PZVOS for Syrdarya CCGT 1600 MWt Project

Developed by

«Juru Energy Consulting» LLC

Director J. Ismailov

Tashkent 2022

LIST OF PERFORMERS

Ishmukhamedova E.	-	Independent environmental expert
Khegay O.	-	Envirinmental Consultant OOO «JURU Energy Consulting»
Kazakova Z.	-	Social Consultant, OOO «JURU Energy Consulting»

Table of contents

Introduction

The purpose of this work is to assess the environmental impact of the construction of combined cycle thermal power plant (with CCGT) with a total capacity of 1200-1600 MW in Bayavut district of Syrdarya region.

The consortium (Enersok) consisting of "Electricity De France" (EDF), "Nebras Power", "Sojitz Corporation" and "Kyuden International", was awarded by the Ministry of Energy of the Republic of Uzbekistan to construct and operate the Combined Cycle Gas Turbine (CCGT) with a maximum capacity of 1600 MW The Consortium will establish a special purpose vehicle 'Project Company' called 'ENERSOK Foreign Enterprise Limited Liability Company', registered in the Republic of Uzbekistan with the commercial registration number 1095919. The Project Company will enter into a 25-year Power Purchase Agreement (PPA) with JSC 'National Electric Grid of Uzbekistan', who will be the off-taker of the generated electricity.

As per the applicable local law, the Consortium shall conduct an environmental and social impact assessment study and report on obtaining an environmental license before commencement of the project. Thus, as part of the Environmental Impact Assessment (National EIA), the consultants of the Consortium on Environmental and Social Issues "5 Capitals Environmental & Management Consulting" (Dubai, UAE) appointed "Juru Energy" (Tashkent, Uzbekistan) to conduct environmental and social studies and collect the data, including submission of the National EIA to the regulatory authority.

The main objectives of the project:

– to ensure accelerated development and increase the competitiveness of the country's in power industry;

– active attraction of foreign direct investment in construction of new generating facilities;

– to meet the growing demand for electric power;

– to reduce the specific fuel consumption indicators;

– to improve the production efficiency;

– to reduce the negative impact on the environment.

Power industry development requires solutions of the challenges of environmental assessment of possible consequences on the environment, life and health of the population. the electric power facilities may substantially affect the biosphere if not properly managed Therefore, when an power source is selected, it is necessary to take into account not the economic consequences only, but also the environmental consequences of the possible impact of power facilities during construction and operation.

This project stipulated construction of a combined cycle gas turbine with a capacity of 1200-1600 MW consisting of as follows: two gas turbine units, two waste-heat boilers and one steam turbine, with the necessary buildings and auxiliary structures, including construction of

appropriate infrastructure in the Bayavut district of the Syrdarya region and also waterpipeline corridor locating in Shirin town.

The main environmental advantage of the project is reduction of the maximum concentrations of pollutants in the surface layer of the atmosphere created by the emissions of new CCGTs compared to the existing power units of the existing thermal power plants of Uzbekistan, with achievement of the standards established by the State Committee of the Republic of Uzbekistan for Ecology and Environment Protection for the level of atmospheric pollution.

The construction facility is referred to the **I category of environmental impact** as specified in the Decree of the Cabinet of Ministers, dated 07.09.2020 No. 541 (Appendix No. 1, high risk, item 32 "Thermal power plants and other power plants for thermal combustion with capacity of 300 MW and above)".

The main tasks in the development of the National EIA 1 stage were as follows:

– to assess the degree of negative impact of the new power plant on the environment;

– to conduct an environmental analysis of the design solution, with determining the types, objects and nature of the impact;

– to conduct an accident risks analysis for a new power plant with a total capacity of 1200-1600 MW;

– to prepare a forecast the environmental impact assessment of power plant after the project implementation;

– to develop an environmental protection management plan and an environmental quality monitoring plan for the period of construction and the power plant operation phase after the project implementation.

The National EIA of the power plant construction and operation was based on the analysis of the current state of the natural environment, the designed technological equipment, identification of sources of emissions, discharges and waste.

The level of atmospheric air pollution emitted by the new power plant after implementation of the technological solution proposed in the project was calculated and determined for compliance with the requirements of the State Committee of the Republic of Uzbekistan for Ecology and Environment Protection.

For this work we followed the "Regulations on the State Environmental Expertise" approved by Decree of the Cabinet of Ministers of the Republic of Uzbekistan, No. 541 dated 07.09.2020, which specifies the composition and scope of the presented section of environmental impact assessment.

1 The state of the environment in the area of the site location

1.1 General information about location of the 1200-1600 MW power plant site

This project examines the environmental impact of the construction and operation of the power plant consisting of two CCGTs with total capacity of 1200-1600 MW.

Administratively, the site intended for implementation of the CCGT construction project is located in the Bayavut district of the Syrdarya region, northwest of the existing Syrdarya thermal power plant, on the right bank of the Yuzhno-Golodnostep Canal named after Sarkisov.

The project is being implemented on the area of Bayavut district, whereas the water pipeline corridor is on Shirin town. The area is aimed to allocated for Ministry of Energy.

The project area is a flat area of the Mirzachoʻl Steppe.

The total area allocated for installation of the CCGT is 55.0 hectares.

The illustration of the territory of the 1200-1600 MW CCGT is shown below in the Figure 1.

The final pipeline design is at the approval stage.

The layout plan for CCGT agreed with the environmental inspector of the Bayaut district. The plot plan with the location of the units is given in the Appendix 2.

The coordinates of the location of the CCGT (as per the "degrees with decimals" system):

1. 40.240786°N; 69.100654°E
2. 40.243186°N; 69.103394°E
3. 40.245963°N; 69.110789°E
4. 40.243296°N; 69.114290°E
5. 40.242360°N; 69.113650°E
6. 40.237539°N; 69.106210°E

Figure 1. Illustration of the CCGT location in the Bayavut district[1]

The relief of the project site is flat. The absolute relief elevations on the area range from approximately 309.0 to 313.0 m above sea level.

The nearest residential buildings of the Sarmich village are located north-west at a distance of 76.0 m from the boundary of the project area. There is Shirin village south-east of the described site (805.5 m), there are residential buildings in the south located along the Yuzhno-Golodnostep Canal (704.2 m), a military unit (1.3 km) and a military camp (1.6 km).

The minimum distance from the chimneys of the CCGT to the nearest residential buildings from the northwest (according to the plot plan) is 390 m from the bypass pipe and 406 m from the chimney after the waste-heat boiler.

[1] The output of electricity produced at the 1200-1600 MW gas turbine to the network of Uzbekistan will be carried out through the substation under construction nearby, constructed by ACWA Power & then transferred to NEGU (JSC). The area of the SS is located in close proximity to the territory of the gas turbine, but it is not included in the subdivisions of the gas turbine under consideration.

There is a 500 kV power line on the area of the land plot allocated for the construction of the CCGT. In the east and north, the project site borders with the area of the future two CCGTs with a total capacity of 1500 MW and the 500/22 kV switchyard. Construction activities are already underway in those areas as conducted by the "ACWA Power Sirdarya" LLC switchyard.

To the south of the project area there is a landfill (37.0 m), methane gas station (782.4 m) and there are three power lines (662.0 m) to the southeast. The Syrdarya TPP is located southwest on the left bank of the Yuzhno-Golodnostep Canal at a distance of 679.3 m from the project area.

The demolition of the residential buildings is not expected during the implementation of the project.

The site of the power plant planned for construction was selected due to occurrence of water sources available for consumption, that is, the Yuzhno-Golodnostep Canal named after Sarkisov and gas, that is, the gas pipeline leading to the Syrdarya TPP.

There is gas distribution station with 40 atmosphere pressure westward from the project area.

The nearest watercourse to the construction site in question is the Yuzhno-Golodnostep Canal named after Sarkisov, running south-east from the project area at a distance of 530 m.

It is envisaged that water from the canal will be used for technical water supply of the power plant under construction, for which it is planned to build a water pumping station and a pipeline to supply water to the power plant site.

Figure 2. Illustration of the pipeline route[2]

The coordinates of the pipeline route (as per the "degrees with decimals" system):

[2] The piping scheme is not final and is subject to change.

1. 40.239446° 69.103299°
2. 40.236677° 69.101152°
3. 40.236175° 69.101624°
4. 40.235373° 69.101001°
5. 40.234249° 69.102994°

The general view of the pipeline route is given in the Appendix 2.

The route of water pipeline will be constructed with access road. The width of water pipeline corridor+access road is approximately 25-27m.

As per the plot plan, the area of the power plant will accommodate such structural units as:

- main production area – gas turbine and steam turbine;
- cooling towers;
- water intake, water treatment and treatment facilities;
- natural gas substation;
- auxiliary areas – warehouses, administrative premises, workshops, storage and supply of hydrogen, parking lot, etc.

The structural units are located in the plot plan in the manner as follows:

- main production area – gas turbine (GT) and steam turbine (ST)

The main area of the power unit is located on the northern side of the plant site, next to the AIS 500/220 kV external substation, which simplifies the tie-in.

GT and ST are located in the machine halls, while the ST hall is located from the side of the GT hall. The GT and ST halls are located in the center of this zone, while the waste-heat boilers are on the south side of the main power unit.

Generator boost transformer, transformers of the unit's own needs and other electrical equipment are located on the north side of the GT and ST halls. The central control building is located on the southeastern side of the main power unit.

- Cooling towers

The cooling tower equipment is located on the south side of the main power unit and consists of a cooling tower with mechanic traction, circulating-water pump house and a chlorine supply system. The cooling tower orientation will be finally determined at the detailed design stage.

- Treatment facilities

The water treatment unit is located in the south of the plant, not far from the source of raw water, and consists of water intake and drainage facilities, water pretreatment unit, dewatering unit, etc.

- Natural gas substation

The natural gas station is located on the northwest side of the plant, facing the natural gas supply line. The natural gas station consists of a natural gas metering and control unit and local control cabinet. Fuel gas compressors are also located in this area.

- Auxiliary equipment

The auxiliary equipment of the plant mainly includes a hydrogen storage and supply plant, administrative building, parking lot, workshop and warehouse, etc. The hydrogen supply plant is located northward of the plant. Other units are located on the south side of the plant, not far from the local main road.

1.2 Holding public hearings devoted the project implementation

The Decree of the Cabinet of the Ministers of the Republic of Uzbekistan No. 541 specifies that materials of the environmental impact assessment of II category submitted to the state environmental expertise shall contain the conclusion of the public hearing on the support of the project, proposals and objections of the public received during the public hearing, in terms of the positive and negative impacts of the proposed project.

