MINISTRY OF ENERGY OF THE REPUBLIC OF BELARUS
STATE INDUSTRIAL CORPORATION BELENERGO

REPUBLICAN UNITARY DESIGN AND RESEARCH ENTERPRISE
BELNIPIENERGOPROM
(RUE BELNIPIENERGOPROM)

CONSTRUCTION OF A PEAK/STANDBY POWER SOURCE AT BEREZOVSKAYA CHPP

AMENDMENTS TO PRELIMINARY PROJECT (PRE-INVESTMENT) DOCUMENTATION

825-ПЗ-ПП3

Book 1

ENVIRONMENTAL IMPACT ASSESSMENT (EIA)

Part 2 Non-Technical Summary

2019

MINISTRY OF ENERGY OF THE REPUBLIC OF BELARUS
STATE INDUSTRIAL CORPORATION BELENERGO

REPUBLICAN UNITARY DESIGN AND RESEARCH ENTERPRISE
BELNIPIENERGOPROM
(RUE BELNIPIENERGOPROM)

CONSTRUCTION OF A PEAK/STANDBY POWER SOURCE AT BEREZOVSKAYA CHPP

AMENDMENTS TO PRELIMINARY PROJECT (PRE-INVESTMENT) DOCUMENTATION

825-ПЗ-ПП3

Book 1

ENVIRONMENTAL IMPACT ASSESSMENT (EIA)

Part 2 Non-Technical Summary

Chief Engineer	/signature/	S.V. Pertsev
Chief Project Engineer	/signature/	P. S. Shimanovich

2019

Repl. Inv. No.	
Signature and date	
Orig. Inv. No.	

Authors of the paper:

Head of the UEC	/signature/	A.V. Kotelnikov
Chief Technologist	/signature/	G.N. Kotelnikova
Chief Technologist	/signature/	N.V. Dorovskaya
Head of Group	/signature/	I.A. Nekhaychik
Head of Laboratory	/signature/	O.N. Zhukovsky

Repl. Inv. No.

Signature and date

Orig. Inv. No.

Rev.	Rev. areas	Sheet	Doc. No.	Signature	Date	825-ПЗ-ПП3

Identification	Description	Note
825-ПЗ-ПП3	Part 2	

Repl. Inv. No.

Signature and

Orig. Inv. No.

Rev.	Rev. areas	Sheet	Doc. No.	Signature	Date
CPE		Shimanovich			
Examined by		Novash			

825-ПЗ-ПП3

Table of Contents

Stage	Sheet	Sheets
	3	50

РУП "БЕЛНИПИЭНЕРГОПРОМ"
Минск Беларусь

Repl. Inv. No.
Signature and
Orig. Inv. No.

A non-technical summary has been prepared with the aim of providing a wide audience with brief information about the results of the environmental impact assessment and social and economic conditions in the implementation of preliminary design solutions for the construction of a peak/standby power source at Berezovskaya CHPP.

The non-technical summary gives a general idea of the planned activity, the state of the components of the environment and social and economic conditions in the potential area of the potential impact of the facility, as well as the main potential impacts during the construction and operation of the Berezovskaya CHPP.

BASIC TERMS AND DEFINITIONS;

Environment *is* a combination of components of the natural environment, natural and natural-anthropogenic objects, as well as anthropogenic objects.

The main natural components of the environment are the land (including soils), subsoil, surface and ground water, atmospheric air, flora and fauna, which provide favorable conditions for the existence of life on Earth.

Natural resources *are* components of the environment, natural and natural-anthropogenic objects that are used or can be used in the implementation of economic and other activities as energy sources, wares and consumables and have consumer value.

Environmental impact assessment *is* a type of activity to identify, analyze and account for direct, indirect and other consequences of the environmental impact of a planned economic and other activity in order to decide on whether it is possible or impossible to carry it out.

Harmful impact on the environment *is* any direct or indirect impact on the environment by economic and other activities, the consequences of which lead to negative changes in the environment.

Pollutant *is* a substance or mixture of substances whose release into the environment causes its pollution (environmental degradation).

Ground waters are waters below the level of the earth's surface, in the strata of rocks of the earth's crust, in all physical conditions.

Surface water is the concentration of natural water on the land surface (river, stream, spring, lake, reservoir, pond, borrow pit pond, canal, etc.).

Wastewater is water discharged after use in industrial and household activities. Wastewater also includes rainwater discharged from built-up areas.

Standards for permissible emissions and discharges of chemical and other substances *are* standards that are established for legal entities and citizens engaged in economic and other activities in accordance with the indicators of the mass of chemicals, including radioactive, other substances and microorganisms, acceptable for release into the environment from stationary and mobile sources in the prescribed manner and taking into account technological standards, and subject to which environmental quality standards are ensured.

Off-design accident is an accident caused by initial events not considered for design accidents or accompanied by additional failures of safety systems in comparison with design accidents over a single failure, the implementation of erroneous decisions of employees (personnel).

Area of possible significant impact is territory (water area), within which, based on the EIA results, direct or indirect significant changes in the environment and (or) its individual components may occur as a result of the implementation of the planned activity.

Analogue object is an object comparable in terms of functionality, technical and economic indicators and design characteristics to the designed object.

Potential area of possible impact is territory (water area), within which, according to published sources and (or) actual data on similar facilities, direct or indirect changes in the environment and (or) its individual components may occur as a result of the implementation of the planned activity. The maximum size of the potential area of possible impact on atmospheric air can be determined based on the calculation of dispersion of atmospheric emissions for each pollutant (combination of substances with summarizing harmful effects) and is limited to the territory where the maximum ground-level concentration of emissions (excluding background) exceeds 0.05 MAC.

LEGAL ASPECTS

The procedure for organizing and conducting an environmental impact assessment is based on the requirements of the following regulatory acts of the Republic of Belarus:

- Law of the Republic of Belarus On State Ecological Expertise, Strategic Environmental Assessment and Environmental Impact Assessment dated 18 July 2016 (as amended by the Law of the Republic of Belarus No. 218-3 dated 15 July 2019);

- Provision on Procedure for Implementation of Environmental Impact Assessment, Requirements for the Content of the Report about Environmental Impact Assessment, Requirements for Specialists Conducting Environmental Impact Assessments (approved by Resolution of the Council of Ministers of the Republic of Belarus No. 47 dated 19 January 2017);

- TKP 17.02-08-2012 (02120) Environment Protection and Management of Natural Resources. Rules for Environmental Impact Assessment (EIA) and Report Preparation.

The objectives of the environmental impact assessment (EIA) of the proposed economic activity are:
- comprehensive consideration of all environmental and related social and economic and other consequences of the planned activity before deciding on its implementation;
- taking effective measures to minimize the possible significant harmful impact of the proposed activity on the environment and human health.

The implementation of the EIA includes the following stages:
- development of an EIA report;
- conducting discussions of the EIA report with the public, whose rights and legitimate interests may be affected when implementing design solutions;
- follow-up revision of the EIA report according to comments and suggestions from the public;
- submission of project documentation for the proposed activity, including the revised EIA report, to the state environmental expertise.

Public consultations

Public consultations of the EIA report are held in order to:
- inform the public on environmental issues;
- take into account comments and suggestions of the public on environmental issues during impact assessment and decision-making regarding the implementation of the planned activity;
- search for mutually acceptable solutions for the customer and the public in matters of preventing or minimizing the harmful impact on the environment during the implementation of the planned activity.

Public consultations about the EIA report are carried out through:
- public disclosure of the EIA report and recording comments and suggestions made;
- holding, in case of public interest, a meeting to discuss the EIA report.

The procedure for conducting public consultation includes the following stages:
- public notice about public consultations;
- ensuring public access to the EIA report;
- public disclosure of the EIA report.

In case of public interest:
- public notice of the date and place of the meeting to discuss the EIA report;
- holding a meeting to discuss the EIA report;

- collecting and analyzing comments and suggestions, drawing up a summary of feedback on the results of public discussions of the EIA report.

In 2017, RUE Belnipienergoprom, as part of the preliminary (pre-investment) documentation “Construction of a Peak/Standby Power Source at Berezovskaya CHPP”, performed an “Environmental Impact Assessment”, went through the process of conducting public discussions and received a positive conclusion from the state environmental review on the preliminary documentation (Conclusion No. 1049/2017 dated 27 June 2017).

Within the framework of this paper, it is planned to amend the above-mentioned preliminary documentation regarding the use of two types of fuel (the main one is natural gas, the standby one is diesel fuel) and the construction of diesel facilities on the designed Peak/Standby Power Source at Berezovskaya CHPP.

1 GENERAL INFORMATION ON PLANNED ACTIVITIES (FACILITY)

Information about the current situation at the facility

Berezovskaya CHPP is a branch of RUE Brestenergo and is part of the SPA Belenergo system of the Ministry of Energy of the Republic of Belarus.

Berezovskaya CHPP is the largest electric power source in the Republic of Belarus. Additionally, it provides heat for utility and domestic needs of Beloozersk and several nearby industrial plants.

The installed electric capacity of the CHPP is 1255 MW, the thermal – 160 Gcal/h.

The following basic equipment is installed at Berezovskaya CHPP:

1) Unit No. 1 in the composition (currently Unit No. 1 and auxiliary equipment are dismantled):
- steam turbine K-160-130-2PRst No.1,
- two steam boilers 2xPK-38 st. No. 1, 2;

2) Unit CCGT-215 st. No.3 comprised of:
- two gas turbines with a capacity of 25 MW each;
- two steam boilers 2xPK-38R st. No. 5, 6;
- steam turbine K-165-130 st. No. 3;

3) Unit CCGT-215 st. No.4 comprised of:
- two gas turbines with a capacity of 25 MW each;
- two steam boilers 2xPK-38R st. No. 7, 8;
- steam turbine K-165-130 st. No. 4;

4) Unit CCGT-240 st. No.5 comprised of:
- two gas turbines with a rated electrical output of 30 MW each;
- two steam boilers 2xPK-38R st. No. 9, 10;
- steam turbine K-175/180-12.8 with a capacity of 180 MW;

5) Unit CCGT-427 st. No.7 comprised of:
- gas turbine unit with a capacity of 286 MW;
- recovery boiler without fuel afterburning;
- steam turbine manufactured by Shanqhai Electric Group.

Boilers of units Nos.1, 3, 4, 5 use natural gas as the main fuel, and heavy fuel oil as the backup fuel, gas turbines of units Nos.3, 4, 5 and CCGT of unit No.7 use gas as the main fuel, backup fuel - none.

Prospects Main Process Solutions

Task order for the amendments of preliminary design provides for two construction cases of the peak/standby power source of Berezovskaya CHPP with a total capacity of 250 MW:

Case 1:

- installation of fourteen 18V50SG GPUs manufactured by Wartsila, 17.622 MW each

Case 2:

- installation of five SGT-800 GTUs by Siemens, 50.5 MW each.

Natural gas is adopted as the main combustion fuel of the GPUs and GTUs to be installed, the reserve fuel is diesel fuel.

Design scope also provides for:

- construction of diesel facilities comprised of:
  a) pump station of diesel facilities;
  b) conveying pumping station with an auto-discharge platform for 3 vehicles;
  c) a diesel facility warehouse consisting of three vertical metal ground tanks with a volume of 2000 m^3 each;
- installation of transformers at the peak/standby power source:
  a) Case 1:
    - five 63 MVA, 330/15 kV transformers;
    - one 2.5 MVA, 6.3/0.4 kV transformer;
    - five 2 MVA, 15/0.4 kV transformers;
  b) Case 2:
    - five 63 MVA, 330/15 kV transformers;
    - two 16 MVA, 10/10 kV transformers;
- expansion of 330 kV Open Switchgear.

Construction provided by the preliminary design will be implemented within the existing territory of Berezovskaya CHPP.

Alternative Process Solutions

Man-made impacts of power engineering facilities on the environment are very diverse. According to properties of primary energy resources used to generate heat and electricity, power engineering facilities cause different levels of environment pollution with production wastes. There are almost no facilities with zero impact on environment. At the same time, power engineering facilities should not be considered equal in terms of environmental impact.

The main interactions of the CHPP with the environment include fuel and water consumption, landscape changes and various emissions to all geospheres. Specific fuel consumption per unit of product depends on fuel type, efficiency of installation and design of all elements, arrangement of fuel combustion process.

