
Mizia municipality - whole	29.v. Voivodovo	243	85	62	23	158
	30. v. Krushovitsa	1533	583	415	168	950
	31. v. Lipnitsa	665	189	..	..	476
	32. town of Mizia	2786	1421	1155	266	1365
	33. v. Saraevo	42	8	..	..	34
	34.v. Sofronievo	1364	531	411	120	833
Oryahovo municipality	35 v. Galovo	4246	2005	1573	432	2241
	36. v. Leskovets	226	39	25	14	187
	37. town of Oryahovo	611	235	186	49	376
	38.v. Ostrov	1280	254	205	49	1026
	39. v. Selanovtsi	3178	1139	836	303	2039
Byala Slatina Municipality	40. v. Altimir	1019	334	177	157	685
	41. v. Burdarski geran	682	271	214	57	411
	42, v. Galiche	1681	482	387	95	1199
	43.v. Turnava	1952	647	508	139	1305
TOTAL		56625	24105	18469	5423	32520

Source: Calculations by the author under final census data in 2011, www.nsi.bg

Economic growth ratio in the investigated territory is comparatively lower than the one of the country and in the areas of Vratsa and Montana table 3.13.2-15). The most favourable is the situation in the town of Kozloduy, where the employment ratio is above the average for the country (52.1%). The higher values are a result of the determinative potential of the electric power generation and related to it production, auxiliary and service activities. Impressive is the low employment ratio – 32.6 % for the villages in 30km zone, which is by 11.8% lower than the average for the country and by 4-5 % lower than the one for the areas of Vratsa and Montana. Considerably higher is the share of the employer economically active persons. Very higher is the share of economically non-active persons in the investigated territory-v. Gorni Tsibur, dolni Tsibur, v. Mokresh, v. Septemvriitsi, v. Furen etc. - (table 3.13.2-14) and (table 3.13.2-15).

Table 3.13.2-15 Economic activity of the population by 1 February 2011

Territorial unit	Ratio of economic activity (%)	Employment ratio (%)	Ratio (level) of unemployment (%)	Economically active persons		Relative share of the economically non-active persons from the population from 15 years and older (%)
				Employed (%)	Unemployed (%)	
30km area town of Kozloduy	42.6 64.0	32.6 57.5	9.6 6.4	76.6 90.0	22.5 10.0	57.4 36.0
Vratsa district	46.7	37.8	9.0	80.8	19.2	53.3
Montana District	47.8	36.8	10.3	78.1	21.9	52.9
Bulgaria	52.1	44.4	7.7	85.1	14.9	47.9

Source: Calculation of the author according to final data of the census in 2011, www.nsi.bg

The economic changes, close down of production capacities (shut down of four units of Kozloduy NPP) or reduction of the activity of some enterprises caused unemployment. Generally, the unemployment is a result of the reduction of the production, discrepancy between the demand and offering of work places and insufficient opening of new work places. As per the census data on 1 February 2011 the number of the unemployed in all 43 populated areas in 30km area of Kozloduy NPP is 5423 people (table 3.15.2-14). The registered unemployed are considerable part of the economically active people – more than 1/5 of them (table 3.13.2-15). Similar is the situation in the districts of Montana and Vratsa This is very unfavorable comparing with the situation in the country. The calculated unemployment rate (according to census data) is higher than the average for the country and close to the ones in the districts of Montana and Vratsa. The lowest is the unemployment level in Kozloduy. According to data provided by Kozloduy municipality as a result of the active measures and programs implemented by the Ministry of labour and social policy on the local labour market, the number of unemployment after 2000 is reduced. In 2007 the level of unemployment in the municipality is 8.5%. The tendency of reduction continued also in 2008 - the unemployment rate in the municipality is 6.7%, with an average 6.3 % for the country. In 2009 and 2011 the presenting economic crisis exerted its influence on the total employment in the country. In this relation the unemployment marks a slight increase as for the whole country and also for the administrative districts of Montana and Vratsa. This partly applies also to the examined territory. As a result of the continuing economic crisis the possibilities for opening of new, permanent work places in the investigated territory are limited. Meanwhile, as in the last months of 2011 and since the beginning of 2012 the number of newly registered unemployed people, which were discharged from the services, industry and other activities is increased It is very concerned that the unemployment is increased, both the absolute and the relative share of the young people up to 29 years and people older than 50. The biggest share of the unemployed people is