Considering that the 1200-1600 MW power plant is referred to the facilities of the I category of environmental impact, the management of the power plant under construction, together with representatives of the district khokimiyat, ecology and environmental protection authorities, organized and held the public hearings, where the issues of the proposed project implementation and the impact of its activities on the environment and social situation were discussed with communities and the public residents of the district.

The minutes of the public hearing with photos are given in the Appendix 3.

1.3 Establishment of a Health Protection Zone (HPZ).

The HPZ is established in accordance with the Sanitary rules, regulations and hygienic standards of the Republic of Uzbekistan Sanitary Rules and Regulations No. 0350-17 "Sanitary rules and regulations for protection of atmospheric air in the populated areas of the Republic of Uzbekistan".

For thermal power plants, the area of the HPZ to the boundary of residential structures is set from the chimneys (clause 2.7.3.).

The capacity of the power plant is 1200-1600 MW. In accordance with the requirements of Sanitary Rules and Regulations No. 0350-17 "Sanitary rules and regulations for protection of atmospheric air in populated areas of the Republic of Uzbekistan", the proposed thermal power plant is referred to the second class of sanitary classification, that is, the area of the sanitary protection zone (HPZ) is 500 m.

In our case, the minimum distance from the chimneys of the CCGT to the nearest residential buildings from the northwest (according to the plot plan) is 390 m from the bypass pipe and 406 m from the chimney after the waste-heat boiler.

The dispersion of pollutants in the atmosphere was calculated for compliance with the standards established by the State Committee of Ecology of the Republic of Uzbekistan (quotas for pollutants emitted into the atmospheric air by enterprises of the Republic of Uzbekistan) in order o determine the area of the impact zone of the project.

Based on the calculation results of the dispersion of pollutants into the atmosphere, a letter was submitted to the Center for Sanitary Welfare of the Ministry of Health (SES) to obtain the permission on reduction of the sanitary protection zone.

A statement was prepared for the Center for Sanitary Welfare of the Ministry of Health (SES), based on the results of calculations of concentrations of pollutants from emissions into the atmosphere beyond the boundaries of the 1200-1600 MW power plant in the Bayavut district of the Syrdarya region, with taking into account climatic indicators.

Based on the results of the analysis of the submitted materials, the location of the designed power plant was approved by the Center for Sanitary Welfare of the Ministry of Health with a reduction in the SPZ from 500m to 300m. The approval of the SES is provided as part of the draft Statement on the impact on the environment. Appendix 4).

1.4 Establishment of a water protection zone

The width of the water protection zone shall be set in accordance with Decree of the Cabinet of the Ministers No. 981, dated 11.12.2019. "On approval of the regulations and the procedure for establishment of the water protection zones and sanitary protection zones of water bodies within the territory of the Republic of Uzbekistan".

The nearest watercourse to the construction site in question is the Yuzhno-Golodnostep Canal named after Sarkisov.

As per the letter of the "Syrdarya" Basin Water Management Association, the Yuzhno-Golodnostep Canal named after Sarkisov is an irrigation canal with a maximum capacity of 150 m^3/s.

The canal bed runs 530 m south-east of the construction site, which corresponds to the width of the water protection zone of the canal, that is 100-150 m, according to the requirements of Decree of the Cabinet of the Ministers No. 981, dated 11.12.2019 (item 29, Chapter 4 of the Appendix), taking into account its maximum capacity of 150 $m^3/$ s.

Annex 4 contains a letter from the Basin Water Association "Syrdarya" on the size of the water protection zone of the South Golodnostepsky Canal (SGC) named after. Sarkisov, as well as a design permit for a water intake with an average intake of 1381 m3/h (maximum 2160 m3/h) and an average discharge of 357.5 m3/h (maximum 562 m3/h).

Currently, a "Permit for special water use" is being developed.

1.5 Required felling of trees and vegetation

In accordance with the Decree of the President of the Republic of Uzbekistan dated December 12, 2017 No. UP-5278 "On measures for cardinal reforming the national system of public services to the population" and in pursuance of further improvement of the public services system in terms of the environmental management, the Cabinet of Ministers has established (Decree of the Cabinet of Ministers the Republic of Uzbekistan No. 255 dated 31.03.2018) the Administrative Regulations on provision of public services for the issuance of permits for trees and shrubs felling that are not included in the state forest fund**.** Trees and shrubs felling that are not included in the state forest fund is prohibited without a permit.

Since the power plant construction project also includes construction of a pipeline and a pumping station for water intake from the Yuzhno-Golodnostep Canal for production purposes, a request was sent to the Division of Ecology and Environmental Protection of the Syrdarya region to conduct an inventory with a visit to the area along the route of the pipeline and site of the pumping station installation, to prepare a statement on availability of species and number of trees which shall be either fall or transplanted, with preparation of a compensation protocol accordingly.

Vegetation within the area considered for construction of a thermal power plant is represented by artificial plantings of ornamental trees.

It is intended to preserve woody and shrubby vegetation to a maximum possible extent when the pipeline will be constructed, or excavate carefully the trees together with their roots and their transplantation to other places, or trees felling, if so necessary.

The project provided materials with a permit for the forced replanting of woody vegetation along the route for the construction of a heat pipeline from the coastal pumping station to the 1200-1600 MW power plant in Bayavut district. (Appendix 4).

1.6 Climatic properties of the area.

The features of the area in question shaped the continental nature of the climate, which is expressed in a sharp fluctuation in temperatures, both daily and annual, with cold winters and dry hot summers.

The climatic properties were analyzed in compliance with the observations by the Uzhydromet under the Cabinet of Ministers of the Republic of Uzbekistan at the weather station in Bekabad-city, which is closest to the proposed facility. The climatic parameters have been selected from the tables of meteorological observations (TMOs) for 2020.

The average annual air temperature is 15.26 °C.

The average monthly temperature of the coldest month (January) is + 0.98 °C, the average temperature of the hottest month (July) is + 27.92 °C.

The average minimum temperature for the year is -2.62 °C, the average maximum temperature is +35.23 °C.

The maximum temperature is +41.40 °C, the minimum is -18.30 °C.

Table 1.1 Climatic parameters of the Bekabad-city

Parameter	**Unit of measurement**	**Value**
Coefficient A, depending on the temperature stratification of the atmosphere		200
Average annual temperature	°C	15.26
Average maximum temperature	°C	35.23
Maximum temperature	°C	41.40

Parameter	**Unit of measure-ment**	**Value**
Average minimum temperature	°C	-2.62
Minimum temperature	°C	-18.30
Average air temperature in January	°C	0.98
Average air temperature in July	°C	27.92
Average soil surface temperature	°C	16.67
Minimum soil surface temperature	°C	-16.0
Maximum soil surface temperature	°C	64.0
Precipitation	mm	306.31
Fog	hours	14.30
Average annual frequency of wind directions by points	%	N-0.36 NNE-0.02 NE-0.83 ENE-0.01 E-32.80 ESE-0.02 SE-26.52 SSE-0.00 S-5.58 SSW-0.01 SW-8,21 WSW-0.00 W-17.93 WSW-0.02 SW-7.71 SSW-0.00 calm – 34.92
Number of cases by grading, %	m/s	
	0-1	71.20
	2-3	14.30
	4-5	6.91
	6-7	1.35
	8-9	1.01
	10-11	1.26
	12-15	3.18
	>15	1.71
Average wind speed	m/s	2.04

Parameter	Unit of measure-ment	Value
The highest wind speed exceeding 5 %	m/s	u*=9.88

The average air temperature is 0.98 ˚C in January, and 27.92 °C in July. A sharp increase in temperature was observed in April, and decrease - in November. The area in question is characterized by deviations in air temperature from the norm, especially in the cold half-year.

The average temperature of the soil surface is 16.67 °C, the minimum is -16.00 °C, the maximum is 64.00 °C.

Dust is cleaned by precipitation, but the average annual precipitation level is small in the area in question - 306.31 mm. Precipitation falls all year round, the minimum precipitation falls in the summer, in some years precipitation is not occurred in July-August.

The greatest level of precipitation is in the winter-spring period, which is up to 90% of the annual precipitation. The maximum duration of precipitation is 73 hours in March. The snow cover is unstable. The summer period is characterized by aridity. The amount of precipitation in summer does not exceed 7-10% of the annual volume of all precipitation.

The average annual cloud cover is 4.8 points.

The average annual relative humidity is 67.4%, the highest average monthly humidity is observed in December (81%), minimal humidity level is in summer (up to 54% in July). Relative humidity is rather low in the first half of autumn by comparison with the spring.

Direction and speed of the wind is one of the meteorological aspects determining the conditions for the pollutants dispersion in the atmosphere.

The area in question is located between the Turkestan and Kuramin mountain ranges and forms a special type of wind regime: prevailing wind directions are eastern (32.8%), south-eastern (26.52%), and south-western (17.93%) winds (Figure 1.1.3.). Calm or wind slack occur in 34.92% of cases, which contributes to the accumulation of pollutants in the surface layer of the atmosphere.

Speed of the wind is one of the meteorological aspects determining the conditions for the wind pollution in the atmosphere. The construction area of the Syrdarya CCGT is generally characterized by small values of average monthly wind speeds. The average annual wind speed is 2.04 m/s. The frequency of winds with a speed from 0 to 1 m/s is 71.20%, which contributes to accumulation of pollutants in the surface layer of the atmosphere. Winds with a slightly higher speed (from 2 to 3 m/s, with frequency of 14.30%), helps to clean the atmosphere, and they are most frequent from March to July. The frequency of winds with a speed from 4 to 15 m/s is much lower (frequency from 6.91 to 3.18%). However, this area is characterized by high wind speeds reaching 40.0 m/s. In 2018, maximum wind gusts with a speed of 35.0 m/s were recorded.

Fog, haze and dust storms are adverse atmospheric phenomena contributing to air pollution. Fogs last 14.30 hours a year in the area in question, mainly in the cold season, and fog occurrence is significantly higher than in other regions of Uzbekistan. During a day, fogs are recorded in the morning, night and evening hours.

Dust storms are quite rare - 1-2 days a year on average.

Thus, the climatic conditions in the study area contribute to the transfer of pollutants over long distances.