This document considers two alternative cases for construction of the peak/standby power source:

<u>Case 1</u>

- design of the peak/standby power source consisting of 14xGPUs;

<u>Case 2</u>

- design of the peak/standby power source consisting of 5xGTUs;

Cancellation on implementation of the peak/standby power source was not considered since commissioning of Belarusian NPP required certain crucial activities, including ensuring reliable operation of the backup capacities.

Comparative analysis of the two alternatives showed that the case with design of the peak/standby power source consisting of 5xGTUs was the preferred one in terms of impact on the main environment components (air, land resources etc.).

Table 1.1 – Comparison of Cases for Construction of the Peak/Standby POWER SOURCE AT BEREZOVSKAYA CHPP

Parameters	Case 1	Case 2
Annual fuel, ton/year	417373	430073
Gross emissions, ton/year	4851.855	3931.759
Maximum ground-level concentrations, MAC units:		
- nitrogen dioxide	0.61	0.34
- carbon oxide	0.25	0.25
- sulfur dioxide - solid particles	0.63 0.36	0.63 0.33
- summation: ∑ SO_2+NO_2	0.93	0.71
- incomplete summation: ∑SO_2+NO_2 +HFO ash (in terms of vanadium)	0.56	0.43

Brief description of the location of the Berezovskaya CHPP

Berezovskaya CHPP is situated in Beloozersk of Berezovo District in Brest Oblast.

There are two water bodies in the area of CHPP: Beloye Lake and Chernoye Lake. Chernoye Lake is located 2.3 km east of the main building and is used for water supply. Beloye Lake is located 2.5 km south-west of the CHPP, and is used for process water supply and as a source of cooling water.

Beloozersk and railway station of the same name are north-west of the CHPP site, and are linked to it by motor and railway approaches 0.7 km and 0.5 km long accordingly.

Terrain of the CHPP site was developed during construction, and today it is a rather plain area with slight elevation difference from 145.5 to 147.5 m.

The CHPP site includes the following three areas:

– Main site (29.5 ha within fence);
– HFO facilities site (17.9 ha within fence);
– Construction yard.

Heavy fuel oil (HFO) facilities site is in south-east part of the plot, in 1.5 km from the main building, construction yard is at the side of 427 MW CCGT.

The nearest to the 180 m stack residential development (emissions source No.0002) is located:

– 550 m northwards (Manevichi village – reference point No.1);
– north-westwards:
  - in 1160 m (Nivki village - reference point No.2);
  - in 1580 m (Beloozersk - reference point No.3);

Southwards, in 870 m from the 180 m stack (emissions source No. 0002) there are garden plots (reference point No.4).

The layout of Berezovskaya CHPP with a potential impact area and specially protected natural sites and natural sites subject to special protection is provided on Figure 1.

Potential impact area is determined as the territory, where calculated ground-level concentrations of each substance and summation group (excluding background) of the combined emission sources of Berezovskaya CHPP exceed 0.05 MAC.

For the Berezovskaya CHPP under consideration, the maximum radius of the potential area of possible impact is a distance of about 26.5 km from the stacks and is caused by pollution with $SO_2 + NO_2$.

Figure 1 – Situational schematic map of the territory in the potential area of possible impact of the Berezovskaya CHPP

2 ESTIMATION OF AS-IS ENVIRONMENT AND SOCIAL AND ECONOMIC CONDITIONS

Climate and Meteorological Conditions

According to SNB 2.04.02-2000, Beloozersk is located within climatic subregion II B.

Climate is moderately continental with influence from marine air masses of the Atlantic Ocean. They are the reason of usually mild winters and moderately warm summers

Main climatic and meteorological phenomena affecting the atmosphere capability to disperse pollutant emissions and form pollution level include: wind conditions, calms, raised inversions, stratification, air temperature, precipitations (by types), fogs.

The average annual wind speed in the considered area is 3.3 m/s, somewhat higher in winter (3.8 m/s) and lower in summer (2.9 m/s). Wind speed (U*) with exceedance probability of 5% in the considered area is 7 m/s.

Table 2.1 provides data on the frequency of wind directions and the frequency of calms. As shown by the table, western and south-western winds prevail throughout the year. Prevailing wind direction in winter is south-western, and north-western wind prevails in summer.

Table 2.1. – Frequency of Wind Directions and Calms

Region, point	Month	Frequency of wind directions and calms, %								
		N	NE	E	SE	S	SW	W	NW	Calm
Beloozersk	I	6	8	8	13	16	20	18	11	6
	VII	13	10	7	6	10	15	19	20	9
	Year	9	10	9	12	13	16	17	14	7

Annual cycle of average monthly air temperatures in the considered area demonstrates maximum values in July and minimum values in January. Average outdoor air temperature of the warmest month is plus 21.3°C, average outdoor temperature of the coldest month is minus 3.5^{0}C.

Amount of precipitations classify the considered area as sufficiently moistened. There are all types of precipitations here: liquid, solid and combined. Precipitations are not evenly distributed throughout the year. The rainiest month is June with 82 mm of precipitations, a little less precipitations fall in July and August. The driest months are February and March (34 mm of precipitations). Average of 630 mm of precipitations fall throughout the year. Maximum daily precipitations can reach 86 mm.

Solid precipitations form snow cover, which mainly appears in the third ten-day period of December, and disappears in the first ten-day period of March. Average snow cover height is 15-22 cm. Observations register winters when no stable snow cover forms.

Based on the above, it can be noted that climatic and meteorological properties of the considered area contribute to dispersion of pollutants in atmospheric air. Considering low frequency of calms (average annual frequency of calms is 5%), inversions will not have a considerable effect on condition of atmospheric air in the considered area.

Since the region is within the sufficiently moistened area, atmosphere here is highly capable of self-purification because pollutants are washed off by precipitations.

Meteorological and climatic properties, which determine conditions for dispersion of hazardous substances in atmospheric air, and are used for further calculations of ground-level concentrations are provided by State Institution Republican Center for Hydrometeorology, Radiation Control and Environmental Monitoring (BELGIDROMET), and are detailed in Table 2.2.

Table 2.2 – Meteorological and Climatic Properties

Description	UOM	Value
Average ambient air temperature of the coldest month	^{0}C	-3.5
Average ambient air temperature	^{0}C	+21.3

Description	UOM	Value
of the warmest month Factor of atmosphere temperature stratification, A	$mg \cdot s^{2/3} \cdot degree^{1/3}$ g	160
Terrain relief factor	no unit	1
Wind conditions:		
Wind speed with exceedance probability of 5%	m/s	7

Atmospheric air

Table 2.3 details background concentrations of pollutants in the atmosphere of Beloozersk provided by State Institution Republican Center for Hydrometeorology, Radiation Control and Environmental Monitoring (GIDROMET).

Table 2.3 – Background pollution of atmosphere (Beloozersk)

Pollutants	MAC, mg/m^3	Background concentrations	
		mg/m^3	MAC units
Sulphur dioxide	0.5	0.062	0.124
Nitrogen dioxide	0.25	0.050	0.2
Carbon oxide	5	0.860	0.172
Solids (sum)	0.3	0.081	0.27

As shown by the table, average background concentrations of the main monitored substances do not exceed standards of atmospheric air quality, but also they are significantly lower.

Environmental situation in the area is stable, environment condition is favorable.

Surface water

In order to timely identify negative processes, predict their development, prevent harmful consequences and determine the degree of effectiveness of measures aimed at the rational use and protection of surface waters, surface waters are monitored for hydrological, hydrochemical and hydrobiological indicators of the state of surface waters.

Republic-established water quality parameters and standard maximum allowed concentrations (MAC) were used to evaluate degree of contamination of water bodies. Those included biological oxygen demand - BOD_5, nitrogen ammonium, nitrite nitrogen, phosphorus phospates and oil products (priority), and nitrates, total phosphorous and synthetic surface active substances (SSAS). The majority of these parameters are recommended by European Community and allow for comparison of estimated surface water condition in the Republic of Belarus and other countries.

Berezovo District is one of Brest Oblast regions with the most numerous water bodies. There are 17 water bodies in the region. The main waterway in the area is the Yaselda river.

Integrated evaluation of surface water quality by hydrochemical properties was conducted using water pollution index (WPI).

The hydrochemical status of the Yaselda River (above and below the city of Bereza) in 2018, like 2017, was assessed as satisfactory.

Geological Environment and Ground Water

According to geotechnical surveys there are deposits in the geological structure of the site:

1) Holocene horizon
   - man-made (artificial formations) t IV,
2) Poozersky horizon
   - lacustrine-alluvial bog deposits

Hydrogeological conditions of the surveyed area are defined by considerable inundation of the territory.

Surveys exposed ground water occurring at the depth of 1.30-2.70 m down.

According to National Environment Monitoring System, quality of ground water in the *basin of the Pripyat River* in 2018 was studied on 10 hydrogeological points (at 21 observation wells).

Chemical composition of ground water in the basin mainly corresponded to sanitary requirements. No significant changes in chemical composition of ground water were identified when compared with 2017.

Regime observations showed that in the ground water of the basin of the Pripyat River, tested in 2018, the excess of the MAC values was revealed for silicon oxide for 1.03 - 1.3 times and for nitrates for 1.21 times in well 1 of the Borovitsky h/g post.

The temperature conditions of ground water during the reporting period were characterized by a change in temperature in the range from 4.0 to 14.0°C.

Compared to 2017, the ground water level in 2018 slightly decreased. The minimum level position in 2018 was mainly in September-November, the maximum - in March-April.

Terrain, Land Resources and Soil Cover

Berezovo District is at south-west of our republic, in the center of Brest Oblast. The district occupies south-east of Pribugskaya Plain and north-west of Pripyat Polesye, and is located at the border of two distinctive geographical regions divided by the Yaselda river - plain region and forest-meadow region.

According to geomorphological zoning, territory of Berezovo District is in the west of East European Craton, within the east part of Podlasko-Brestskaya tectonic depression, and the west part of Poless saddle. Surface of the region is a flat, water-logged, aqueoglacial plain.

Territory is a plain with prevailing elevations of 150 - 160 m above sea level. The highest absolute elevation of the territory is 189 m (Bronna Gora). The lowest point of the area is in the south-east, in flood plain of the Yaselda river – 139 m. The area is generally sloped from north-west to south-east.

Terrain was formed by quaternary glaciations, their melt water, fluviation, ash processes.

Landscapes around the city are mainly man-made — agricultural lands, gardening settlements, individual forest areas.

According to state land registry as of 1 January 2019 the land fund of Berezovo District amounted to 141.277 thousand ha. Main land users in the area are agricultural and forestry companies.

Share of agricultural land in the region is 47.2%, which is higher than the average regional level (42.3%).

There are 24 ha of irrigated agricultural lands in the area. Total area of all drained lands in the area is 37.9 thousand ha.

Share of forest lands of the state forest fund, and lands occupied with other trees and shrubs is 28.6%, which is lower than average level in the region (40.9%).

Share of bogs and water bodies in Berezovo District is 16.1%, which is higher than average level in the region (9.7%). Area of disturbed, unused and other lands is 2.1%.

According to soil and geographic zoning of the Republic of Belarus, Berezovo District is in South (Polesskaya) province, south-west county and within Brest-Drogichin-Ivanivo area of soddy-podzolic, water-logged sandy loamy and clayey soils, and Gantsevichi-Luninets-Zhitkovichi subarea of peat-bog and soddy-podzolic, water-logged sandy soils.

Structure of soil cover in the area is dominated by soddy-podzolic and peaty-marshy soils, particle size distribution shows prevailing sandy loams - 46.8%, sands - 25.4% and peat-bog soils – 26.7%.

Soil cover takes upon pressure from flows of industrial and utility emissions and wastes, and has the crucial buffer and detoxicant role. Soil accumulates heavy metals, pesticides, hydrocarbons, detergents, other polluting chemicals, preventing their ingress in natural water and cleaning them off atmospheric air.

In 2018, soil surveys were conducted in the city of Beloozersk as part of observations of chemical land pollution. The content of heavy metals, sulfates, nitrates, oil products and pH were determined in soil samples.

Comparison of data on the content of chemicals in soil samples with hygienic standards showed that none of the determined ingredients in the soils of the city of Beloozersk exceeded the standards.