the one of the people with high school, secondary and lower education. In the beginning of 2012 the average unemployment rate for the country was from 11.5% and 18.40 % for the district of Vratsa (including most of the municipalities involved in 30km area of Kozloduy NPP“) the unemployment ratio in the most municipalities, included entirely or partially in the examined territory is higher. The lowest is the share of the unemployed in the municipality of Kozloduy (13.54%),, which traditionally differs with higher employment of the population. In the other municipalities the level of unemployment varies from 19.75 % for the municipalities of Mizia and Oryahovo - 27.94 %, for municipality of Hayredin - 37.82 %, and the highest is the share of unemployment in Borovan municipality – 56.49 %. The reasons for high unemployment in the investigated territory from the North-West region (the most undeveloped region not only in the country, but in the European Union) are economic, social, demographic and of other origin. The work places announced by the employers on the primary labour market are still insufficient. Also, it is not possible to provide sufficient work places under different employment programs, moreover thay have different duration and engagement of the hired people. The effective solution of the problem of high unemployment not only on the investigated territory, but in the North-West Bulgaria would be eventual construction of new unit seven of Kozloduy NPP. Contribution in the mitigation of the negative unemployment effect and to provide incomes has the Updated strategy for decommissioning of units 1-4 of Kozloduy NPP adopted by the Management of Kozloduy NPP in 2006 [7].

According to the strategy for so-called "continuous dismantling" during both decommissioning stages, the staff of high qualified and experienced experts, which has serviced the shut down reactors, is re-employed in the new decommissioning activities. In this connection there is an agreement signed between Kozloduy NPP and SE “RAW” giving more detailed characteristic of the employment recontracting and transfer of the personnel of KNPP – EP1 to the new employer SE ”RAW”. By this many positive aspects will be achieved in practice - maintenance and provision of jobs for the specialists made redundant due to the shutdown of the reactors, using their rich experience and knowledge, achieving greater efficiency in the new activities, ensuring continuity and last but not least the negative crisis effects will affect less the level of unemployment. The retention of qualified staff in the new activities on the decommissioning may also have another positive effect - providing qualified personnel for the eventual construction and operation of the new 7th unit of Kozloduy NPP.

Typical for the work force is the high relative share of the persons with high school and university graduation, with specific qualification concentrated in Kozloduy municipality (table 3.13.2-16). Meanwhile in many populated areas of the investigated territory the achieved level of the education of their citizens is very low. In the most of them the people with secondary, primary education, without finished education or such ones, who have never attended school exceeds 50% of the total number of their population – v. Glozhene (54.1%), V. Lipnitsa (56.1%),v. Malorad (64.6%), v.Furen and Septemvriytsi (67.6%), v. Dolni Tsiburp (77.3%) etc.

Table 3.13.2-16 Educational structure of the population (relative share of the population of 7 age and older depending on the educational degree by 1 February 2011, %)

Terri-torial unit	University degree	High school	Secondary school	Primary school	Non-finished primary school	Not attending school	Child (incl. to 7 years.), who does not attend school
30-km area Municipality of Kozloduy town of Kozloduy	10.1 17.0 23.8	41.3 43.4 45.5	32.0 22.9 17.8	9.5 8.7 7.0	5.5 6.0 5.1	1.1 1.6 0.6	0.2 0.2 0.2
Municipality of Vratsa	14.9	46.6	25.4	7.3	4.7	0.9	0.2
Municipality of Montana	12.2	45.5	27.6	8.7	5	0.8	0.2
Bulgaria	19.5	43.4	23.1	7.8	4.8	1.2	0.2

Source: Calculation of the author according to final data of the census in 2011, www.nsi.bg

As far as there is no statistic information available as a base for searching of correlating dependency between the features of the educational structure and the features of ethnic structure we could not bound our study in this regard. Data about the ethnic structure of the population of the investigated territory shows that the share of the Bulgarian population is higher (89,5%) that the one in the country. Typical for the settlement in this region of the country is that there is almost no Turkish population and population from other ethnic groups. Meanwhile, the average relative share of the gypsy population in the country is 4.9% and for the investigated territory its share is almost twice higher – 9.4% (table 3.13.2-17).