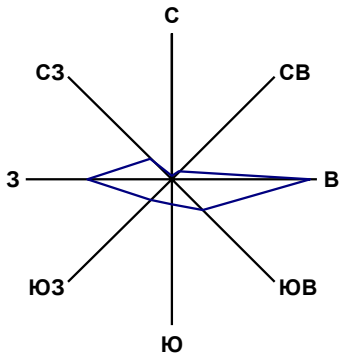

Figure 3. Annual wind rose, Bekabad-city

1.7 Existing sources of impact

The nearest large industrial company to the construction site is Syrdarya TPP JSC, which is the main source of environmental impact in the area in question. It is located south-west on the left bank of the Yuzhno-Golodnostep Canal at a distance of 679.3 m from the project area.

In addition to the Syrdarya TPP JSC, there are other industrial companies that contribute to the environmental impact.

In the city of Shirin, located south-east of the project zone, the sources of environmental impact are mainly the companies located in the industrial zone in the north-western part of the city, including the Farkhad railway station. The heavy industry is represented by the Shirin machine-building plant. The light industry companies are bakery plant, district bakery, sewing workshop and printing house located in the city center. Construction organizations are represented by construction departments, mobile mechanical division, and bridge construction crew.

There is a fattening livestock complex, a high-pressure gas distribution station, and municipal sewage treatment plants outside the city boundary.

In total, there are about 10 companies in the city, and several small and private enterprises. City companies are mainly referred to the objects of the III and IV categories with low and local impact: these are the companies of food, light, repair and mechanical industries.

Nitrogen oxides, carbon, sulfur, soot, hydrocarbons, benzo(a)pyrene, and lead compounds are emitted into the atmosphere through the exhaust gases of motor vehicles and rail transport.

The underlying surface is also the source of the environmental impact, since the atmosphere is polluted with inorganic dust during the dusting created by winds with high speed.

In addition, road transport in the construction area of the proposed facilities is a source of noise and vibrations.

The emissions of the above objects are the sources of impact on the soil and vegetation in the area in question, which enter the soil and plants from the atmosphere with precipitation, rains and direct absorption.

The natural sources of pollution of the atmosphere, soil and vegetation include the dry underlying surface during winds with high speed, especially the plowed lands of farmland. Soils, air, ground and surface waters are regularly contaminated with defoliants when the farm fields are processed with those.

The district is mainly agricultural due to its natural conditions that enable to develop the irrigation agriculture and pasture cattle breeding. The economic activity of communities has both positive and negative impact on the environment. Poor behavior of livestock farms contaminates soil, vegetation and air with liquid and solid waste, which is discharged into water bodies or the relief without treatment. Manure without special treatment is used as fertilizer, which is a source of infection spread. The environmental situation in the region is getting worse due to improper storage of manure, inadequate compost preparation technology and its disinfection.

The long-term intensive use of mineral fertilizers on large areas, the imbalance of plant nutrition elements, and improper fertilizing the agricultural crops has created an artificial environment in the aeration zone, which impact adversely on the soil fauna, and reduce the soil fertility. Pesticides are used to combat plant diseases and pests, with this, some of the chemicals enter the groundwater, collector and drainage runoff, i.e. mineral fertilizers together with pesticides are pollutants of the components of nature.

Agriculture, in particular irrigated agriculture, is the main source of pollution of surface and groundwater with such pollutants as pesticides and defoliants, mineral fertilizers, salts that define their mineralization.

Settlements without sewers and organized landfills for storing municipal solid waste impact negatively at a considerable extent.

Thus, the main sources of environmental impact in the area of the project CCGTs are as follows: Syrdarya TPP, companies of the city of Shirin, vehicles, disturbed underlying surface and livestock facilities.

The level of atmospheric pollution is determined by the emissions of stationary and portable sources existing in the area and equipment with gas and dust cleaning devices, meteorological aspect that takes into account the ability of the atmosphere to accumulate or disperse the air emissions.

Since Syrdarya TPP JSC is the nearest major source of environmental impact, we will consider the degree of impact of its activities.

Syrdarya Thermal Power Plant JSC is the largest thermal power plant of the Republic of Uzbekistan and one of the most powerful in Central Asia.

The power plant has ten power units with a capacity of 300 MW each with direct-flow twin-furnace gas and oil-fired boilers. The turbine is of K-300-240 LMZ type, boilers are TGMP-114S by Taganrog plant, generators are TVV-320-2 by "Electrosila" plant.

The main used fuel is gas from the Shurtan field, the fuel oil is a back-up resource.

The main production parameters of Syrdarya TTP JSC are given in the table below.

Table 1.2 – General production parameters

Syrdarya TPP JSC

No.	Indicators	Unit of measurement	2019	2020	2021
1	2	3		4	5
1	Installed capacity at the end of the year	MW	3115	3165	3215
2	Average annual installed capacity	MW	3115	3125.4	3179.6
3	The number of hours of use of the average annual installed capacity	hour	4697	4788	4976
4	Power generation	thousand kWh	14631428.5	14965762.9	15822272.9
5	Electricity supply	thousand kWh	14055106.7	14402124.6	15249043.1
6	Heat power supply	Gcal.	207752.9	148431.6	148372.6
7	Specific consumption of conventional fuel for electric power supply	kg/kWh	365.7	357.0	347.8
8	Specific consumption of conventional fuel for thermal power supply	kg/Gcal.	160.0	160.0	160.0
9	Consumption of conventional fuel for production of electric power and heat, including: Gas Fuel oil		 5173490.0 5032107.0 141383.0	 5165204.7 4859054.7 306150.0	 5327865.5 5119675.1 208190.4
10	Consumption of conventional fuel for thermal power supply		33240.5	23749.1	23739.8
11	Share of fuel oil	%	2.73	5.93	3.91
12	Consumption of electric	thousand	572166.7	569669.7	570262.3

No.	Indicators	Unit of measurement	2019	2020	2021
1	2	3		4	5
	power for own needs	kWh %	3.91	3.75	3.60

Atmospheric air is impacted during operation of the plant as a result of fuel burning for electric power generation.

According to the Maximum Permissible Emission document developed in 2022, there are 24 sources of pollutant emissions at the Syrdarya TPP JSC, of which 14 sources are organized, 10 - are unorganized. There are no sources equipped with dust and gas cleaning equipment. In total, 21 types of pollutants are emitted into the atmosphere.

The regulatory status is set at the level of 2134.74018 gr/s and 54114.7619 t/a.

The main input in the balance of atmospheric air pollutants at the enterprise, namely 99.91%, is contributed by ingredients as follows:

1. Nitrogen dioxide – 73.88%
2. Nitric oxide – 12.00%
3. Sulfur dioxide – 10.00%
4. Carbon monoxide – 3.74 %
5. Fuel oil ash – 0.29

Thus, 5 ingredients out of 21, contribute for 50341.3669 tons of the emissions to atmospheric air.

Table 1.3. Gross emission by Syrdarya TPP JSC

No.	Name of the substance	gram per second	tons per year
1	Metal dust	0.00627	0.00001
2	Lime	0.75226	0.001
3	Sodium chloride (salt)	4.95235	0.01
4	Nitrogen dioxide	39270.0629	72.57
5	Nitric oxide	6381.43137	11.79
6	Sulfur dioxide	5876.0064	10.86
7	Carbon monoxide	2337.9020	4.32
8	Hydrocarbons	46.4423	0.09
9	Fuel oil ash	196.9682	0.36
10	Abrasive dust	0.0010	0.000002

11	Benzo(a)pyrene	0.0008	0.000001
12	Iron oxide	0.1924	0.0004
13	Silicon oxide	0.0069	0.00001
14	Copper oxide	0.0006	0.000001
15	Chromium oxide	0.0022	0.000004
16	Wood dust	0.0003	0.000001
17	Manganese compounds	0.0173	0.00003
18	Fluorides	0.0068	0.00001
19	Hydrogen fluoride	0.0084	0.00002
20	Nickel compounds	0.0004	0.000001
21	Vanadium pentoxide	0.0006	0.000001
	Total	54114.7619	100.00

Table 1.4. Properties of pollutants emitted into the atmosphere by Syrdarya TPP JSC and concentrations created by those

No.	Name of the sub-stance	Maximum allowable one-time concentration or Maximum allowable mean daily concen-tration, mg/m3	Hazard class	Established quota (share of Maximum allowable concen-tration (MAC)		Max. concentration outside the industrial area (MAC shares)	Compliance with the estab-lished quota (+/-)	Total discharged in the air, tons/year	Percentage of contribution to emissions
1	Metal dust	0.2	3	0.33		0.001	+	0.00627	0.00001
2	Lime	0.3	3	0.33		0.01	+	0.75226	0.001
3	Sodium chloride (salt)	0.5	3	0.33		0.04	+	4.95235	0.01
4	Nitrogen dioxide	0.085	2	0.25		0.21	+	39270.0629	72.57
5	Nitric oxide	0.6	3	0.33		0.02	+	6381.43137	11.79
6	Sulfur dioxide	0.5	3	0.33		0.02	+	5876.0064	10.86
7	Carbon monoxide	5	4	0.5		Tmc <0.1*	+	2337.9020	4.32
8	Hydrocarbons	1	4	0.5		0.01	+	46.4423	0.09

9	Fuel oil ash	0.002	2	0.25		0.02	+	196.9682	0.36
10	Abrasive dust	0.04	3	0.33		Tmc <0.1*	+	0.0010	0.000002
11	Benzo(a)pyrene	0.000001	1	0.2		Tmc <0.1*	+	0.0008	0.000001
12	Iron oxide	0.2	3	0.33		Tmc <0.1*	+	0.1924	0.0004
13	Silicon oxide	0.15	3	0.33		Tmc <0.1*	+	0.0069	0.00001
14	Copper oxide	0.002*	2	0.25		Tmc <0.1*	+	0.0006	0.000001
15	Chromium oxide	0.01	3	0.33		Tmc <0.1*	+	0.0022	0.000004
16	Wood dust	0.3	3	0.33		Tmc <0.1*	+	0.0003	0.000001
17	Manganese com-pounds	0.005	2	0.25		Tmc <0.1*	+	0.0173	0.00003
18	Fluorides	0.2	2	0.25		Tmc <0.1*	+	0.0068	0.00001
19	Hydrogen fluoride	0.02	2	0.25		Tmc <0.1*	+	0.0084	0.00002
20	Nickel compounds	0.005	2	0.25		Tmc <0.1*	+	0.0004	0.000001
21	Vanadium pentox-ide	0.002	2	0.25		Tmc <0.1*	+	0.0006	0.000001
								54114.7619	100.00

1.8 The state of atmospheric air

The state of atmospheric air pollution is determined by the interaction of two aspects - emissions of harmful substances and the conditions of their dispersion.

Based on climatic parameters, the area in question is referred to the zone of high climatic atmospheric pollution potential (APP).