However, comparison of the data on the content of chemicals in soil samples for previous years of observations (surveys were conducted in Beloozersk in 2013) revealed a slight increase in the average and maximum contents of all the tested substances in the soils of Beloozersk.

Flora and Fauna Forests

According to geobotanical zoning of Belarus, the entire territory of Berezovo District is located in Bugsko-Polessky forest area, subarea of broad-leaved forests.

Forests occupy 37.6 hectares or 26.6% of the area. Part of them is classified as protected zones. There are large forest areas - Golovitsky, Budy and Bronna Gora, part of Sporovsky republican biological reserve and part of Buslovka reserve. Forests are not evenly distributed, the majority of forest areas are concentrated north and north-east of the plant. The lowest forest coverage is south-west of the plant, with significant amount of forest outliers.

Forests are dominated by pine, birch and black alder formations. There are fragments of planted spruce, ash, hornbeam and aspen. Share of oak wood is small.

Bogs occupy 8.9% of the district territory or 12.6 thousand ha. Black bogs are frequent in the area. Area and natural preservation of Sporovskoye black bog land make it unique for Central Europe, it is one of the largest black bogs in Polesye.

Shrubs occupy about 2.1% of the area. They are very diverse in habitat and composition. Birch, sorbus, hazel shrubs are confined to normally moistened and water-logged soddy-podzolic soils. Low water-logged areas with soddy-gley and peat-bog low soils are occupied by black alder, willow, buckthorn shrubs. Ground cover is dominated by large sedge and bog herbage.

Large share in the considered area is occupied by meadow and bog vegetation. Meadows include dry and bottomland meadows. In agricultural terms, meadow lands are divided to hay-fields and pastures. Bottomland meadows are spread mainly in the Yaselda river flood plain. Considerable areas are occupied by cultural haylands and pastures made primarily in reclaimed lands.

Faunistically, Berezovo District, as the entire territory of the Republic of Belarus, is within European-Siberian subarea of Palearctic. Animal life of Berezovo District is extensive and diverse.

The most numerous mammals are forest species: mountain hare, white-breasted hedgehog, red squirrel, which find rather favorable environmental conditions to maintain constant population in the region. Forest areas are habitat of ungulates - moose, capreolus. Deer is observed in the region. Regular inhabitants of local forests might include weasel, pine marten, wolf; the more rarely occurring – forest dormouse and hazel dormouse. Habitat of the other rare theriofauna species is directly associated with forests – badger, which is rarely though regularly observed in the area.

Wildlife of meadows, bogs, water bodies and reclamation areas includes muskrat, otter, water vole.

Natural complexes and natural objects

Potential impact area of Berezovskaya CHPP includes a specially protected natural site (SPNS) – Sporovsky republican biological reserve (registered under No.281 dated 23 February 2009) and natural areas subject to special protection - biological monuments of nature of local importance. Ancient parks of the city of Bereza, Starye Peski and Signevichi-2.

Sporovsky biological reserve with total area of 19384 ha is located in Berezovo, Drahichyn, Ivanovo and Ivatsevichi Districts of Brest Oblast. The reserve was established in 1991 to preserve unique low bogs, reference bog-meadow and forest areas with extensive flora and fauna. This bog area is one of the last large bogs within catchment of the Yaselda river.

The reserve is a flat plain with lakes, river valleys, terraces above flood plains, and unique mineral islands. Bogs are spread in a single mass (75% of the territory), stretched along the Yaselda river for 35 km.

Vegetation of the reserve is very diverse. There are over 600 species of vascular plants in the reserve, or about 35% of the vascular plants in republic.

Flora of the reserve demonstrates absolute dominance of herbaceous plants over woody plants and shrubs, which amount to only 9.5% of the total number of species. There are 15 species of woody plants, with proper and apparent timber stands formed by European pine, European black alder, drooping birch and European black alder. Some species are represented by individual specimens, which do not have significant influence as forest forming species.

Out of 81 shrubs and subshrubs of Belarusian flora, 37 are found in the reserve. Among shrubs, there are 3 cultivated species, which ended up in the reserve: thicket shadbush, elderberry and gooseberry. Low number of woody plants among flora is associated with low variety of ecotopes.

Bottomland vegetation is represented mainly by bottomland sedge meadows.

Fauna includes 20 mammalian species, 112 bird species including 17 listed in Red Book of the Republic of Belarus, 6 reptile species, 8 amphibian species. It is the largest European habitat of aquatic warbler.

The most numerous reptile is lizard – sand lizard and viviparous lizard, grass snake. Occurring are pond turtle and smooth snake - protected species. The most regular amphibians are moor frog and common frog, rare species include natterjack toad, listed in Red Book of the Republic of Belarus.

The ancient park of the city of Bereza with an area of 5.4 hectares, which is located on the outskirts of the city of Bereza, was laid in the XIX century. One of the best locations of the Crataegus submollis. The park is heavily modified; the forest stand is very sparse.

Starye Peski Park covers an area of 10 hectares. The basis of its composition is the water system of two ponds connected by channels to the lake. The forest stand is represented by hornbeam, maple, two Weymouth pines, alder, horse chestnut, common ash, little-leaved linden, snap willow, white poplar, northern oak, European larch, elm tree.

A small cozy old park Signevichi-2 with growing exotics is located separately behind the village.

The location of specially protected natural sites and natural sites subject to special protection is shown in Figure 1.

Social and Economic Conditions

Production and Economic Situation

Beloozersk is a city in Berezovo District of Brest Oblast in Belarus. The city is located between three lakes - Beloye, Chernoye and Sporovskoye 27 km south-east of Bereza.

Beloozersk was founded in 1958 nearby Nivki village as an energy workers camp due to construction of Berezovskaya CHPP.

The main production industry of the city is power engineering. There are several energy complex plants active in Beloozersk including such facilities as Beloozersk Electromechanical Plant (the only Belarusian manufacturer of power engineering equipment and spare parts for thermal power plants) and Berezovskaya CHPP. Among active plants of the city are Osmos, cellular concrete production plant, Beloozersk Concrete Products Plant - the manufacturer of flagstone, wall blocks, road and sidewalk kerb, Belkelme Belarusian shoe factory, Beloozersk battery plant.

The city has a well-developed education system. There are two regular schools and one preparatory school, Beloozersk State Professional Electrotechnical College. There are five preschool institutions.

Medical and Demographic Situation

Medical and demographic parameters such as birth rate, death rate, average life expectancy and disease rate are indicators of social and economic development of any country, markers of human health, life quality and style.

Since 1998, the current demographic situation in Brest Oblast and the Republic of Belarus in general has been marked by negative trends - the reduction and ageing of population. At the same time, the demographic situation in Brest Oblast is much better than the average situation in the Republic with the highest birth rate (11.1% in 2018) and the lowest death rate after the rate of Minsk (12.7% in 2018).

According to the national statistics committee of the Republic of Belarus, population in Brest Oblast as of 01 January 2019 amounted to 1380.4 thousand people. If in 2017 the population decreased by 1875 people, then in 2018 this figure increased by 2.2 times and amounted to 4085 people. As before, women prevail in the structure of the population of the region; in 2018, the number of women exceeded the number of men by 5.8% (730.4 thousand people).

Table 2.5 details the main medical and demographic indicators of Brest Oblast and Berezovo District in 2014-2018.

Table 2.5 – Main Medical and Demographic Indicators in 2014-2018

Administrative areas	Birth rate per 1000 people					Death rate per 1000 people					Natural population increase per 1000 people				
	2014	2015	2016	2017	2018	2014	2015	2016	2017	2018	2014	2015	2016	2017	2018
Brest Oblast	13.4	13.5	13.5	11.8	11.1	12.6	12.7	12.6	12.8	12.7	0.8	0.8	0.9	-1.0	-1.6
Berezovo District	12.9	12.7	13.6	12.2	11.2	13.2	13.9	14.9	13.9	14.4	-0.3	-1.2	-1.3	-1.7	-3.2

The morbidity of the population is the most important indicator of public health, the most objective and sensitive indicator of medical and social well-being. A decrease in the morbidity of the population is of great social and economic importance.

According to the official reports of health organizations in 2018, 1558866 cases were recorded in the region (in 2016 - 1549637) of cases of acute and chronic diseases in patients aged 18 years and older. This indicator is 0.6% higher than in 2017, 38.5% of this indicator (in 2017 - 39.1%, in 2016 - 37.7%, in 2015 - 38.3%) correspond to the first proven case in life.

The level of the general morbidity indicator of the adult population of the region in recent years is wave-like. In the region there has been a moderate upward trend in the overall morbidity rate of the adult population. The average annual growth rate over the past 10 years was 1.2%.

In 2018, the total morbidity indicator of the adult population of the region compared with 2017 increased by 0.9% and amounted to 1433.1 cases per 1000 population, which is lower than the republican one (1582.1 cases).

The demographic situation, the state of health of the population, as well as the social and economic situation affect the formation of the indicator of total life expectancy at birth (TLE). According to the National Statistics Committee of the Republic of Belarus, in 2018 the TLE of the population of the region grew by 0.4% compared to 2017 and amounted to 74.7 years, which is 0.3% higher than the national indicator (74.5%).

Resolution of the demographic problems of Brest Oblast provides for health promotion activities, reduction of general death rate, increase of population life expectancy, improvement of population reproductive health, protection of motherhood and childhood, increase of birth rate, enforcement of social and economic support for families at birth and bringing up children, control of external migration processes in view of national interests, etc.

3 SOURCES AND TYPES OF POTENTIAL IMPACT DUE TO PLANNED ACTIVITIES. PREDICTION AND ESTIMATION OF POSSIBLE CHANGES IN ENVIRONMENTAL CONDITIONS AND SOCIAL AND ECONOMIC CONDITIONS

Any economical or other activities planned have direct or indirect impact on the environment. In general terms potential environmental impacts can be defined based on the following attributes:

1) Withdrawal from the environment of:

- land resources (spatial-territorial resources);
- water resources;
- flora and fauna resources;
- mineral resources;
- agricultural resources (fertile lands);
- habitats of valuable flora and fauna species;
- monuments of culture, history or nature.

2) Introduction to the environment of:

- pollutants;
- noise and vibration;
- electromagnetic radiation.

Impact parameters depend on the following factors:

- facility location;
- current economic conditions;
- production capacity of the enterprise;

- composition of the main equipment;
- technological cycle;
- type and composition of fuel;
- waste handling efficiency;
- measures for the protection of atmospheric air, surface and ground water, as well as for land reclamation.

The main objects of such impacts are components of the natural environment, facility staff, population within the impacted area, and social and economic conditions of population life including employment, demographic shifts, social infrastructure, ethnic specifics, etc.

3.1 Prediction and Estimation of Possible Changes in Atmospheric Air

The quality of atmospheric air, as one of the main components of the natural environment, is an important aspect in assessing the environmental impact of a designed facility.

The stages of the construction of the peak/standby power source at the Berezovskaya CHPP and the operation of the CHPP will be accompanied by emissions of pollutants into the atmosphere.

During construction, the main contribution to air pollution will be made by the following main processes and special equipment:

- dismantling;
- construction and road equipment used during construction and installation;
- welding and painting.

Volumes of pollutant emissions during construction with non-concurrent nature of certain works are low and temporary.

Based on the results of environmental impact assessment during construction of similar facilities, it can be expected that scale of impact will be classified as *local* (within the facility site) long-term (1 to 3 years) with minor impact intensity (environmental changes do not exceed the existing limits of natural variability). Based on the above, the impact on atmospheric air during construction of the peak/standby power source at the CHPP is classified as an impact of low significance.

Implementation of construction under design will not result in considerable or stable adverse consequences for atmospheric air condition in this area of city, and will not affect population health.

During CHPP operation, the main impact on atmospheric air will be associated with emissions of atmospheric pollutants due to fuel combustion.

The influence of the Berezovskaya CHPP on the air basin was carried out taking into account the solutions provided for in the architectural design (hereinafter referred to as AD) Electric Boiler and Steam Gas-and-Oil Fired Boiler Unit of Berezovskaya CHPP and a positive environmental review report was received for it (Decision No. 4884/2018 dated 21 December 2018).