Table 3.13.2-17 Ethnic structure of the population (%, by 1 February 2011)

Territorial unit	Bulgarian	Turkish	Gypsy	Other	Not determined
30km area	89.5	0.3	9.4	0.2	0.5
Municipality of Vratsa	92.7	0.3	6.2	0.3	0.5
Municipality of Montana	86.3	0.1	12.7	0.3	0.6
Bulgaria	84.8	8.8	4.9	0.7	0.8

Source: Calculations of the author under final data of the census of the population in 2001, www.nsi.bg

Recently, the opening of new work places is not sufficient. In this regard, definitely the shut down of the first nuclear units has negative impact thus reducing the prospects and motivation for employment of highly educated and qualified staff.

Leading position in the structure of the economy and employment is the one of the secondary (industry and construction) and the primary sectors (agriculture). The largest share in the structure of the industry is the one of the activities for production and distribution of electricity. There are a few large industrial plants (NPP, Pulp and Paper Plant in the town of Mizia, Agrotechchast in the town of Oryahovo, etc.).

The nuclear power plant is the most important industrial company in the 30-km area as a source of revenue for the national budget as a source of jobs. The operation of the Pulp and paper plant is still very limited. In Oryahovo spare parts and attached agricultural equipment are produced. Significantly larger is the number of the small and medium companies. They are mostly from the manufacturing industry and are specialized in

various sectors - food processing (mills, production of eggs and poultry meat, slaughterhouses and production of meat products, milk processing, production of soft drinks, bread and pastries, etc..) machine-building production (hydraulic and mechanical jacks, fasteners and joining parts, etc.), woodworking, sewing and knitting production, etc. Small is the number and proportion of the companies from the extractive industry – extraction of aggregates, building materials, gas and others. Defined role in the economy of this territory have the construction companies engaged primarily in construction and repair works related to the nuclear power plant and also to new civil construction and repair activities, and activities in the implementation of projects under various programs (for example under operational program “Environment” in the municipality of Kozloduy and others).

For the development of the agriculture there are facilities for the fertile soils, plain-hilly relief and favorable agro-climatic and hydrological conditions. Various forms of organization of production have been developed - co-operatives, large leaseholder farms, and small private farms. Agriculture employs are some of the workforce. It is also a source of income for a part of the pensioners. The agriculture is specialized mainly in the production of grain (wheat, corn, etc.). The same is valid for the production of sunflower and other agricultural crops. This production is both for the needs of the market and for private needs. Significantly less is the production of vegetables and fruit, mainly for private needs. Through the last years the stock-breeding production is insufficient, mainly for private needs.

The development of the services contributes to the better service of the population, to create new work places and to increase the income of the population. Highest number of work places is opened at the different types of trade facilities, the education and the public health care.

In the investigated area various types of transport are developing. Danube River, which developes as a pan-European transport Corridor No 7, provides opportunities not only for transport, but also for economical relation and cooperation with other Danube countries. In the 30-km area are built two ports for different purposes - in the town of Oryahovo (ferry link with Romania) and in the town of Kozloduy (with importance for the NPP). Nearby is the port of Lom. The road transport is of ther highest importance for the realization of internal connections as well as for the connection with other cities in the country.

The narrow-gauge railway line to Oryahovo is no longer active. The nearest railway line is Mezdra-Brusartzi-Lom.

Recently, the importance of tourism is increasing, for the development of which at the present stage there are insufficiently used resources. Major tourist attractions for the development of informative tourism are the national museum - ship “Radetski”, the Botev’s road and Botev’s park, the ruins of ancient Roman fortresses in the lands of Harlets, Kozloduy, Oryahovo etc. There are certain opportunities for development of business tourism in relation to visits of specialists in the NPP, for development of rural tourism, etc.

The importance of the services is increasing for the development of the business – banking services, insurance, internet, business incubator in the town of Kozloduy and others.

In the part of the 30-km zone of influence of Kozloduy NPP on Romanian territory, as regarding the population and economy, there are no production and service activities associated with both until recently suspended operation of the 4 reactors and the

activities of their decommissioning. Therefore, it is determined that the decommissioning work on 4 Bulgarian reactors can not have economic and social impacts on the economy and population of the Romanian part of concerned 30-km zone of influence of NPP "Kozloduy".