The current state of the climatic parameters of the construction area was analyzed as per the observations of the Uzhydromet under the Cabinet of Ministers at the weather station of Bekabad-city.

The climatic indicators were selected from the tables of meteorological observations of the "Review of the state of atmospheric air pollution in the Republic of Uzbekistan" (data from the Yearbook as of 2020).

The observations are carried out at 3 fixed monitoring station of the Uzhydromet. Methodological guidance is provided by the Monitoring Service for Atmospheric Air Pollution, Surface Water and Soil.

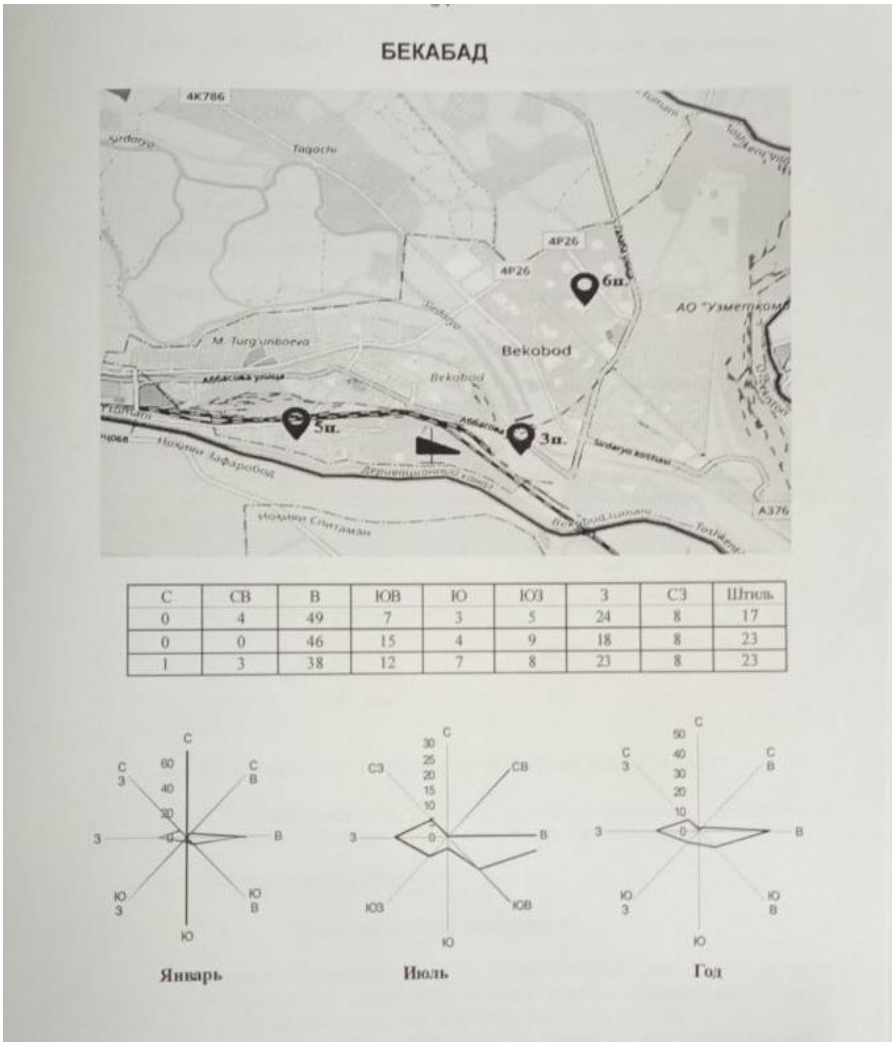

Figure 4. Location of stations of the Uzhydromet of the Bekabad station

The stations are divided into as follows:

"Background" - urban, located in residential areas (station No. 6)

"Industrial" – near the enterprises (station No. 5)

"Auto" - near highways or in the areas with heavy traffic (station No. 3).

Characteristics of air pollution recorded by the stations in the city of Bekabad according to published observation data as of 2020 (annual data) are given below in the Table 1.5.

Table 1.5 Characteristics of air pollution in Bekabad-city annual data (2020)

Impurity	Station	$q_{aver.}$	G	q_m	q	q_i	n
Dust	3	0.1	0.059	0.3	0.0	0.0	888
	5	0.1	0.059	0.2	0.0	0.0	891
Sulfur dioxide	3	0.023	0.009	0.040	0.0	0.0	901
	5	0.023	0.009	0.048	0.0	0.0	900
	6	0.024	0.009	0.049	0.0	0.0	905
Carbon monoxide	3	1	0.971	4	0.0	0.0	908
Nitrogen dioxide	3	0.05	0.021	0.11	0.0	0.0	901
	5	0.04	0.019	0.10	0.0	0.0	900
	6	0.04	0.018	0.11	0.0	0.0	905
Nitric oxide	3	0.03	0.015	0.07	0.0	0.0	901
Ozone	3	0.033	0.006	0.055	0.0	0.0	285
Solid fluorides	6	0.02	0.008	0.03	0.0	0.0	300
Hydrogen fluoride	3	0.003	0.002	0.010	0.0	0.0	901
	6	0.003	0.002	0.009	0.0	0.0	905
Ammonia	5	0.02	0.012	0.06	0.0	0.0	900
Air pollution source (5) = 3.69							

Note: $q_{aver.}$ is the average concentration of impurities in the air, mg/m³;

q_m is the maximum impurity concentration in the air, mg/m³;

q_{m*} is the highest concentration of impurities in the air, mg/m³ from the observations by CSW, industrial enterprises, according to the method (1, 4, 5, 7, 8, GOST 17.2.602-85);

q is frequency of impurities concentration in the air above the maximum permissible concentration of Maximum allowable one-time concentration, in %;

q_i is frequency of impurities concentration in the air above 5 Maximum allowable one-time concentration, in %;

n is the number of observations;

G is the mean square deviation.

Dust concentrations

The average annual level was 0.023 mg/m³ (0.5 Maximum allowable mean daily concentration.), the maximum one-time concentration was 0.049 mg/m³ (0.1 Maximum allowable one-time concentration).

Air pollution source = 0.80

Sulfur dioxide concentration

The average annual concentration was 0.023 mg/m3 (0.5 maximum allowable mean daily concentration) and the maximum annual one-time concentration in the city was 0.049 mg/m^3 (0.1 maximum allowable one-time concentration).

Air pollution source = 0.47

Carbon monoxide concentration

The average concentration for the year was 1 mg/m³ (0.3 maximum allowable mean daily concentration), the maximum one-time concentration was 4 mg/m³ (0.8 maximum allowable one-time concentration)

Air pollution source = 0.41

Nitrogen dioxide/nitric oxide concentrations

The average concentration of nitrogen dioxide was 0.04 mg/m³ (0.3 maximum allowable mean daily concentration). The maximum value of the maximum allowable one-time concentration was recorded at the station No. 6 in January, that is, 0.11 mg/m³, exceeding the Maximum allowable one-time concentration by 1.3 times.

Air pollution source = 1.10

The average annual and maximum one-time concentrations of nitric oxide did not exceed the MAC.

Air pollution source = 0.55

Concentrations of specific impurities

The average annual ozone concentration was 0.033 mg/m³, exceeding the maximum allowable mean daily concentration by 1.1 times. The maximum one-time value of MAC was 0.055 mg/m³ (0.3 maximum allowable one-time concentration).

Air pollution source = 1.16

The average annual and maximum single concentrations of solid fluorides did not exceed the MAC.

Air pollution source = 0.42

The average annual and maximum one-time concentrations of hydrogen fluoride did not exceed the MAC.

Air pollution source = 0.60

The average annual and maximum one-time concentrations of ammonia did not exceed the MAC.

Air pollution source = 0.64

The level of air pollution is low.

Air pollution source = 3.69

The number of days when maximum allowable mean daily concentration was exceeded

Table 1.6. The number of days when maximum allowable mean daily concentration was exceeded

Impurity	Number of days
Dust	30
Sulfur dioxide	0
Carbon monoxide	0
Nitrogen dioxide	69

Table1.7 Dynamics of changes in the average level ($q_{aver.}$) of pollution for 2016-2020, Bekabad-city

Year	Concentration (mg/m³), MAC					
	Dust	Maximum allowable mean daily concentration	SO_2	Maximum allowable mean daily concentration	CO	Maximum allowable mean daily concentration
2016	0.1	0.15	0.014	0.05	1	3
2017	0.1	0.15	0.017	0.05	1	3
2018	0.1	0.15	0.017	0.05	1	3
2019	0.2	0.15	0.019	0.05	1	3
2020	0.1	0.15	0.023	0.05	1	3

Year	Concentration (mg/m³), MAC					
	NO_2	Maximum allowable mean daily concentration	NO	Maximum allowable mean daily concentration	Ozone	Maximum allowable mean daily concentration
2016	0.04	0.04	0.03	0.06	0.033	0.03

2017	0.05	0.04	0.03	0.06	0.033	0.03
2018	0.05	0.04	0.02	0.06	0.033	0.03
2019	0.05	0.04	0.03	0.06	0.031	0.03
2020	0.04	0.04	0.03	0.06	0.033	0.03

Year	Concentration (mg/m³), MAC					
	Solid fluorine	Maximum allowable mean daily concentration	HF	Maximum allowable mean daily concentration	Ammonia	Maximum allowable mean daily concentration
2016	0.01	0.03	0.004	0.05	0.03	0.04
2017	0.01	0.03	0.004	0.05	0.03	0.04
2018	0.01	0.03	0.004	0.05	0.02	0.04
2019	0.01	0.03	0.004	0.05	0.02	0.04
2020	0.02	0.03	0.004	0.05	0.02	0.04

1.9 Surface water

The main natural watercourse of the area in question is the Syrdarya River. The remaining artificial hydraulic structures regulated by the river flow were built in the late 1940-70s for the needs of power industry, land reclamation and drinking purposes.

The Syrdarya River is formed by the confluence of the Naryn and Karadarya rivers, its total length is 2,142 km, drainage basin area is 219,000 km². Syrdarya River is a snow-and-glacier fed stream. In addition, reservoir waters flow into the Syrdarya riverbed. Along with the discharges of collectors and rivers, groundwater drained by the Syrdarya and Kara Darya is also an additional source of feeding within the Fergana Valley. According to data from the Bekabad weather station, the average annual flow of the river is 540 m^3/s, the average monthly long-term minimum flow is 315-320 m^3/s (January-February), the maximum is 1 160 m/s (July).

The section of the river from the Kayrakum reservoir to the Chardarya reservoir is a source of the technical water supply of the Syrdarya thermal power plant.