The main atmospheric emission sources of the CHPP, according to preliminary design (taking into account AD), are stacks:

1) existing stacks:

- 180 m stack with mouth bore of 7.0 m connected to PK-38 boilers of plants Nos.9-10 (emission source ES No. 0002);
- 90 m stack of CCGT 400 No. 7 with mouth bore of 7.6 m (emission source ES No.0086).

2) stacks to be designed:

- 45 m stack with mouth bore of 1.5 m connected to two designed boilers 35 ton/hour each (designed according to AD) (emission source ES No. 0105),

- case 1: fourteen 80 m stacks (each GPU under design with an individual stack) with mouth bore of 1.6 m (emission sources ES No.0091 – 0104),

- case 2: five 20 m stacks (each gas turbine unit under design with an individual stack) with mouth bore of 3.7 m (emission sources ES No.0091 – 0095).

Since for the designed gas piston (according to case 1) and gas-turbine (according to case 2) plants, diesel fuel is supposed to be used as backup fuel, at the Berezovskaya CHPP the preliminary documentation provides for the construction of a diesel facility consisting of:

- pump station of diesel facilities;
- conveying pumping station with an auto-discharge platform for 3 vehicles;
- diesel facility warehouse consisting of three vertical metal ground tanks with a volume of 2000 m^3 each.

According to the preliminary solutions:

- sources of auxiliary production emissions are designed from diesel facilities (ES No. 0106-0108 - reservoir breathing valves during their filling).

Configuration of the fuel-burning equipment incl. fuel flow rates during heated season by construction cases is provided in Table 3.1, and in Table 3.2 for unheated season.

Table 3.3 shows the quantitative indicators of annual pollutant emissions expected after the construction of the peak/standby power source at the Berezovskaya CHPP. It also shows the emissions of the Berezovskaya CHPP according to the previously developed EIA.

As shown by the Table, the total amount of gross emissions of pollutants in case 2 (with the installation of GTUs) is 1.2 times lower than in case 1.

In general, from the Berezovskaya CHPP, gross pollutant emissions from both cases relative to the previously developed EIA will decrease.

In order to assess how the level of air pollution in the potential area of possible impact of the Berezovskaya CHPP will change after the implementation of preliminary design solutions, the dispersion of pollutants generated by fuel combustion and emissions of similar substances from auxiliary production sources were calculated using the software UPRZA Ecolog 3, taking into account background pollution under the condition of operation of the fuel-burning equipment of the CHPP in the heated and unheated seasons for two cases of construction of peak/standby power source at Berezovskaya CHPP.

As a result of emissions dispersion calculations, the values of ground-level concentrations of pollutants at the calculation site, at the nearest residential area and at the border of garden plots (reference points No. 1–4) and at objects of specially protected natural sites and natural sites subject to special protection (reference points No. 5 - 8).

The values of maximum ground-level concentrations at the calculation site, at the reference points of residential areas for preliminary design decisions are shown in Table 3.4.

According to the results of the calculations of dispersion of pollutant emissions it can be seen that:

1) Maximum ground-level pollutant concentrations in atmospheric air for two construction cases during heated and unheated seasons do not exceed standard parameters of atmospheric air quality;

2) Maximum ground-level concentrations of certain substances in Case 2 are lower than in Case 1;

3) Maximum pollution in residential area and at the border of gardening plots (with background) are much lower than maximum allowed values, by each pollutant, and by combined action of pollutants.

The values of ground-level concentrations at reference points in specially protected natural sites (SPNS) and natural sites subject to special protection are given in Table 3.5.

The obtained calculated values of the concentrations showed that the atmospheric air pollution at the analyzed points does not exceed the ECS standards given in Table E.43 of Annex F to EcoNiP 1717.01.06-001-2017.

The calculation of dispersion from the designed sources of diesel facilities emissions was carried out for the following pollutants: hydrogen sulfide (code 0333) and saturated hydrocarbons of the aliphatic limits C_{11}-C_{19} (code 2754) and showed that the calculation for these pollutants is not reasonable.

Therefore, we can conclude that when implementing design solutions, in accordance with existing criteria, the expected impact on atmospheric air is assessed as acceptable. No adverse impact will be made on atmospheric air of the considered area. No irreversible changes in atmosphere will occur.

Considering the scale of impact (potential impact area), duration of impact (many years) and the significance of changes (minor), a total estimation of Berezovskaya CHPP's impact on atmosphere on the basis of the three parameters amounts to 16 points (based on the impact significance estimation method of TKP 17.02-08-2012), which corresponds to an impact of average significance.

Table 3.1 – Configuration of Fuel-Burning Equipment by Construction Cases (heated season)

Type and quantity of installed equipment	Stack		Maximum load of boilers (GT)		Number of boilers (GT) operating	Type of fuel	Hourly fuel flow rate per 1 boiler (GT), TFOE t/h	Annual fuel flow rate, TFOE		
	H, m	d, m	t/h	MW				Total	gas	HFO (diesel fuel)
					Case 1					
Unit No.5*) - (CCGT mode gas):	180	7						167032	160157.2	6874.8
- 2xGTU			-	2x30	2	gas	10.2			
- 2xPK-38, plants Nos. 9, 10			2x270	-	2	gas	24.835			
(SPPC mode HFO):										
- 2xGTU			-	-	-	-	-			
- 2xPK-38, plants Nos. 9, 10			2x270	-	2	HFO	27.81			
Unit No.7 CCGT including:										
1xGT + WHB (no afterburning)	90	7.6	-	-	-	-	-	200232	200232	-
Boilers (designed according to AD):										
2xE-35-1,3-250 GM	50	1.4	2x35	-	-	-	-	4609	4418.2	190.8
Peak/standby power source:	14 stacks:									
4xGPU	80	1.6	-	17.622	14	diesel fuel	4.78	45500	40600	(4900)
							Total:	**417373**	**405407.4**	**7065.6 (4900)**
					Case 2					
Unit No.5*) - (CCGT mode gas):	180	7						167032	160157.2	6874.8
- 2xGTU			-	2x30	2	gas	10.2			
- 2xPK-38, plants Nos. 9, 10			2x270	-	2	gas	24.835			
(SPPC mode HFO):										
- 2xGTU			-	-	-	-	-			
- 2xPK-38, plants Nos. 9, 10			2x270	-	2	HFO	27.81			
Unit No.7 CCGT including:										
1xGT + WHB (no afterburning)	90	7.6	-	-	-	-	-	200232	200232	-
Boilers (designed according to AD):										
2xE-35-1,3-250 GM	50	1.4	2x35	-	-	-	-	4609	4418.2	190.8
Peak/standby power source:	5 stacks:									
5xGTUs	20	3.7	-	50.5	5	diesel fuel	17.73	58200	51700	(6500)
							Total:	**430073**	**416507.4**	**7065.6 (6500)**

*) Unit plant No.5:
- in the CCGT mode on gas (with uninterrupted gas supply);

- in SPPC mode on HFO (in the absence of natural gas supply)

Table 3.2 – Configuration of Fuel-Burning Equipment by Construction Cases (unheated season)

Type and quantity of installed equipment	Stack		Maximum load of boilers (GT)		Quantity of boilers (GT) operating	Type of fuel	Hourly fuel flow rate per 1 boiler (GT), TFOE t/h	Annual fuel flow rate, TFOE		
	H, m	t/h	MW	MW				Total	gas	HFO (diesel fuel)
					Case 1					
Unit No.5:	180	7						167032	160157.2	6874.8
- 2xGTU			-	-	-	-	-			
- 2xPK-38, plants Nos. 9, 10			-	-	-	-	-			
Unit No.7 CCGT including:										
1xGT + WHB (no afterburning)	90	7.6	-	286	1	gas	94.98	200232	200232	-
Boilers (designed according to AD):										
2xE-35-1,3-250 GM*	50	1.4	1x35	-	1	HFO	2.86	4609	4418.2	190.8
					1	gas	3.2			
Peak/standby power source:	14 stacks:									
4xGPU	80	1.6	-	17.622	14	diesel fuel	4.78	45500	40600	(4900)
							Total:	**417373**	**405407.4**	**7065.6 (4900)**
					Case 2					
Unit No.5:	180	7						167032	160157.2	6874.8
- 2xGTU			-	-	-	-	-			
- 2xPK-38, plants Nos. 9, 10			-	-	-	-	-			
Unit No.7 CCGT including:										
1xGT + WHB (no afterburning)	90	7.6	-	286	1	gas	94.98	200232	200232	-
Boilers (designed according to AD):										
2xE-35-1,3-250 GM*	50	1.4	1x35	-	1	HFO	2.86	4609	4418.2	190.8
					1	gas	3.2			
Peak/standby power source	5 stacks:									
5xGTUs	20	3.7	-	50.5	5	diesel fuel	17.73	58200	51700	(6500)
							Total:	**430073**	**416507.4**	**7065.6 (6500)**

*) Gas boiler (with uninterrupted gas supply); on HFO (in the absence of natural gas supply).

Table 3.3 – Total Annual Emissions from Berezovskaya CHPP

Description substances	Code	EIA emissions (2017)	Emissions per preliminary design, ton/year		
			Total	equipment per AD (no changes)	designed equipment
Case 1					
Total from fuel-burning equipment, including:		**7636.134**	**4841.036**	**3276.298**	**1564.738**
Nitrogen (IV) oxide (nitrogen dioxide)	0301	1029.839	866.123	669.269	196.854
Nitrogen (II) oxide (nitrogen oxide)	0304	167.349	140.746	108.756	31.99
Black carbon (soot)**	0328	1.74	2.149	1.267	0.882
Sulphur dioxide	0330	332.564	208.172	181.656	26.516
Carbon oxide	0337	4649.635	3514.48	2291.86	1222.62
Saturated hydrocarbons of the aliphatic series C_1-C_{10}	0401	1453.760	-	-	-
Total organic carbon		-	102.516	22.534	79.982
Benz(a)pyrene**	0703	0.000928	0.000758	0.000758	-
Oil ash of heat power plants (in terms of vanadium)**	2904	0.901	0.689	0.689	-
Heavy metals:					
Cadmium and its compounds (in terms of cadmium)**	0124	0.000355	0.000427	0.000259	0.000168
Copper and its compounds (in terms of copper)**	0140	0.002561	0.003083	0.001865	0.001218
Nickel oxide (in terms of nickel)**	0164	0.317625	0.382395	0.231363	0.151032
Mercury and its compounds (in terms of mercury)**	0183	0.000965	0.015923	0.015699	0.000224
Lead and its inorganic compounds (in terms of lead)	0184	0.008963	0.069546	0.006529	0.004256
Chromium trivalent compounds (in terms of chromium)**	0228	0.003414	0.004111	0.002487	0.001624
Zinc and its compounds (in terms of zinc)**	0229	0.011527	0.013872	0.008398	0.005474
Arsenic, inorganic compounds (in terms of arsenic)**	0325	0.000142	0.000174	0.000104	0.00007
Solid particles (dust/aerosol undifferentiated in composition)*	2902	-	8.999	2.223	6.776
POPs:					
Benzo(b)fluoranthene	0727	0.000069	0.000	0.000	0.000
Benzo(k)fluoranthene	0728	0.000040	0.000	0.000	0.000
Indeno(1,2,3, c, d)pyrene	0729	0.000069	0.000	0.000	0.000
Hexachlorobenzene (HCB)	0830	$7.15*10^{-8}$	0.000	0.000	0.000
Dioxins/Furans	3620	$2.3*10^{-8}$	0.000000	0.000000	0.000000
Polychlorinated biphenyl (by the amount of PCBs)	3920	$7.0*10^{-7}$	0.000000	0.000000	0.000000
Total from auxiliary production, including:		**10.789247**	**10.819281**	**10.789247**	**0.030034**
- designed:		-	0.030034	-	0.030034
Hydrogen sulphide		-	0.000084	-	0.000084
Saturated hydrocarbons C_{11}–C_{19}		-	0.02995	-	0.02995

Description substances	Code	EIA emissions (2017)	Emissions per preliminary design, ton/year		
			Total	equipment per AD (no changes)	designed equipment
Total for Berezovskaya CHPP		***7646.923***	***4851.855***	***3287.087***	***1564.768***
Case 2					
Total from fuel-burning equipment, including:		**7155.565**	**3920.938**	**3276.298**	**644.64**
Nitrogen (IV) oxide (nitrogen dioxide)	0301	1000.248	741.444	669.269	72.175
Nitrogen (II) oxide (nitrogen oxide)	0304	162.541	120.486	108.756	11.73
Black carbon (soot)**	0328	1.74	2.432	1.267	1.165
Sulphur dioxide	0330	332.564	216.836	181.656	35.18
Carbon oxide	0337	4332.314	2779.22	2291.86	487.36
Saturated hydrocarbons of the aliphatic series C_1-C_{10}	0401	1324.910	-	-	-
Total organic carbon		-	55.334	22.534	32.8
Benz(a)pyrene**	0703	0.000928	0.000758	0.000758	-
Oil ash of heat power plants (in terms of vanadium)**	2904	0.901	0.689	0.689	-
Heavy metals:					
Cadmium and its compounds (in terms of cadmium)**	0124	0.000355	0.0000484	0.000259	0.000225
Copper and its compounds (in terms of copper)**	0140	0.002561	0.003480	0.001865	0.001615
Nickel oxide (in terms of nickel)**	0164	0.317625	0.431718	0.231363	0.200355
Mercury and its compounds (in terms of mercury)**	0183	0.000979	0.015984	0.015699	0.000285
Lead and its inorganic compounds (in terms of lead)	0184	0.008963	0.012184	0.006529	0.005655
Chromium trivalent compounds (in terms of chromium)**	0228	0.003414	0.004642	0.002487	0.002155
Zinc and its compounds (in terms of zinc)**	0229	0.011527	0.015668	0.008398	0.00727
Arsenic, inorganic compounds (in terms of arsenic)**	0325	0.000142	0.000194	0.000104	0.00009
Solid particles (dust/aerosol undifferentiated in composition)*	2902	-	7.618	2.223	5.395
POPs:					
Benzo(b)fluoranthene	0727	0.000069	0.000	0.000	0.000
Benzo(k)fluoranthene	0728	0.000040	0.000	0.000	0.000
Indeno(1,2,3, c, d)pyrene	0729	0.000069	0.000	0.000	0.000
Hexachlorobenzene (HCB)	0830	$7.15*10^{-8}$	0.000	0.000	0.000
Dioxins/Furans	3620	$2.3*10^{-8}$	0.000000	0.000000	0.000000
Polychlorinated biphenyls (by the amount of PCBs)	3920	$7.0*10^{-7}$	0.000000	0.000000	0.000000
Total from auxiliary production, including:		**10.789247**	**10.821517**	**10.789247**	**0.03227**
- designed:		-	0.03227	-	0.03227
Hydrogen sulphide	0333	-	0.00009	-	0.00009
Saturated hydrocarbons C_{12}–C_{19}	2754	-	0.03218	-	0.03218
Total for Berezovskaya CHPP		***7166.354***	***3931.759***	***3287.087***	***644.672***

Description substances	Cod e	EIA emissions (2017)	Emissions per preliminary design, ton/year		
			Total	equipment per AD (no changes)	designed equipment

***)** According to EcoNiP 17.01.06-001-2017, solid particles include the total amount of pollutants having a solid aggregate state, formed during technological processes and emitted into the atmosphere;
** Pollutants having a solid aggregate state.

Table 3.4 – Maximum Ground-Level Concentrations Caused by Berezovskaya CHPP

	Reference point No. (B1, B2)	In residential area				On the designed site			
		Case 1		Case 2		Case 1		Case 2	
		incl. back-ground	excl. back-ground	incl. back-ground	excl. back-ground	incl. back-ground	excl. back-ground	incl. back-ground	excl. back-ground
Heated season									
Nickel oxide (in terms of nickel)	***1, 3***	0.06	0.06	0.06	0.06	0.06	0.06	0.07	0.07
Lead and its compounds (in terms of lead)	***1, 3***	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Nitrogen dioxide	***1, 3***	0.59	0.45	0.31	0.22	0.61	0.45	0.34	0.21
Sulphur dioxide	***2, 3***	0.25	0.23	0.28	0.26	0.63	0.61	0.63	0.61
Carbon oxide	***1, 3***	0.22	0.07	0.18	0.03	0.25	0.13	0.25	0.13
Benz(a)pyrene	***4, 4***	0.04	<0.01	0.04	<0.01	0.04	<0.01	0.04	<0.01
HFO ash of power plants	***3, 3***	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Solid particles	***1, 3***	0.35	0.08	0.32	0.05	0.35	0.08	0.32	0.05
Black carbon (soot)	***1, 3***	0.03	0.03	0.04	0.04	0.04	0.04	0.04	0.04
Summations: (184 + 330)	***2, 3***	0.27	0.25	0.30	0.28	0.63	0.61	0.63	0.61
(184 + 325)	***1, 3***	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
(301 + 330)	***1, 3***	0.82	0.65	0.55	0.49	0.92	0.70	0.71	0.65
Incomplete summation: SO_2+NO_2+HFO ash (in terms of vanadium)	***1, 3***	0.49	0.40	0.34	0.30	0.55	0.42	0.43	0.39
Unheated season									
Nickel oxide (in terms of nickel)	***2, 3***	0.06	0.06	0.07	0.07	0.06	0.06	0.07	0.07
Lead and its compounds (in terms of lead)	***2, 3***	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Nitrogen dioxide	***1, 3***	0.59	0.45	0.32	0.24	0.61	0.46	0.34	0.21
Sulphur dioxide	***2, 2***	0.31	0.29	0.31	0.29	0.33	0.31	0.31	0.29
Carbon oxide	***1, 3***	0.22	0.07	0.18	0.03	0.23	0.07	0.20	0.05

		In residential area				On the designed site			
	Reference point No. (B1, B2)	Case 1		Case 2		Case 1		Case 2	
		incl. background	excl. background	incl. background	excl. background	incl. background	excl. background	incl. background	excl. background
Black carbon (soot)	***2, 2***	0.03	0.03	0.04	0.04	0.04	0.04	0.04	0.04
HFO ash of power plants	***1, 1***	0.03	0.03	0.03	0.03	0.03	0.04	0.03	0.03
Solid particles	***1, 3***	0.35	0.08	0.33	0.06	0.36	0.09	0.33	0.06
Summations: (184 + 330)	***2, 2***	0.32	0.30	0.33	0.31	0.35	0.33	0.33	0.31
(184 + 325)	***2, 3***	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
(301 + 330)	***1, 3***	0.82	0.66	0.58	0.52	0.93	0.71	0.59	0.53
Incomplete summation: SO_2+NO_2+HFO ash (in terms of vanadium)	***1, 2***	0.49	0.41	0.36	0.32	0.56	0.47	0.37	0.33

Table 3.5 – Maximum Ground-Level Concentrations in Atmospheric Air of Specially Protected Natural Sites (SPNS) and Natural Sites Subject to Special Protection

Name of SPNS and natural territories subject to special protection	Reference point No.	Ground-level concentration including background, μg/m³			
		hourly average		average over 8 hours	Daily average (24 hours)
		nitrogen dioxide	sulphur dioxide	carbon oxide	solid particles
Case 1					
Heated season					
Sporovsky Republican Biological Reserve	5	48	50	467	36
Biological monuments of nature of local importance:					
- ancient park of the city of Bereza;	6	45	49	462	35
- ancient park Starye Peski	7	60	51	484	38
- ancient park Signevichi-2	8	44	50	460	35
Unheated season					
Sporovsky Republican Biological Reserve	5	47	39	467	36
Biological monuments of nature of local importance:					
- ancient park of the city of Bereza;	6	44	43	461	35
- ancient park Starye Peski	7	59	40	483	38
- ancient park Signevichi-2	8	43	44	460	35
Case 2					
Heated season					
Sporovsky Republican Biological Reserve	5	51	69	474	37
Biological monuments of nature of local importance:					
- ancient park of the city of Bereza;	6	46	60	464	36
- ancient park Starye Peski	7	58	79	483	39
- ancient park Signevichi-2	8	44	57	462	35
Unheated season					
Sporovsky Republican Biological Reserve	5	49	57	472	37
Biological monuments of nature of local importance:					
- ancient park of the city of Bereza;	6	45	52	463	36
- ancient park Starye Peski	7	57	71	482	39
- ancient park Signevichi-2	8	44	52	461	35

3.2 Prediction and Estimation of Physical Impact

Noise Impact

The main noise source during construction will be operation of construction equipment. Considerable reduction of noise impact during construction does not seem possible. It should be noted, however, that such impact will be discrete and short-term, equipment will be operated on business days only within business hours at the facility premises. Based on the above, construction will not cause considerable increase of noise load to the nearest residential area.

1) Existing noise sources

Existing power units of plants Nos. 3 and 4, according to the design solutions, will be in the cold reserve, and, therefore, all equipment of these plants, including those that are noise sources, will be transferred to the cold reserve:

a) air intakes of GTUs of plants Nos. 3, 4 - 4 pcs. The maximum possible noise level at a distance of 1 m from the air intake of the GTU is 80 dB(A);

b) draft equipment:

- 8xD-21.5x2 smoke exhausts of plants Nos. 3, 4 with a maximum sound power level of 96 dBA from a single smoke exhaust;
- 8xVDN-24-II fans of plants Nos. 3, 4 with a maximum sound power level of 115 dBA from a single fan;

c) transformers:

- 1xTDTsG-200000/220 transformer of the plant No. 3 with a maximum sound power level of 110 dBA;
- 2xTRDN-80000/220 transformers of plants Nos. 3, 4 with a maximum sound power level of 102 dBA from a single transformer;
- 2xTRDN-25000/35 auxiliary transformers of plants Nos. 3, 4 with a maximum sound power level of 89 dBA from a single transformer;
- 1xTDC-180000/220 transformer of plant No. 4 with a maximum sound power level of 107 dBA.

The total sound pressure level from all noise sources transferred to the cold reserve will be

$$L_p = 10 \lg \sum_{i=1}^{n} 10^{0.1*L_i} = 10 \lg (4x10^{0.1*80} + 8x10^{0.1*96} + 8x10^{0.1*115} + 1x10^{0.1*110} +$$

$$+ 2x10^{0.1*102} + 1x10^{0.1*107} + 2x10^{0.1*89}) = 125 \text{ dBA}$$

In addition, at present, the unit of plant No. 1 and all auxiliary equipment of the unit, including those that are noise sources have been dismantled at the Berezovskaya CHPP:

a) draft equipment:

- 4xD-21.5x2 smoke exhausts of plant No. 1 with a maximum sound power level of 96 dBA from a single smoke exhaust;
- 4xVDN-24-II fans of plant No. 1 with a maximum sound power level of 115 dBA from a single fan;

b) transformers (dismantled):

- 2xTDC-200000/110 transformers of the plant No. 1 with a maximum sound power level of 110 dBA from a single transformer;
- 1xATDCTN-125000/330 auto-type transformer of plant No.1 with a maximum sound power level of 108 dBA;

- 1xTRDN-25000/35 auxiliary transformer of plant No. 1 with a maximum sound power level of 89 dBA from a single transformer.

The total sound pressure level from all dismantled noise sources of the plant No.1 equals to

$$L_p = 10 \lg \sum_{i=1}^{n} 10^{0.1*Li} = 10 \lg (4x10^{0.1*96} + 4x10^{0.1*115} + 2x10^{0.1*110} + 1x10^{0.1*108} +$$

$$+ 1x10^{0.1*89}) = 122 \text{ dBA}$$

Thus, the total sound pressure level from the dismantled noise sources and noise sources transferred to the cold reserve of plants Nos. 1, 3, 4 will be

$$L_p = 10 \lg \sum_{i=1}^{n} 10^{0.1*Li} = 10 \lg (10^{0.1*125} + 10^{0.1*122}) = 127 \text{ dBA}$$

***2) Noise sources (designed according to the architectural design)*:**

a) draft equipment

- 2xDN-17 smoke exhausts with a maximum sound power level of 98 dBA (according to the manufacturer data) from a single smoke exhaust (noise sources NS Nos. 1, 2);
- 2xVDN-15 fans with a maximum sound power level of 96 dBA (according to the manufacturer data) from a single fan (noise sources NS Nos. 3, 4);
- 2xDN-10 recirculation smoke exhausts with a maximum sound power level of 100dBA (according to the manufacturer data) from a single fan (noise sources NS Nos. 5, 6);

b) TDN-32000/110 transformer with a maximum sound power level of 90 dBA, determined according to GOST 12.2.024-87 Noise. Power Oil-Immersed Transformers (noise source NS No. 7).