There is a significant inflow of return and discharge waters in the section in question. The steady inflow of about 10 m³/s is observed during the year from the Kairakum hydroelectric complex to Farkhad.

The river flow from the reservoir of the Farkhad HPP (46 km³) is divided into three streams: the Diversion canal of the Farkhad HPP, the Dalverzin canal and the riverbed itself. The diversion canal itself is feeding the Yuzhno-Golodnostep Canal, Kirov Canal and canal of pump irrigation of the lands of Tajikistan for irrigation of the Golodnostep lands. Excess in diversion is discharged directly into the Syrdarya riverbed. The river flow is reunited at the Nadezhdin village.

The direct source of water supply of the Syrdarya thermal power plant is the diversion canal of Farkhad Hydroelectric Power Plant with water intake from the Farkhad reservoir created on the Syrdarya River. The diversion canal with a total length of 13.8 km, has a kettle cross-section, with slopes in the lower part 1:4, and 1:2 in the upper part. The width along the riverbed ranges from 42.8 m to 28 m. Geological structure of the canal: sandy loam, pebbles, sands, clay, loam, etc. The canal is operated year-round. Its throughput capacity enables to switch the entire flow of the Syrdarya River to 500 600 m³/s.

The irrigation network is widely developed on the area of this project implementation. The largest canals are Yuzhno-Golodnostep Canal (YGC) (254.0 m southwest from the construction site of the CCGT) and the Dustlik Canal (named after Kirov) (2.1 km northwest). Distributors and small irrigation canals are fed from those canals. The width of the Dustlik canal is 146 meters, the depth is 5.0 m. The width of the Yuzhno-Golodnostep Canal is 70 meters, the depth is 5.1 m.

The maximum flows in the canals are observed during the crop season, and the minimum - in the autumn-winter months. The maximum flow of the Dustlik canal is 228 m^3/s, and of the Yuzhno-Golodnostep canal - 300 m^3/s.

Engineering canals. Those are fed from the Syrdarya River through a diversion canal.

The location of the hydraulic structures of the Syrdarya thermal power plant stipulated the area of impact of the plant on the surface waters, into which all the described artificial watercourses and partially - the Syrdarya River are flowing.

Table 1.8 shows the hydrological parameters of the described watercourses. The regime of the Syrdarya River and outgoing watercourses during the crop season is distorted by very large water intakes for irrigation of the Fergana Valley, Jizzakh and Golodnaya steppes.

Table 1.8. Average values of watercourses runoff

Name of watercourse	Parameter, m^3/s
Syrdarya river, village Kyzyl-Kishlok	481
Syrdarya river, village Nadezhdin	360
Diversion canal	354
Yuzhno-Golodnostep Canal	113
Dalverzin	36.7
Discharge after the Kirov canal	177
Syrdarya river after discharge by TPP	364
Canal named after Kirov	76

Chemical composition of the Syrdarya River before village of Kyzyl-Kishlok is formed under the influence of pollution entering the river with effluent water from industrial companies of Namangan, Kokand, Khojent cities. After the fork of the Farkhad reservoir, the residual river flow is impacted by the enterprises of Bekabad-city, with this, mineralization is increased, and

heavy metals, suspended solids, petroleum products, organic compounds are brought into the water. In addition, the water of the Syrdarya, especially in the lower reaches, is affected by agricultural runoff. Circulation: surface water - saline soils - groundwater and again surface water, increases the salinity of the watercourse.

When the hydro-chemical indicators of the Syrdarya River downstream the city of Bekabad were analyzed, it was noticed a distinctive deterioration in water quality compared to the diversion canals and the YGC. Concentration increases in terms of almost all ingredients, mineralization increases, the content of suspended solids, sulfate ions, and total nitrogen increases significantly. At Nadezhdin village, the content of ions, calcium, magnesium and sodium exceeds the MAC. The increased content of zinc and chromium is observed after the city of Bekabad already.

The condition of surface watercourses is characterized as moderately polluted, water is referred to the Class III.

The planned source of water supply for the power plant in question is the Yuzhno-Golodnostep Canal, running 530 southwest of the power plant site.

The Yuzhno-Golodnostep Canal named after A.A. Sarkisov is an irrigation canal. The canal originates from the dam of the Farkhad HPP and runs from east to west, providing water to the lands of Uzbekistan with a total area of 301.9 thousand hectares. It starts from the reach of the Farkhad HPP located on the Syrdarya River (on the left bank), runs from east to west along the southern part of the Golodnaya Steppe through Yangier-city, ends with discharging into the Sanzar River north of Jizzakh. It was built in 1949-72 (1st stage of 92 km was commissioned in 1963, 2nd stage - in 1972).

The total length of the YGC is 127 km, the throughput capacity in is 300 m^3/s its head. Till 103 km of its stream, the canal is laid in an earthen bed, then it goes in a concrete lining. The canal width ranges from 10 - 25 m, depth is 2.5 - 6 m.

The state of the water in the canal was assessed as per the data of observations of the Uzhydromet in the corresponding dam site in the background dam site (Table 1.9).

Table 1.9. Characteristics of surface water pollution of the Yuzhno-Golodnostep canal (named after Sarkisov) with breakdown by monitoring stations as of 2020

Water body (item, category, dam site)	Predominant pollutants (parameters of pollution)	2020		
		number of samples	average concentration	maxim. concentration
Yuzhno-Golodnostep Canal (named after Sarkisov)	Weighted substances, mg/l	4	3.3	5.0
	oxygen, mgO_2/l	4	12.76	10.98
	Mineralization, mg/l	2	1175.8	1213.0
	COD, mgO/l	3	13.05	19.50
	BOD5, mgO_2mgO_2/l	4	1.51	1.85

Water body (item, category, dam site)	Predominant pollutants (parameters of pollution)	2020		
		number of samples	average concentration	maxim. concentration
	Ammonium nitrogen, mg/l	4	0.04	0.06
	Nitrite nitrogen, mg/l	4	0.003	0.011
	Nitrate nitrogen, mg/l	2	1.71	3.04
	Iron, mg/l	3	0.00	0.001
	copper, μg/l	4	3.6	6.5
	Zinc, μg/l	4	9.4	17.2
	Chromium VI, μg/l	2	0.1	0.2
	Arsenic, μg/l	-	-	-
	Phenols, mg/l	2	0.001	0.001
	Petroleum products, mg/l	4	0.07	0.17
	Synthetic surfactants, mg/l	-	-	-
	Fluorine, mg/l	-	0.92	1.20
	DDT, μg/l	-	-,-	
	Alpha-HCH, μg/l	4	-	-
	Gamma-HCH, μg/l	4	-	-

Since the Yuzhno-Golodnostep Canal is a source of technical water supply of the proposed power plant, to determine the characteristics of the source water quality, by “Uzgeorazvedka” LLC and laboratory of Sanitary-epidemiological welfare and public health service of the RUz., the water quality of the Yuzhno-Golodnostep Canal (YGC) was also analyzed, the characteristics of this are given in the Table 1.10 and in the Appendix 6.

Table 1.10 Characteristics of the water of the Yuzhno-Golodnostep Canal measurement as of 2022

Parameters	Unit	2022
Raw water		
pH		8,06
Прозрачность/ Turbidity	mg/dm^3	0.03
Al^{3+}	mg/dm^3	8.5
Fe^{3+}	mg/dm^3	3.00
Cu^{2+}	mg/dm^3	2.4

SO_4^{2}	mg/dm³	536
NH^{4}	mg/dm³	<0.01
Chlorides	mg/dm³	89
As	mg/dm³	4.4
Al	mg/dm³	8.5
Cd	mg/dm³	<0.1
Cu	mg/dm³	2.4
Hg	mg/dm³	<0.01
Ni	mg/dm³	6.3
Fe	mg/dm³	3.00
Pb	mg/dm³	0.180
Zn	mg/dm³	1.60

1.10 Soils and groundwater

The area of the future CCGTs is located on the fourth terrace above flood-plain of the Syrdarya River (Golodnostep), near the border with the Shirin-Kyz plateau. The surface of the terrace is a sloping plain with a slight slope to the north and to the Syrdarya River. The absolute elevations of the site range slightly from 312.9 to 321.0 m.

The structure of the site was formed by Quaternary deposits of the Golodnostep complex, and mainly represented by loams and, to a lesser extent, loess-like sandy loams and tributary layers and lenses of sand and gravel, less often pebbles. By area and in section, the area is characterized by predominance of light loams. Soil color ranges from light brown to light gray, macroporous, low-moisture, of hard and low-plastic consistency, below the groundwater level, the soil is moist, water-saturated, have a plastic and fluid consistency.

Lithologically, the territory of the described area of the region is composed by a thickness of loam, topped off from the surface by bulk soil in the form of local sections with a capacity of up to 2 m in the southern and northern parts and covered by thin sandy loam (0.708 m) in the central part.

The total thickness of the alluvial deposits of the fourth terrace of the Syrdarya River is about 70 m or more, decreasing to the south, where they are underlain by Neogene and ancient Quaternary deposits of the Shirin-Kyz plateau.

The soil thickness is plastered to some extent, in the form of rarely occurring inclusions of crystalline gypsum or its small clusters, of amorphous origin. There are also inclusions of fine gravel and carbonate compounds in the form of nodules.

The thickness of the interlayers and lenses is up to 1 m. Clay soils are non-subsiding. The filtration capacity of soil is low, the filtration coefficient is -20.5 m/day.

The specific gravity of soils is mostly characterized by a fairly constant value for entire thickness. The bulk weight depends on porosity and humidity.

Thanks to the close occurrence of the groundwater level, the natural humidity of soil varies within relatively small limits, due to their almost complete saturation. The exception is the soil lying closer to the surface of the earth. The average soil moisture is 20%.

The mineralization of soil is determined by both gypsum compounds and easily soluble salts and is uneven in terms of area and depth. The total salt content ranges from 0.188 to 2.092%, and according to GOST 55.4287 the soil can be classified as saline. At the boundary of the groundwater occurrence, the salinity of the soil is the lowest.

Salt accumulated in the soil due to strong evaporation and insufficient natural outflow of groundwater. The composition of the salts is dominated by SO_4^{2-}, Ca^{2+}, Na^{+} and K^{+} ions, i.e. the salinity of soil is determined by both gypsum compounds and easily soluble salts (Table 1.5.1).

The hydrogeological parameters of the area are complicated due to geological, climatic and water management aspects.