The total sound pressure level from all noise sources in the AD is

$$L_p = 10 \lg \sum_{i=1}^{n} 10^{0.1*Li} = 10 \lg (2x10^{0.1*98} + 2x10^{0.1*96} + 2x10^{0.1*100} + 1x10^{0.1*90}) = 106 \text{ dBA}$$

3) Designed noise sources

Case 1

According hereto, gas piston units in Case 1 (noise sources) are to be installed in an enclosed room. Noise from GPUs to be installed indoors will ingress the adjacent territory through enclosing structures of the building. Noise penetrating from the building to the territory through enclosing structures (as shown by calculations of reference facilities) will not exceed sanitary and hygienic standards.

External noise sources under *Case 1* are:

a) transformers to be installed at the peak/standby power source:

- five 63 MVA, 110/15 kV transformers;
- five 2 MVA, 15/0.4 kV transformers;
- one 2.5 MVA, 6.3/0.4 kV transformer.

Arrangement of noise sources under Case 1 is shown in Annex K.

Sound power level of transformers in accordance with GOST 12.2.024-87 Noise. Power Oil-Immersed Transformers, are provided in Table 3.6.

Table 3.6 – Sound Power Levels

No.	Transformer standard power MVA	Sound power level Of a single transformer, dBA
1	5x63, 110/15 kV	99
2	1x2.5, 6.3/0.4 kV	76
3	5x2, 15/0.4 kV	75

Total sound pressure level is as follows:
a) from five 63 MVA, 110/15 kV transformers:

$$L_c = L_i + 10lqn = 99 + 10lq5 = 106 \text{ dBA}$$

b) from five 2 MVA, 15/0.4 kV transformers;

$$L_c = L_i + 10lqn = 75 + 10lq5 = 82 \text{ dBA}$$

Total sound level from all noise sources to be installed under Case 1 is equal to

$$L_p = 10 \lg \sum_{i=1}^{n} 10^{0.1*Li} = 10 \lg (1x10^{0.1*106} + 1x10^{0.1*82} + 1x10^{0.1*76}) = 106 \text{ dBA}$$

Total sound pressure level from all installed noise sources (according to Case 1 and noise sources designed by AD) is equal to

$$L_p = 10 \lg \sum_{i=1}^{n} 10^{0.1*Li} = 10 \lg (1x10^{0.1*106} + 1x10^{0.1*106}) = 109 \text{ dBA}$$

As can be seen from the calculation, according to Case 1, the total sound pressure level from the designed noise sources (109 dBA) at the Berezovskaya CHPP is less than from noise sources dismantled and transferred to the cold reserve (127 dBA).

In addition, the present project does not provide for the simultaneous operation of existing noise sources from plants Nos. 5 and 7.

Case 2

External noise sources under *Case 2* are:

a) 5x Container-type GTUs;

b) transformers to be installed at the peak/standby power source:
- five 63 MVA, 110/15 kV transformers;
- two 16 MVA, 10/10 kV transformers;

Arrangement of noise sources under Case 2 is shown in Annex L.

Sound pressure level in 1 m from container of a single GTU is 85 dBA according to the manufacturer data.

Sound power level of transformers in accordance with GOST 12.2.024-87 Noise. Power Oil-Immersed Transformers, are provided in Table 3.7.

Table 3.7 – Sound Power Levels

No.	Transformer standard power MVA	Sound power level Of a single transformer, dBA
1	5x63, 110/15 kV	99

2	2x16, 10/10 kV	88

Total sound pressure level is as follows:
a) from 5 GTUs to be installed:

$L_c = L_i + 10lgn = 85 + 10\ lg5 = 92$ dBA

b) from five 63 MVA, 110/15 kV transformers:

$L_c = L_i + 10lqn = 99 + 10lq5 = 106$ dBA

c) from two 16 MVA, 10/10 kV transformers:

$L_c = L_i + 10lqn = 88 + 10lq2 = 91$ dBA

Total sound level from all noise sources to be installed under Case 2 is equal to

$$L_p = 10\ lg \sum_{i=1}^{n} 10^{0.1*Li} = 10\ lg\ (1x10^{0.1*106} + 1x10^{0.1*92} + 1x10^{0.1*91}) = 106.3 \text{ dBA}$$

Let us find total sound pressure level from all installed noise sources (according to Case 1 and noise sources designed by AD)

$$L_p = 10\ lg \sum_{i=1}^{n} 10^{0.1*Li} = 10\ lg\ (1x10^{0.1*106} + 1x10^{0.1*106.3}) = 109 \text{ dBA}$$

According to Case 2, the total sound pressure level from the designed noise sources (109 dBA) at the Berezovskaya CHPP is less than from noise sources dismantled and transferred to the cold reserve (127 dBA).

In addition, the present project does not provide for the simultaneous operation of existing noise sources from plants Nos. 5 and 7.

Consequently, during the implementation of this project, the noise impact of the Berezovskaya CHPP on the adjacent territory will slightly decrease according to both Cases, thereby improving the environmental situation in the area where the CHPP is located.

Electromagnetic Emission and Vibration

Among various environmental physical factors, which can have adverse impact on human and biological objects, the biggest challenge is presented by electromagnetic fields.

According to literature, long-term effect of electromagnetic fields can cause disorders, subjectively expressed in complaints about headache, fatigue, sleep disorders, decline of memory, increased irritability, apathy, pains in the region of heart. Chronic effect of power frequency electromagnetic interference (EMI) is associated with heart rhythm disorders and slow heart rate, nervous disorders, immune suppression, etc.

Standardization requirements were developed to prevent adverse impact of EMI. Power frequency EMI for habitable territories is standardized by maximum permissible levels (MPL) of electrical and magnetic fields intensity of 50 Hz.

According to hygienic standards Maximum Permissible Levels of Electric and Magnetic Fields of Current of Industrial Frequency 50 Hz When They Affect the Population, approved by Decree of the Ministry of Health of the Republic of Belarus No. 67 dated 12 June 2012, maximum permissible levels of tension (magnetic induction) of 50 Hz electric and magnetic fields in the residential area are:

– electric field intensity - 1 kV/m;
– magnetic field intensity - 8 A/m (flux density – 10 mcTl).

For equipment under preliminary design, sources of electromagnetic interference (EMI) in Berezovskaya CHPP are open switchgear (OSG) and transformers.

These solutions provide for protective activities to reduce adverse EMI impact both within and beyond the CHPP.

Switchgears consist of state-of-art equipment - all live parts are screened. This is why presence of maintenance personnel near exposed live parts and EMI impact on them is practically avoided.

In addition, electromagnetic interference sources under design are in considerable distance from the residential development (the nearest residential development is Manevichi village, approximately in 1300 m) and will not have a considerable impact on electromagnetic background of these areas, since in such distance from the sources the intensity of electric and magnetic fields will be much lower than the established limits. According to literature, electric field intensity in 250-1000 m from EMI sources is 1-3 V/m only and flux density is 40-80 nT, which is much lower that the established limit of electrical and magnetic field components. Therefore, they do not have a considerable impact on electromagnetic background of these premises.

Consequently, the impact of electromagnetic fields caused by the operation of transformers and switchgear under design at Berezovskaya CHPP during the implementation of design is characterized as an impact of low significance.

Vibration is mechanical oscillation and waves in solid bodies. Vibration action depends on frequency and oscillating amplitude, duration of exposure, area of application and direction of vibration axis, damping properties of human tissues, resonance effects and other conditions. Vibration is one of the factors with high bioactivity, and can have adverse effect on working efficiency, emotions and mental activity. Like noise, vibration causes disorders in perception and evaluation of time, reduces information processing rate. Low frequencies cause disturbance of muscular coordination. Continuous action of vibration can lead to persistent pathologies.

Source of Berezovskaya CHPP vibration impact on environment and the nearest inhabited territory is the rotating equipment (steam turbines, electric generators, feed pumps, axial fans, booster compressors, etc.).

Reduction of vibration along propagation ways is achieved by the use of vibration absorption, avoiding resonant behavior, damping of vibration, vibration insulation, etc. All vibrating equipment with rotating parts at all stages of operation and maintenance undergoes thorough balancing as determined primarily by requirements for operation safety. Certain equipment is installed on anti-vibration mounts to reduce vibration and noise levels and enable complete vibration insulation.

Equipment with reliable vibration properties preventing propagation of excessive vibration beyond the site, and vibration prevention activities allow to contain vibration impact of the sources within the facility under review within the CHPP territory.

Based on the above, the impact of vibration will have a local nature and is characterized as an impact of low significance.

3.3 Prediction and Estimation of Changes in the Condition of Surface and Ground Water

CHPP impact on surface and ground water depends on water consumption and wastewater discharge conditions.

Water consumption and discharge at Berezovskaya CHPP is conducted on the grounds of integrated environmental permit No.11 dated 30 June 2016, issued by Brest Oblast Natural Resources and Environment Protection Committee valid through 30 June 2021 (Annex L).

Water utilization is permitted under the following conditions:

- maximum water intake not more than: 23136.2 m^3/day; 8444.7 thousand m^3/year; including consumption from urban water pipeline: 5.5 m^3/day; 2.0 thousand m^3/year;
- ground water: 6949.3 m^3/day; 2536.5 thousand m^3/year;
- process water from Chernoye Lake: 16181.4 m^3/day; 5906.2 thousand m^3/year;

Artesian ground water intake is used for domestic and potable water needs of CHPP, Beloozersk, water treatment for steam boilers and heating systems, supply to other consumers.

Surface water is used to make up for evaporation in Beloye Lake and to purge recirculation system in the Dorogobuzh river.

Domestic wastes of Beloozersk, CHPP together with wastes from other facilities are discharged to biotreatment facilities of Beloozersk.

In discharge channel No.1 of the cooling system to discharge rainwater from roofs of buildings and facilities, and, partially, gullies of CHPP site.

Treatment facilities for oil-contaminated wastewater with capacity of 200 m^3/hour receive oil-contaminated industrial wastewater and rainwater, the treated wastewater is discharged in the make-up channel of Beloye Lake.

Mineralized wastes from water treatment are discharged to the filtered section of the mud disposal site.

Neutralized acid wash wastes are discharged to the non-filtered section of the mud disposal site (for HFO operation).

This preliminary design for construction of the peak/standby power source at Berezovskaya CHPP for two construction cases (GPU or GTU) provides for:

– retention of all water supply and discharge systems operating in the CHPP site;
– retention of sources and receivers of wastewater;
– retention of water consumption and discharge balance in the entire CHPP according to processes and adopted water supply and discharge design;
– retention of all activities for protection and efficient use of water resources implemented in the plant.

In accordance with the design assignment, changes were made to a previously developed project.

Case 1 includes:

1 construction stage: 6 GPU 18V50DF gas piston units manufactured by Wartsila with a unit capacity of 17.622 MW with local automatic control systems (LACS) in a block-container version;

2 construction stage: 8 GPU 18V5018V50DF gas piston units manufactured by Wartsila with a unit capacity of 17.622 MW with local automatic control systems (LACS) in a block-container version.

Case 2 includes:

1 construction stage: 2 GTU SGT-800 gas turbine units with a unit capacity of 50.5 MW in a block-container version.

2 construction stage: 3 GTU SGT-800 gas turbine units with a unit capacity of 50.5 MW in a block-container version.

According to both Cases, the design provides for the construction of a diesel fuel facilities, which is a backup for GPU and GTU. The diesel fuel reserve is designed for a 3-day operation of the peak/standby power source with a nominal load.

The present preliminary documentation provides the preservation of the existing water supply and sewage systems with the construction of the peak/standby power source.

Additionally, construction of the peak/standby power source (PSPS) provides for construction of the following for water supply and discharge systems:

– domestic/potable and industrial water pipeline system on the territory of PSPS and diesel fuel facilities with power source supplied from drinking/potable and industrial/fire water pipeline of CHPP;

– fire/water pipeline of PSPS and diesel fuel facilities with power source supplied from CCGT industrial/fire water situated on the territory of the CHPP;

– domestic sewerage of PSPS and diesel fuel facilities with discharge of domestic wastes to the CHPP system with the same name;

– creation of rainwater and conventionally-clean industrial wastewater sewerage system of PSPS with wastewater discharge into discharge channel No.1;

– creation of a sewage system for oil-containing wastewater of PSPS and diesel fuel facilities with treatment facilities and the discharge of treated wastewater to the discharge channel No.1;

– creation of a system of emergency drain of transformer oil;

– creation of plants for foam extinguishing and cooling of tanks.

Number of staff to maintain the peak/standby power source is 29. No growth of production personnel number is provided for Berezovskaya CHPP during the construction of the peak/standby power source. Need in manpower to maintain the peak/standby power source will be met by involvement of the staff of Berezovskaya CHPP (workers and engineers) available after units will be put out of service. It should be noted that the peak/standby power source will operate for maximum of 700 hours a year.

Construction of the peak/standby power source at Berezovskaya CHPP does not provide for increase in water consumption for potable and industrial needs of Berezovskaya CHPP, or increase in costs of discharge of domestic and industrial wastes, since:

- there is no increase in staffing;
- part of Berezovskaya CHPP main equipment will be put out of service.

After Belarusian NPP is commissioned, CHPP will retain units No.5 and No.7 (No.5 will operate during heated period, No. 7 will operate during unheated period). Maximum allowed values for Berezovskaya CHPP are calculated for the operation of five units.

Rainwater volume will not increase since the CHPP area will remain the same, though provision is made for rainwater to be cleared off the roads.

Berezovskaya CHPP general water consumption and discharge will be retained at the current level.

No additional outlets from the CHPP site will be provided. Construction of the PSPS does not cause change in quality of wastewater discharged from Berezovskaya CHPP site in the current situation.

3.4 Prediction and Estimation of Possible Changes in Land Resources and Soil Cover Condition

The main impact on the geological environment and soil cover will be observed during construction (reconstruction). Impact on land resources and soil cover due to construction can be associated with alienation of land resources for construction, consolidation of soil, potential pollution of soils and ground with domestic wastewater and municipal solid waste, relocation of topsoil to temporary dumps, carryover of pollutants by construction equipment, vehicles and certain processes.

According to preliminary design solutions the land plot (site) for construction of the peak/standby power source is located within Berezovskaya CHPP, i.e. no additionally allocated lands are needed. All works will be done within the existing land allocation.

The most frequent type of soil cover disturbance during construction will be trampling, consolidation (crumpling). Such impact cannot be avoided during any construction in field.

Earth works for foundations, routing utility tranches, making approaches and roads are associated with earth excavation. If there is vegetable soil at the construction site, topsoil will be removed, retained and reapplied without mixing with the underlying soil horizons. Due to the degradation of humus matter by water and wind erosion when earth mass is stored in pits, earth works will be conducted so that topsoil is removed from ground for the minimum possible time.

Using results of impact evaluation during construction of other facilities, it can be predicted that there will be no apparent impact on geology and soil cover during construction. Scale of impact is described as *local (*within construction territory).

The main type of potential adverse impact during operation of the facility will be soil pollution associated with pollutant emissions in atmospheric air followed by deposition. Pollutants are removed from atmosphere by dry or wet deposition, and can have impact on soil - especially on chemistry and biology.

It should be noted that any soil has self-purification ability, which is a buffer action reducing man-made pollution of other environment components (surface and ground water, vegetation and living organisms). Soil self-purification and substance conversion laws depend on soil-formation factors (heat and moisture ratio, physical and chemical properties of parent rock, position in terrain, nature of vegetation, etc.), and number and toxicity of pollutants entering the soil.

Considering than pollution of atmospheric air caused by emissions from Berezovskaya CHPP after design solutions for two construction cases are implemented is considerably lower than MAC in atmospheric air almost by all ingredients and summation groups, it can be expected that there will be no considerable adverse consequences for soils.

In addition, the total emissions of pollutants (t/year) from the Berezovskaya CHPP according to preliminary design solutions are reduced relative to the existing state and the previously developed EIA.

3.5 Prediction and Estimation of Possible Changes in Objects of Flora and Fauna

Initial CHPP construction has already had impact on flora and fauna. A characteristic biogeocoenosis has formed here.

The existing territory of Berezovskaya CHPP is a typical production site with buildings and facilities as required for production activities, vacant areas are covered with solid asphalt concrete, and are partially allocated for mandatory landscaping (individual trees, shrubs, lawns and flower gardens).

There are no specially protected plants in the production site or in the practicable distance.

No additionally allocated areas are required for construction of the peak/standby power source at Berezovskaya CHPP – all construction works are conducted within the previously allocated land plot.

There is no direct impact on vegetation due to destruction of vegetation within construction areas.

Impact on vegetation during operation of CHPP is associated with man-made load to the natural phytocenosis (ingress of pollutants from fuel burning in atmospheric air and deposition).

Assessment of the level of atmospheric air pollution in the potential area of possible impact of the Berezovskaya CHPP (which, according to calculations, covers an area at a distance of about 26.5 km) showed that the maximum ground-level concentrations of pollutants due to emissions of the considered facility are below the MAC in atmospheric air, below the values considered in the literature as acceptable (even for very susceptible plants) and below the standards of environmentally friendly concentrations of pollutants in the atmospheric air of specially protected natural sites.

Therefore, the impact of CHPP on the flora and fauna can be described as minor: environmental changes do not exceed the existing limits of natural variability.

Due to the fact that there is no direct seizure of land for reconstruction of the facility (all reconstruction works are carried out at the existing industrial site of the CHPP), there is no impact on animals associated with the alienation of land.

The period of possible impact on the fauna is confined to the stage of construction work; during the operation of the facility, the influence is practically not traced.

Potential adverse consequences from the designed facility for fauna of the area may include spatial relocations of some susceptible species. Among terrestrial vertebrates, birds are the fastest to respond to changes in living conditions, due to their high mobility. Therefore, they move within the city to other areas.

Territory of Berezovskaya CHPP is not a key reproduction area, it is not crossed by the main migration paths of any animal species, there are no nesting spots of rare and endangered birds, or habitats of specially protected animal species within the production site or in reasonable distance from it.

Based on the above, it is expected that impact of Berezovskaya CHPP on fauna will be rather localized over time and space, and will not cause radical deterioration of animals living conditions. No irreversible changes in natural environment with potential irreparable damage to fauna is expected from implementation of engineering solutions within the design.

3.6 Prediction and Estimation of Possible Changes of Impact on the Environment during Waste Management

Potential environmental impact of wastes depends on qualitative and quantitative properties of wastes (physical and chemical properties, hazard class, quantity).

Apparent problem in construction and operation of the facility is removal and storage of production and consumption wastes followed by disposal and landfilling.

The waste management system should be constructed considering the requirements of environmental legislation (Law of the Republic of Belarus On Waste Management), and the following basic principles:

- priority of waste utilization in respect of neutralization or landfilling with fulfillment of environmental law requirements and in view of economic efficiency;
- priority of waste neutralization in respect of landfilling.

Construction and installation (according to comparable facilities) can generate the construction wastes, such as:

- scrap concrete (code 3142707, non-hazardous);
- scrap reinforced concrete (code 3142708, non-hazardous);
- steel structures and damaged iron and steel parts (code 3511500, non-hazardous).

Since the majority of construction-generated wastes are inert to environment components, their adverse impact will manifest itself mainly in littering of the area. Therefore, attention should be paid to timely removal and disposal during this period. Considering that the construction is staged, total amount of simultaneously stored wastes will not be high.

Temporary wastes accumulated on the site under the established storage conditions do not emit atmospheric pollutants and do not have adverse impact on atmospheric air.

All generated construction wastes according to the priority of waste utilization in respect to landfilling (Law of the Republic of Belarus No.271-3 dated 20 July 2007 On Waste Management (amended by No.6-3 on 12 December 2012) will be sent to appropriate waste utilization facilities according to register of the Ministry r of Natural Resources valid as of implementation of design solution.

No new production waste types are generated during facility operation according to design solutions.

Recommended waste management and correct waste storage prevent pollution of environment with degradation products - pollutants do not ingress soil, ground and surface water. Fulfillment of waste collection, storage and transportation rules ensures facility operation safe for human life.

3.7 Prediction and Estimation of Changes in Social-and-Economic Conditions

Evidently, any economic activity may result in changes of social conditions, either increasing material goods and benefits of local population in the fields of economy, education, health care, or decreasing social and environmental situation due to adverse consequences.

It can be considered that the main impact on social sphere is the change of life quality, which is evaluated by a variety of parameters, the main of which are: population health; demographic situation, level of education, employment, scientific and cultural level, economy development stage, personal income, etc.

Since construction of the peak/standby power source at Berezovskaya CHPP does not require withdrawal of additional lands, implementation of preliminary design solutions will not have impact on the existing conditions of land use, living and recreation of population.

Taking into account that during implementation of preliminary design solutions, the calculated maximum ground-level concentrations of pollutants are below the relevant hygienic standards, the degree of air pollution will correspond to the acceptable (acceptable risk level). Therefore, it can be expected that adverse impact of pollutants from emission sources of Berezovskaya CHPP will not have effect on health (background disease level).

Potential positive impact on society and economy will be demonstrated in:

– ensuring reliable operation of backup capacities;

- ensuring stability by frequency control when there is a deviation between power consumption and power generation;

- ensuring emergency backup to maintain system stability in case of failures, such as shutdowns or accidents at energy sources or grids;

– commissioning of new, state-of-the-art equipment.

Positive impact of the planned activity on economy of the city and district in general during CHPP construction will be associated with award of contracts for construction and supply of construction materials. Manpower for construction will be based on staff of construction companies of Beloozersk and the district.

Therefore, implementation of the project is advisable as socially and economically beneficial both in local and regional scale.

3.8 Integrated Possible Environmental Impact Assessment

The results of the environmental impact assessment of the Berezovskaya CHPP, at the stage of construction of the peak/standby power source and operation, with an assessment of the significance of the impact are presented in Table 3.8.

Table 3.8 - Integrated Evaluation of Impact on Components of the

Environment

Sources and types of impact	Significance of changes (evaluation point)	Spatial scale of impact (point)	Time scale of impact (point)	Impact significance (total points)
Atmospheric air				
Construction				
Pollutant emissions from construction equipment and vehicles	Minor (1)	Local (1)	Continuous (3)	Minor significance (3)
Operation stage				
Emissions from process equipment	Minor (1)	Regional (4)	Multi-annual (4)	Average significance (16)
Surface water				
Construction				
Water consumption and wastewater discharge	Minor (1)	Local (3)	Continuous (3)	Average significance (9)
Depletion and pollution of surface water	Minor (1)	Local (3)	Continuous (3)	Average significance (9)
Operation stage				
Depletion of surface water	Minor (1)	Local (3)	Multi-annual (4)	Average significance (12)
Surface water pollution	Minor (1)	Local (3)	Multi-annual (4)	Average significance (12)
Ground water				
Construction				
Pollution of ground water (CHPP site)	Minor (1)	Local (1)	Continuous (3)	Minor significance (3)
Operation stage				
Pollution of ground water with wastewater, potential spills of fuels and lubricants	Minor (1)	Local (1)	Multi-annual (4)	Minor significance (4)
Soils and soil cover				
Construction				
Mechanical disturbance of soil cover during construction	Minor (1)	Local (1)	Continuous (3)	Minor significance (3)
Industrial waste pollution	Minor (1)	Local (1)	Short-term (1)	Minor significance (1)
Operation stage				

Sources and types of impact	Significance of changes (evaluation point)	Spatial scale of impact (point)	Time scale of impact (point)	Impact significance (total points)
Pollution of soil cover with accidental spill and leakage of fuels and lubricants, various wastewater and solid wastes	Minor (1)	Local (1)	Multi-annual (4)	Minor significance (4)
Vegetation				
Operation stage				
Movement of vehicles, pollution of vegetation with accidental spill and leakage of fuels and lubricants	Minor (1)	Local (1)	Multi-annual (4)	Minor significance (4)
Fauna				
Construction				
Disturbance of habitat	Minor (1)	Local (1)	Continuous (3)	Minor significance (3)
Disturbance factor, noise, light, vehicle movement	Minor (1)	Local (1)	Continuous (3)	Minor significance (3)
Operation stage				
Physical presence	Minor (1)	Local (1)	Multi-annual (4)	Minor significance (4)
Vehicle movement	Minor (1)	Limited (2)	Multi-annual (4)	Minor significance (8)

Construction of the peak/standby power source at Berezovskaya CHPP is planned for the period of 1 to 3 years. Therefore, time scale of the impact during construction deemed as long-term.