Table 1.5.1

Chemical composition of water extract of soil

Name	Content	
	%	mg-eq/l
Bicarbonates	0.026-0.11	0.43-1.804
Chlorides	0.02-0.239	0.395-8.488
Sulfates	0.06-1.498	1.249-31.884
Calcium	0.05-0/52	0.798-2.948
Magnesium	0.002-0.077	0.164-6.329
Sodium-potassium	0.02-0.489	0.86-21.239

The dominant aspect in the formation of the groundwater regime is the flow of the Syrdarya River.

The groundwater is presented in the sediments of the Syrdarya River valley, mostly with a free surface, developed in the thickness of alluvial-proluvial deposits. The main of the two aquifers is confined to coarse-grained soil and rarely, in its upper part, to fine-grained soil. The depth of the groundwater occurrence of this bedrock is determined by the terrain and decreases towards the riverbed - from 9.0 to 1.5 m.

The second aquifer is confined to fine-grained sands lying in the thickness of ancient alluvial deposits.

It is characterized by pressure waters, isolated from the upper bedrock by sandy clays and dense loams.

The closest occurrence of the groundwater level is observed along large irrigation canal (the diversion canal of the Farkhad Hydroelectric Power Plant, the Yuzhno-Golodnostep Canal, pump irrigation, technical water supply canals and in the areas of intensive irrigation agriculture).

Groundwater is mainly fed by underground runoff from the overlying bedrock, as well by infiltration of water from large canals and irrigation network.

The groundwater regime is mainly determined by the regime of surface watercourses (canals), as well as by the regime of irrigation and watering of fields. During the beginning of

the irrigation season and until the end of autumn, the groundwater level rises rapidly. The highest level is observed in summer (June-September), the lowest - in winter and in the first months of spring (December-April). The annual amplitude of the groundwater level fluctuation is 1-2 meters.

The general direction of the underflow follows the absolute elevations of the earth surface, that is, north, north-west, towards the bed of surface watercourses.

The chemical composition of groundwater varies significantly in both quantitative and qualitative parameters. Groundwater is mineralized and highly mineralized. The value of dry residue reaches 5g/dm³. By the chemical composition, groundwater belongs to sulfate sodium, more rarely sodium chloride.

Groundwater is classified as highly aggressive against concrete on all types of cement. The aggressiveness of groundwater is sulphate and magnesian.

The values of the total stiffness vary in such ranges as from 46.8 to 118.0 mg-eq, which confirms its extra stiffness.

The hydrogen index varies from 6.0 to 9.0.

There is a tendency in decrease in mineralization, despite this, the level of salinity is quite high and fluctuates largely depending on the sampling site, but mostly, mineralization level is 3 g/dm³.

Thus, there is a close occurrence of groundwater in the area of the project zone. The water is aggressive against concrete, and the soil is saline, and characterized by low filtration capacity. The composition of groundwater in the area in question prevents to use it for domestic and technical needs.

1.11 Vegetation

The vegetation cover of the area in question is represented by irrigated agricultural crops, mainly cotton (Gossypium hirsutum), Malvaceae family and wheat (Triticum durum), Grass family (Poaceae), orchards, artificial tree plantings, a complex of meadow, ephemeroid meadow communities with significant share of weed species.

The state of vegetation in the area of implementation of the project in question is typical for areas with residential buildings.

The Deciduous trees are commonly planted around residential buildings: Oriental sycamore (Platanus orientalis, Platanaceae), Juniper (Juniperus), Common ash (Fraxinus exelcior, Oleaceae), Catalpa (Catalpa speciosa, Bignoniaceae), White poplar (Populus alba, Salicaceae), Common maple or sycamore (Ácer platanoídes, Sapindaceae), Western and Eastern thuja (Thuja occidentalis and Thuja orientalis, Cupressaceae). There are plantings of young tree, predominately fruit trees: Common apricot (Armeniaca vulgaris, Rosaceae), Common peach (Persica vulgaris).

Vegetables and fruits are mainly cultivated on the private plots of residential buildings.

There are plantings of garden crops in the gardens of the household plots: Cabbage (Brassica oleracea, Brassicaceae), Tomato (Solánum lycopérsicum), Solanaceae), Cucumbers

(Cucumis sativus), Pumpkin (Cucurbitaceae), Potato (Solánum tuberósum, Solanaceae), Eggplant (Solánum melongéna, Solanaceae), Onion (Allium cepa L., (Liliaceae), Garlic (Allium satívum, Amaryllidaceae), etc.

Apple trees (Malus sylvestris var. domestica (Borkh.) Mansf., Malus pumila var. domestica (Borkh.) C.K.Schneider., Malus pumila auct., Pyrus malus L., Pyrus malus var. mitis Wallr., (Rosaceae), Pear (Pyrus communis L., Rosaceae), Apricot (Armeniaca vulgaris Lam., Rosaceae), Peach (Prúnus pérsica, Rosaceae), Cherries (Prúnus ávium, Rosaceae) are cultivated in the gardens.

Plantings of Grapes (Vitis vinifera, Vitaceae) of different varieties is quite common.

Silver poplar (Populus alba, Salicaceae), Sycamore (Platanus orientalis, Platanaceae), Ash (Fráxinus excélsior, Oleaceae), Maple (Acer platanoídes, Sapindaceae), Sophora (Styphnolóbium japónicum, Fabaceae), Western thuja and Eastern thuja (Thuja occidentalis and Thuja orientalis, Cupressaceae) are planted along the streets.

Actively vegetative ephemeroids are ubiquitous: Meadow bluegrass (Poa praténsis, Poaceae), Dandelion (Taraxacum officinale, Asteraceae), as well as Annual and Perennial wormwood (Artemisia absinthium and other types of wormwood, Compound flowers (Asteraceae), Wheatgrass (Elytrígia répens, Poaceae), Wild carrot (Dáucus caróta, Apiaceae), Shoreweed (Aeluropus, Poaceae).

Weed vegetation is developed along irrigation and drainage systems, along the outskirts of roads, under the canopy of trees and on small plots of unused land.

The coastal vegetation is mainly represented by thickets of river reeds (Scirpus, Cyperaceae) and Reeds (Phragmites, Poaceae). There are isolated cases of Willow (Salicaceae), Cattail (Týpha, Typhaceae), Snyt (Aegopódium podagrária, Apiaceae), Aleppo grass (Sorghum, Poaceae).

1.12 Biodiversity

Since the territory in question is located in an area with intensive infrastructure development, animal biodiversity is minimal out here and fauna is mainly represented with as follows:

– Rodents (vole (Microtus arvalis, Cricetidae), House mouse (Mus musculus, Muridae), Gray rat (Rattus norvegicus, Muridae);

– Avifauna (Rook (Corvus frugilegus, Corvidae), Jackdaw (Coloeus monedula, Corvidae), Gray crow (Corvus cornix, Corvidae), Starling (Sturnus vulgaris, Sturnidae), various species of Sparrows (Passer domesticus and other Sparrows, Passeridae), Mynas (locust starling (Acridotheres tristis, Sturnidae), Pigeons (Columba livia, Columbidae), Larks (Alauda arvensis, Alaudidae), European swallow (Hirundo rustica, Hirundinidae), Red-bellied swallow (Hirundo daurico, Hirundini dae), Black swift (Apus apus, Apodidae) etc.;

– domestic animals of farmsteads (cattle and small cattle (Cows (Bos taurus taurus, Bovidae), Sheep (Ovis aries, Bovidae), Horses (Equus ferus caballus, Equidae), Donkeys (Equus asinus asinus, Equidae);

– poultry (mainly Chicken (Gallus gallus domesticus, Phasianidae), and Turkey (Meleagris gallopavo Linnaeus, Phasianidae), Goose (Anser anser and A. Cygnoides, Anserinae) and Duck (Anas platyrhynchos, Anatidae).

During the expedition survey of the project area, we have noticed:

– numerous flocks of Sparrows (Passer domesticus, Passeridae);

– flocks of Mynas in flocks and single individuals (locust starling (Acridotheres tristis, Sturnidae);

– Pigeons (Columba livia, Columbidae);

– Larks (Sky lark (Alauda arvensis) and Crested lark (Galerida cristata), (Alaudidae);

– Turtledoves (Streptopelia turtur, Columbidae);

– Magpies (Pica pica, Corvidae);

– Blue-larks (Coracias garrulus, Coraciidae).

– White stork (Ciconia ciconia)

Among the animals inhabiting near the construction site of the new power plant, in the area characterized by significant dust and noise, we can also name the groups that can hide from the noise impact of the plant on the soil - these are insects (Winter scooper (Agrotis segetum, Noctuidae) and Cotton scooper (Helicoverpa armigera, Noctuidae), Caradrina (Spodoptera exigua, Noctuidae), Spider mite (Tetranychus urticae, Tetranychidae) and Reptiles - Rapid fringe-toed lizard (Eremias velox, Lacertidae), Water snake (Natrix tessellata, Colubridae), or species that can quickly leave unfavorable areas – the species listed above. Amphibians - toads (various species of Bufonidae) and frogs (various species of Ranidae) habitat the areas with stagnant or running water.

The insects are commonly represented by mosquitoes, fleas, flies, plant pests, and other species living in residential areas and adapted to modern conditions.

2 Social and economic aspects of construction of 1200-1600 MW power plant in the Syrdarya region

Syrdarya region is an important administrative division of Uzbekistan. The administrative center is the city of Gulistan.

The total area is 4.28 thousand km².

Syrdarya region is located in the central part of Uzbekistan on the left side of the river Syrdarya.

It borders in the north with Maktaaralsky and Saryagash districts of South Kazakhstan region of Kazakhstan, in the south - with Istaravshan and Zafarabad districts of Sughd region of Tajikistan, in the west - with Jizzakh region, in the east – with Tashkent region.

Syrdarya region consists of 8 districts (tumans) and 3 cities of regional significance:

Akaltyn district (center is the Sardoba village);

Bayaut district (center is the Bayaut village);

Gulistan district (center is the Dehkanabad village);

Khavast district (the center is the village of Khavast);

Mirzaabad district (center is the Navruz village);

Sardobin district (center is the Pakhtaabad village);

Saykhunabad district (center is the Saykhun village);

Syrdarya district (center is the city of Syrdarya.

The project is being implemented in Bayavut district of Syrdarya region.

Construction of the 1200-1600 MW new power plant consisting of two gas turbines and one steam turbine with the required auxiliary buildings and structures, with establishment of appropriate infrastructure in the Bayavut district of the Syrdarya region, will contribute to the development of the power industry of Uzbekistan and enable to use of the country's fuel resources optimally.

New power plant will ensure an uninterrupted and reliable supply of electric power to the consumers.