As shown in the table, the intensity of the impact (the significance of changes) on environment components during the construction is characterized as *minor*.

During operation, intensity of the impact on all environment components will be *minor*, in time scale the impact will be *multi-annual*, in spatial scale (for some impacts) the impact will be regional.

Integrated evaluation allows for a conclusion that the impact significance category both during the construction and during operation of the CHPP can be generally classified as *minor.* The impact on surface water and the impact on atmospheric air during operation are evaluated as an impact of average significance (the maximum number of points is 16). It should be noted that an impact of average significance according to the applied method corresponds to a total number of points 9 - 27 (a product of points evaluating impact intensity, spatial and time scale of the impact). In other words, an impact of average significance corresponds to a wide range of values starting from the minor impact threshold to a level almost exceeding the legal limit.

The planned activity for construction of the peak/standby power source at Berezovskaya CHPP will not have considerable impact on natural environment and, therefore, is acceptable from environmental perspective.

4 PREDICTION AND ESTIMATION OF THE CONSEQUENCES OF POTENTIAL DESIGN AND OFF-DESIGN ACCIDENTS

Main causes of accidents at various facilities are violations of processes, technical errors of maintenance staff, violation of fire safety rules and safety procedures, disconnection of power supply systems, water supply and discharge systems, natural disasters, acts of terrorism, etc.

Off-design accidents differ from design accidents only by the source event, usually an exclusive one, which cannot be taken into consideration unless specifically established by the technical assignment. Off-design accidents cause destruction of the same facilities, and have the same environmental consequences as design accidents.

An accident is any change in normal operation of equipment, which poses hazard of failure-free operation, safety of equipment and maintenance personnel. These situations can be caused by effects of hazardous natural phenomena, man-made accidents.

Natural factors are destructive phenomena caused by geophysical reasons beyond human control (earthquakes, hurricanes, increased precipitations and thunderstorms).

Based on the information characterizing the geophysical, geological, meteorological and other phenomena in the area where the Berezovskaya CHPP is located, the probability of accidents related to natural factors is very low.

Man-made factors are destructive changes caused by human activities, or technical devices and productions made by human. As a rule, accidents occur due to violation of equipment operation regulations or operation standards (technical failures). The main causes of failures are most frequently: manufacturing defects or poor quality of materials, ageing of equipment, erroneous actions of staff.

A list of potential accidents affecting the environment during operation of the CHPP and measures for their elimination are provided in Table 4.1.

Table 4.1 - List of Potential Accidents and Measures for Their Elimination

Description	Elimination activities
Breakage of gas pipeline within the facility or at the supply gas pipeline	Automatic cutoff of gas supply, additional fire safety measures
Breakage of main heating pipeline	Automatic cutoff of network pumps and water supply to consumers
Ignition of OSG and CSG transformers	Disconnection of transformers and use of firefighting means of the plant
Breakage of oil pipeline	Cutoff of oil supply, additional fire safety measures. Clearance of spill area

Based on the consequences of similar situations on facilities within the industry and in foreign power industry, it can be noted that they cannot leave territory of the production site and sanitary protection area, therefore potential accidents during CHPP operation can be evaluated as local.

Mandatory fire safety and emergency protection activities as provided by design, limit probability and duration of accidents, and, consequently, reduce impact on environment.

5 MEASURES FOR PREVENTION, MINIMIZATION AND (OR) COMPENSATION OF IMPACT

In order to avoid significant adverse impact on environment components during construction and operation of the power plant, design solutions provide for certain activities.

Atmospheric air

To minimize the impact on atmospheric air, it is proposed to:

- strictly follow equipment operation process regulations;
- ensure timely and quality repair and maintenance;
- restrict operations at the time of adverse meteorological conditions;
- ensure fulfillment of CHPP operation specifications;
- conduct production monitoring.

At the moment, Berezovskaya CHPP applies the following activities to reduce generation of nitrogen oxides in units Nos. 1, 3, 4, 5:

– recirculation of flue gases and their feed to gap between two air flows in all boilers;

– staged combustion at boilers of units Nos. 3, 4, 5 by supplying hot air to the tertiary blast nozzles above the burners.

Physical impact mitigation activities:

- nighttime operations should be minimized;
- use of construction equipment according to established noise and vibration levels;
- use of equipment with reliable vibration performance preventing propagation of excess vibration beyond the production site, and anti-vibration activities (anti-vibration mounts, separation of equipment frame structures from building steel structures, installation of equipment on dedicated foundations with sufficient weight to absorb vibration, etc.).

Topsoil

The following should be provided to ensure efficient use and protection of topsoil:

- maximum use of the existing transport infrastructure of the area;
- prohibition to operate construction machinery with leaking fuels and lubricants;
- maximum use of low-waste construction and operation processes;
- storage of materials, raw products and equipment on concrete and diked sites;
- arrangement of temporary waste disposal sites according to valid standards and regulations;
- timely housekeeping of construction and domestic wastes to avoid washing, blowing and settlement in soil profile;
- timely removal of generated production and consumption wastes, prevention of overfilling of temporary waste laydown areas;
- monitoring over fulfillment of storage rules, condition of temporary waste laydown areas, waste utilization, arrangement, disposal and fire safety rules.

These activities will help to avoid infiltration or superficial pollution of topsoil.

Fauna

Activities to protect and prevent damage to fauna:

- maximum preservation of topsoil;
- minimization of lighting in nighttime on construction sites;
- avoiding access of birds and animals to storages of food and production wastes;

- keeping the adjacent areas clean.

The listed activities will allow for significant reduction of adverse impact on fauna

Surface and ground water

The following is provided to prevent depletion of surface and ground water:
- use of drinking water for potable and drinking purposes only;
- use of circulation cooling system for equipment;
- use of treated production wastewater and rainwater in the cycle.

The following is provided to prevent pollution of ground water:
- measures against leakage from underground utility water pipeline and sewerage;
- discharge of designed transformer oil in oil sumps.

The following is provided to prevent pollution of surface water:
- monitoring over composition of feed surface water;
- divided discharge of wastewater;
- dilution of wastewater;
- oil-contaminated wastewater treatment facilities;
- monitoring over wastewater composition at outlets.

KEY FINDINGS FROM THE IMPACT ASSESSMENT

1. Berezovskaya CHPP is the branch of RUE Brestenergo. Berezovskaya CHPP is the largest electric power source in the Republic of Belarus. Additionally, it provides heat for utility and domestic needs of Beloozersk and several nearby industrial plants.

Assignment for amendments into preliminary design provides for construction of the peak/standby power source at Berezovskaya CHPP. The assignment provides for two construction cases of the peak/standby power source at Berezovskaya CHPP with total capacity of 250 MW:

Case 1:
- installation of fourteen 18V50SG GPUs manufactured by Wartsila, 17.622 MW each

Case 2:
- installation of five SGT-800 GTUs by Siemens, 50.5 MW each.

Natural gas is used as the main fuel for the designed peak/standby power source, diesel fuel is the standby one.

2 Environmental impact assessment and prediction of consequences of operation of Berezovskaya CHPP were conducted by certain criteria provided by engineering and scientific practice of environmental pollution consequences analysis according to the regulative requirements of the Republic of Belarus, valid method guidelines and scientific research.

3 Analysis was conducted with respect to as-is condition of natural environment components and social-and-economic conditions. The results obtained confirm the favorable nature of environment and social-and-economic conditions for implementation of the planned activity.

4 Sources were determined, potential environmental impacts during construction and operation were identified and evaluated. The spatial and time scale of impact and intensity, i.e. the significance of changes in the natural environment, served as a basis in the assessment of the impact significance of Berezovskaya CHPP.

5 Impact on atmospheric air was assessed from the perspective that the expected atmospheric air pollution caused by Berezovskaya CHPP conforms to the legal and regulative requirements for quality of atmospheric air.

5.1 The expected maximum pollution of atmospheric air with all ingredients following the implementation of the planned activity is lower than MAC in atmospheric air of populated areas:

a) maximum pollution is described by the following values:

Case 1:
- nitrogen dioxide - 0.46 MAC (0.115 mg/m^3), including background pollution - 0.61 MAC (0.1525 mg/m^3);
- carbon oxide - 0.13 MAC (0.65 mg/m^3), including background pollution - 0.25 MAC (1.25 mg/m^3);

Case 2:
- nitrogen dioxide - 0.21 MAC (0.0525 mg/m^3), including background pollution - 0.34 MAC (0.085 mg/m^3);
- carbon oxide - 0.13 MAC (0.65 mg/m^3), including background pollution - 0.25 MAC (1.25 mg/m^3);

Sulphur dioxide in both cases - 0.61 MAC (0.305 mg/m^3), including background pollution – 0.63 MAC (0.315 mg/m^3). Maximum ground-level concentration of sulphur dioxide is contained within the production site and the main contributor is the existing source of auxiliary production (ES No. 24 - air extraction system of a forging site of central repair shop);

b) ground-level pollutant concentrations reduce with distance from emission sources. At a distance of about 26.5 km around the stacks, the ground-level concentration for the SO_2 + NO_2 summation group will be 0.05 MAC and will limit potential CHPP impact area (area, where maximum ground-level pollutant concentration excluding background exceeds 0.05 MAC).;

c) maximum ground-level concentrations (including background): in the nearest residential development: 0.59 MAC of nitrogen dioxide and 0.22 MAC of carbon oxide (Case 1), 0.32 MAC of nitrogen dioxide and 0.18 MAC of carbon oxide (Case 2), sulphur dioxide – 0.31 MAC in both cases.

5.2 According to the available criteria, the expected impact from Berezovskaya CHPP in atmospheric air is evaluated as acceptable. There will be no irreversible impacts on atmosphere condition.

Considering the scale of impact (regional with a potential impact area of approximately 15 km), the duration of impact (multi-annual) and the significance of changes (minor), the general estimate of the significance of CHPP’s impact on atmospheric air on the basis of these parameters (16 points) corresponds to an impact of average significance. It should be noted, however, that according to the applied method, an average impact significance has wide range of values starting from threshold of minor impact to the level almost exceeding the legal limit (average impact is characterized by total points within the range of 9 - 27).

6 After the implementation of the designed activities, total gross pollutant emissions in Case 2 are 1.2 times lower than that in Case 1. In general, from the Berezovskaya CHPP, gross pollutant emissions from both cases relative to the previously developed EIA will decrease.

7 Physical factors impact (noise, electromagnetic fields, vibration) will not exceed sanitary and hygienic standards, and is evaluated as low.

8 CHPP impacts on surface and ground water depend on water consumption and wastewater discharge conditions.

8.1 Water consumption and discharge of Berezovskaya CHPP due to construction of the peak/standby power source at Berezovskaya CHPP, and thermal load to coolers (winter/summer) will not exceed values as established and approved for Berezovskaya CHPP.

8.2 Considering the scale of impact, the duration of impact and the significance of changes, the significance of CHPP’s impact in terms of the impact on ground and surface water (during construction) is generally evaluated as minor, and in terms of the impact on surface water (during operation) – as average.

9 Impact of Berezovskaya CHPP on other environmental components including impacts on soil cover, flora and fauna is evaluated as low. Construction of the peak/standby power source will not change environmental conditions of animal habitat, will not disturb links between populations, will not result in direct withdrawal of animal specimen and destruction of suitable biotopes.

10 Prediction and estimation of changes in social-and-economic conditions showed that implementation of the project is advisable as socially and economically beneficial both in local and regional scales. Potential positive impact on society and economy will be demonstrated in:

– ensuring reliable operation of backup capacities;

– ensuring stability by frequency control when there is a deviation between power consumption and power generation;

– ensuring emergency backup to maintain system stability in case of failures, such as shutdowns or accidents at energy sources or grids;

– commissioning of new, state-of-the-art equipment.

11 In general, on the basis of a combination of all parameters, the environmental impact assessment for Berezovskaya CHPP confirms that its operation is acceptable without adverse consequences for the environment, since the impact of the planned activity on the natural environment will stay within acceptable limits, not exceeding the self-recovery capability of natural components.