By comparison with the steam turbines used currently at the thermal power plants of Uzbekistan, CCGT have such advantages as fundamental simplicity, almost complete automation, which greatly simplifies the operation of the units. In addition, they are more compact than traditional units and highly maneuverable (a set of loads is done within 5-20 minutes by comparison with several hours required in case of steam turbine). The transition to combined-cycle gas technologies will increase the efficiency of fuel use, and with this, will improve the environmental situation in the study area, due to reduction in the specific emissions of pollutants per unit of power produced.

Thus, the construction of a new power plant in the Syrdarya region with a number of social and economic advantages, will contribute to improvement in the efficiency of power conversion, and will satisfy the projected demand for electric power from the developing economy of Uzbekistan.

Stable electric power production will improve the standard of living of people residing in the Republic of Uzbekistan.

The implementation of the project will contribute to the development of gender policy in Uzbekistan by involving women from local communities in the maintenance of new equipment.

The implementation of the project for new CCGT plant in the Syrdarya region will address partially the problem of employment and training of highly qualified personnel.

There will be an opportunity for employment for unskilled labor, in particular, workers, dispatchers, drivers, etc. from the local communities.

According to the investor's data, during the operation period, the working staff will be 67 people, from 1000 to 2100 workers will be involved during the construction. The exact number of local workers has not yet been determined, but the majority of workers during operation will consist of local workers.

Employment by the project is not limited to the direct staffing. There also will be indirect income and employment of the people through procurement of goods and payment for services rendered by the contractors. There also will be employment created at the expense of personal expenses of project employees, but this scale will be insignificant. The other side of the emergence of significant local procurement and business opportunities due to implementation of this project is the influx of people from other areas of the region, which can provide a noticeable development of the local economy. It is expected that part of the construction staff will be the specialists of the Syrdarya region.

The implementation of the project will result to the economic benefits for the government, which will be reflected in the collection of income tax on staff payrolls, and production of cheaper and more reliable electric power for the growing needs of Uzbekistan. In general, the implementation of the project will contribute to raising the overall level of the economy.

Possible sources of disturbance of the peace of the local communities will presumably include transportation of workers, transportation of construction materials, accommodation of construction personnel for residing, as well as noise and dust to appear during construction activities. Such disturbances will be minimal and short-term, they may occur initially during the transportation of personnel and raw materials only.

Mitigation measures shall be taken to minimize the negative impacts, with expansion of the positive impacts. To do this, the following measures will be taken:

– construction activities will be managed in manner which enables to minimize the unavoidable and short-term impacts (smoke, noise, vibration, dust, dirt, delays, accidents) from construction activities on local residents and other road users;

– the operations will be managed in a manner which enables to minimize the impact on the local communities, in particular, it will be introduced time constraints for noisy work during daytime hours with preparation of the schedule for delivery of materials avoiding the traffic violations;

– local residents will be actively involved during the construction phase;

– the equipment will be delivered from abroad.

3 Environmental analysis of the design solution

3.1 Design solution

The project stipulates construction of a combined cycle power plant (PP) with combined cycle gas turbine (CCGT).

The plant planned for construction can operate in two modes – a simple cycle and a combined cycle.

The "simple cycle" means generation of electric power by burning natural gas in gas turbines with emission of high-temperature flue gases through a bypass pipe.

The "combined cycle" means further use of flue gases for production of steam in waste heat boilers, and additional generation of electric power from steam in a steam turbine. In this case, the flue gases with a lower temperature will be emitted through the chimney after the waste heat boiler.

Combined-cycle gas turbines (CCGTs) are the most promising and widely used in the power industry, they are distinctive by simple process scheme and highly efficient for electric power generation. Steam-gas units are a combination of steam turbine and gas turbine units combined in a common process cycle (combined cycle). Combining of such units into a single unit enables to reduce the heat lost with the outgoing gases of gas turbine (GT). It is useful to use the gases in a waste heat boiler behind the gas turbines, generate additional power and increase efficiency compared to steam turbine and gas turbine power plants, reduce emissions of nitrogen oxides into the atmosphere. The efficiency of typical gas turbine units is 34-40%. In the combined cycle, the efficiency of the CCGT is 50-60% depending on the series of gas turbines. The construction period of the CCGT is much shorter than the construction period of powerful thermal power plants of other types. Using a combined-cycle gas cycle enables to improve the environmental indicators of a power company and reduce significantly the level of harmful emissions into the atmosphere.

The main parameters of the project are given in the Table 3.1.

Table 3.1 Main parameters of the project

Parameter	Description/value
Type of technology	Combined cycle technology with simple and combined cycles
Number of CCGT units	1
CCGT power	1200-1600 MW
CCGT configuration	2GT + 2WHB+ 1ST;
Number of working hours (max)	8 111 hours;
Annual electric power generation	13 776 492 MW·h;

Parameter	Description/value
Net efficiency of CCGT, %	60
Fuel	Natural gas
Hourly consumption of natural gas (1 CCGT)	129.44 thous. Nm^3/h;
Annual consumption of natural gas (1 CCGT)	1 049 819.5 thous. Nm^3/year;
Type of condenser cooling	Water-cooled
Type of cooling tower	Cooling towers with artificial ventilation
Source water – cooling water	Source water is supplied from the canal
Process water – boiler water	Process demineralized water will be supplied from own water demineralization unit through connection to the demineralized water system
Production consumption of water	1381.0 m^3/h
Height of chimneys of waste-heat boilers (WHB)	2 x 60m;
Height of bypass pipes	2 x 45m

The operating mode of the new thermal power plant is basic, year-round, round-the-clock with maximum possible number of hours of electric power use.

As per the plot plan, the area of the power plant will accommodate such structural units as:

- main production area – gas turbine and steam turbine;
- cooling towers;
- water intake, water treatment and treatment facilities;
- natural gas station;
- auxiliary areas – warehouses, administrative premises, workshops, storage and supply of hydrogen, parking lot, etc.

The site of the power plant is considered as located on the north side of the site planned for the power plant.

The main production site is a power plant based on a single set of a multi–shaft power unit configuration:

Power Unit No. 1: Gas turbine unit No. 1. 1 (GT 1)

Power Unit No. 2: Gas turbine unit No.2. 2 (GT 2)

Power unit No. 3: Steam turbine generator (ST)

Gas turbine generator units (GT) are the gas turbine units of the M701JAC model equipped with two (2) waste steam generators (HRSG) without additional heating, with triple pressure intermediate heating and natural circulation. The steam turbine generator (ST) is of a

triple type with intermediate heating and condensation, in accordance with the boiler water steam cycle of the waste-heat boiler.

Each power unit has a dedicated boost transformer and a delivery point at the outgoing line. Power units 1 and 2 will be commissioned before the plant and will operate in a simple cycle through a bypass chimney during the Early Contract Period after the commencement date of commercial operation of power unit No. 1 and the Commencement Date of commercial operation of power unit No. 2. Both power unit No. 1 and power unit No. 2 will be able to operate in a simple cycle mode independently of other power units.

The natural gas is only fuel of the plant, back-up fuel is not considered.

The generated electric power will be diverted through a 500 kV substation and a 220 kV substation, which will be constructed near the Site.

River/canal water will be used as the main source of make-up feed water of the power plant, while a secondary water-cooling system based on a mechanical draft cooling tower will be used for the exhaust gas cooling system of a steam turbine.

The plot plan of the plant is designed for the external conditions as follows:

The main gas pipeline will be located in the western part of the plant's area.

The water intake and drainage will be connected to the river/canal located on the southwest side of the plant site by a direct and direct route.

The outgoing power line will be connected to a 500/220 kV substation, which will be built by "Acwa Power" Company to the northeast of the plant site.

The access road will be connected to the existing local road located on the southwest side of the plant site, and the main and secondary entrances will be located on the southeast side of the plant site.

The device and the principle of operation of the CCGT

The CCGT has two separate blocks in its design: gas turbine and steam turbine. In a gas turbine unit, the turbine is rotated by gas generated during fuel combustion. The air compressed in the GT compressor is supplied uninterruptedly to the combustion chamber, where it promotes the combustion of gaseous fuel at constant pressure. The combustion products are supplied to the gas turbine, where the kinetic energy of the gas flow is converted into the mechanical work of the turbine rotor rotation. The temperature of the gases in front of the gas turbine is 1100 - 1500 °C, depending on the turbine series.

A generator is located on the shaft with the turbine, which generates electric power due to the rotational movement of the rotor. When the gas passes through the turbine, its pressure value is close to the outdoor pressure, which prevents it from doing work. However, its temperature is still quite high and is about 430-500 °C.

After the gas turbine, the exhaust gases with a temperature of 430-500 °C are supplied to the waste heat boiler, where the steam is generated by transferring the thermal energy of the gases received from the gas turbine to the feed water and steam. Gases from the waste heat boiler are emitted into the atmosphere through the chimney with a temperature from 131.57 to 141.83 °C. The steam generated in the waste heat boiler enters the steam turbine, where the kinetic power of the steam is converted into the mechanical work of the turbine shaft rotation. The spent steam is sent to the condenser and, due to heat exchange with cooling water, is converted

into condensate, and then is sent back to the boiler. The process losses of steam and water are compensated by constant replenishment with chemically desalinated water in the power unit.

It is expected that the efficiency of the 1200-1600 MW CCGT will be 60%, which is 1.4-1.7 times higher than the efficiency of existing power plants of the Uzbek power system (on average - it is 34-37%).

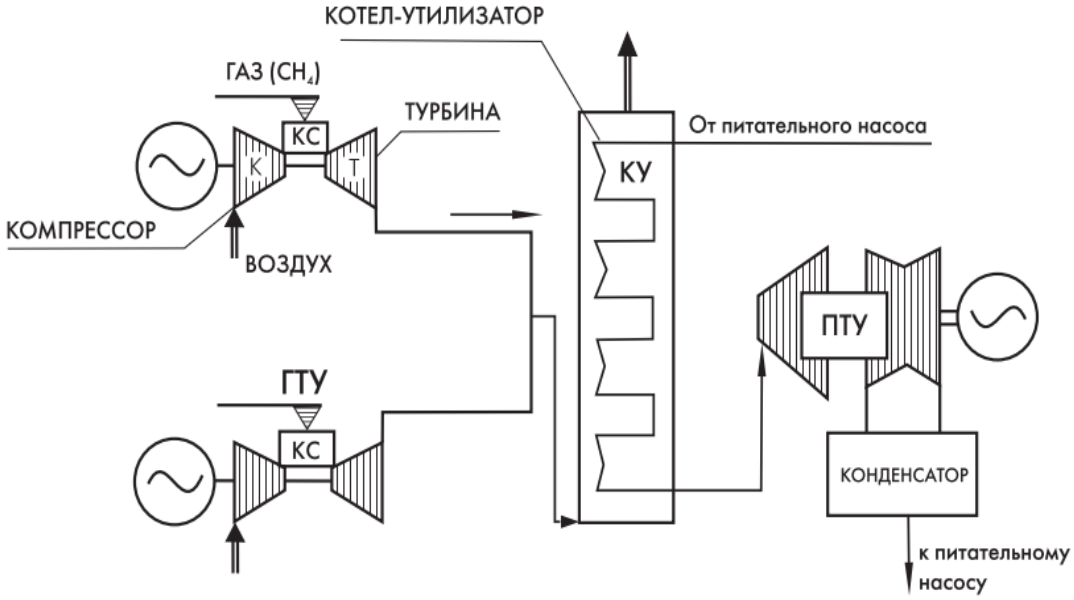

Figure 5. Process flow diagram

Description of the operation modes of the unit

The plant will be able to operate uninterruptedly with full or partial load as per the needs and requirements of the electric network which it will be connected to.

The plant will also be able to operate in a cyclic mode, for example, with a shutdown at night or during weekends.

In general, the unit is designed for the most efficient operation in the 2-on-1 combined cycle mode.

Meanwhile, it can operate with one GT, followed by its waste heat boiler, which drives the ST at low load.

Each of the GT is equipped with a bypass pipe and can operate in one cycle when necessary.

The GT can be started quickly without classification of cold, warm and hot start depending on the idle time.

Prior to start, it is necessary to ensure that the equipment of the blowout preventer that supports the operation of the launchers is on working status. This needs to be checked to enable the remaining auto-start process. The delivery package does not include a starting boiler to support the start of the plant. An auxiliary boiler for steam supply is provided to maintain a vacuum in the steam turbine system in case of operation in cyclic mode.

A fully integrated cascade steam bypass system will be provided for high pressure steam turbine, intermediate heating of intermediate pressure and low pressure steam to ensure rapid matching of steam and metal temperatures of the steam turbine during start-up, as well as for

waste heat steam generators to continue steam generation after the steam turbine, load relief without operating the safety valves of the waste heat boilers, and pressure relief to avoid opening the safety valves of the waste heat boilers when they are operated at full or sliding pressure.

Specifications of the expected parameters of a gas turbine operating in "simple" and "combined" cycles are given in the Appendix 5.

Parameters of the fuel used

The main fuel of the CCGT is sulfur-free natural gas. (The test report of gas samples is given in the Appendix 4).

Gas supply to the territory of the power plant site is planned to be carried out from a separate outlet line of the gas pipeline. Attachment 4 contains a letter from JSC "Uztransgaz" regarding the request of JSC "National Electric Grids of Uzbekistan" to JSC "Uztransgaz" to request Technical conditions and permission to connect to the gas pipeline.

The consumption of natural gas in general for one CCGT unit will be 129.44 thousand Nm3/h or 1049819.5 thousand Nm3/year. Accordingly, the total annual gas consumption for 2 CCGT units will be 2,099,639.0 thousand Nm3/year.

A clear advantage of the CCGTs to be installed under this project is reduction of specific fuel consumption parameters by comparison with specific parameters for the power system: 265 goe/kWh versus 375.8 goe/kWh for electric power generation.

Natural gas is supplied to the combustion chambers of the GT by a gas booster station (GBS).

The gas booster station is intended to compress a mixture of hydrocarbon gases, which is a fuel for a gas turbine, with constant operation of the CCGT with the necessary interruptions for preventive maintenance (oil refilling, filter cleaning, etc.). GBS is designed for GT operation with maximum gas consumption. Gas to the compressor station is supplied from the GBS to the GT to the input unit of operational regulation and measurement of gas flow.

The average parameters of the gas used as the fuel of the CCGT are given below in the Table 3.2

Table 3.2 Parameters of natural gas

Components	**Gas composition, mol %**
Carbon dioxide, CO_2	2.10%
Hydrogen sulfide, H_2S	< 0.020 g/Nm3
Methane, CH_4	91.21%
Ethan, C_2H_6	4.98%
Propane, C_3H_8	0.71%
i-Butane, i-C_4H_{10}	0.05%
n-Butane, n- C_4H_1	0.06%
i-Pentane, i-C_5H_{12}	0.02%

Components	Gas composition, mol %
n-Pentane, n- C_5H_{12}	0.01%
Hexane, C_6H_{14}	0.02%
Nitrogen, N_2	0.84%
Oxygen, O_2	0.00%
Wobbe index (upper) (kcal/m³)	48.53
Lowest calorific value (kcal/m³)	34.31

3.2 Expected emissions of pollutants

During the operation of the CCGT, the pollutants in the composition of flue gases (natural gas combustion products) will emit:

- under a "simple cycle" (without use of a steam turbine) through bypass pipes (2 units) installed on the CCGT, with a height of 45 m and a mouth diameter of 9.84 m;

- under a "combined cycle" (with using a steam turbine) through the chimneys behind the waste heat boiler, with 60 m high and a mouth diameter of 9.55 m.

The plant can operate in two modes, but the volume of sources of flue gas emissions will remain unchanged, that is, 2 units.

Moreover, the conditions for the pollutants dispersion during emission through a bypass pipe under a "simple cycle" are more optimal, since the flue gases have a higher temperature in this case by comparison with a "combined cycle".

When any of the above cycles of operation of the plant is in effect, three pollutants will be emitted into the atmospheric air – nitrogen oxide, nitrogen dioxide, carbon monoxide through two individual pipes.

According to the data of test report of gas samples, the gas supplied to the power plant is sulfur-free, and therefore generation of sulfur dioxide is not expected.

Generation of benzo(a)pyrene is also not expected since the oxygen content (O_2) is about 15% in the exhaust flue gases. The excess air factor (α) is calculated by the formula $\alpha = 21 / (21\text{-}O_2)$, which is equal to α – 3.5. With such an excess of air in the turbine, the hydrocarbon gas is completely combusted without the generation of benzo(a)pyrene.

According to calculations, **2787.2133 tons/year** of the pollutants will be emitted into the atmospheric air during the combustion of 1049819.50 thousand Nm³/year of natural gas.

The contribution of each pollutant to the gross emission is as follows:

carbon dioxide - 679,8081 t/year (24.39% of the mass of emissions),

nitrogen oxide – 294.5835 t/year (10.57% of the mass of emissions),

nitrogen dioxide – 1812,822 tons/year (65.04% of the mass of emissions).

The parameters of the emission sources were determined based on the technical and economic performance of the equipment.

Based on the operating performance of similar thermal power plants (with steam-gas technology), 99% of the gross emission of pollutants from the power plant is emitted through chimneys during gas combustion, the remaining 1% refers to the emissions from auxiliary units of the plant. The emissions from auxiliary units will be adjusted after determination of all the characteristics of the equipment (main and auxiliary) before commission of the power plant, during development of the standards for maximum allowable emissions, as part of the National EIA 3 stage.

Calculations of emissions of pollutants into the atmosphere and parameters of emission sources during operation are given in the Appendix 6.

The main advantage of the proposed design solution from the standpoint of ecology is the reduction of nitrogen oxide emissions compared to the power units currently operating at the TPPs of Uzbekistan, which is achieved through the use of a combustion system with a reduced content of nitrogen oxides and moisture (Dry Low NOx technology).

This provides the following benefits:

• Reduce water consumption

• Improving plant efficiency by reducing flue gas heat losses.

Low concentrations of NO_x are achieved not just by the applied technical solutions, but also due to the design features of the combustion chambers of the CCGT, as well as the combustion mode created, when the fuel is burnt almost completely.

These technical solutions make it possible to reduce the emission of nitrogen oxides from new units.

All technological processes are controlled (ACS) at the control room, where the monitoring panel is also located and the parameters of pollutants in flue exhaust gases are broadcast on the monitors of the control room through gas analyzers included in the ACS system.

GT is a new development in terms of electric power generation, with the highest standards for reducing the emissions into the environment taken into account. To control those standards, the GT includes an automatic system for monitoring the concentrations of pollutants (nitrogen and carbon oxides) in the exhaust gases from the GT by means of the gas analyzers. Gas analyzers are intended to determine the content of one, two or three components in multicomponent mixtures. The intent of the gas analyzers application is to control the gaseous substances in technological processes and during environmental monitoring when such facilities are operated.

The gas analyzer operates on the principle of non-dispersive infrared two-beam alternating light and allows to measure the gases with high selectivity when their absorption bands are within the infrared wavelength range from 2 to 9 microns, for example, CO, CO_2, NO, SO_2, NH_3, H_2O, CH_4 and other hydrocarbons.

The control of new unit by means of an automated control system with operational control, will enable to achieve high operational reliability and reduce emergency risks.

3.3 Water consumption and sanitation

A single water supply system is provided at the industrial site of 1200-1600 MW power plant, to meet the production and drinking needs, the source of this water is the Yuzhno-Golodnostep Canal.

The Law of the Republic of Uzbekistan No. 837-XII dated 06.09.1993, "On water and water use", specifies that the system of technical water supply of the power plant shall be recycling.

The water from the canal shall be treated for its use for production and household needs.

The water supply system will be designed to supply the required volume of filtered and river water to the water treatment plants, make-up cooling water for cooling towers and other consumers, such as technical and fire water systems.

The canal water intake pumps will be located at the river water pumping station located on the canal bank. The capacity of the pumps will be rated to meet the maximum water demand of the plant during the estimated lifetime of the plant.

Flow meters will be installed at the station to measure water flow. The river water pumps will be rated for conditions of low cavitation reserve without cavitation. The materials for the pump design will correspond to the state of the river water.

The installed pumps will have properties that will ensure their stable joint operation when they are used together. The properties of the upstream head will increase with the fall of the flow, so that the pressure in the closed valve will be sufficient to self-fill the system. The entire river water supply system (including pumps) will be able to withstand the transient pressure occurred during the simultaneous shutdown of all operating pumps, with provision of tools to limit the valve closing speed to a safe value.

The pumps and their auxiliary equipment will be controlled and monitored by the DCMS system. Each pump will be blocked for the conditions necessary for safe start-up and will be shut down during appearance of any condition that may cause immediate or rapid damage to the unit.

The needs of the plant will be satisfied with the pre-treated water from the clarified water storage system. The reservoir of process and fire-fighting water will ensure an average water consumption of the power plant for 72 hours at full load, including supply for desalination. The raw water storage system will be able to store within 24 hours of all the make-up water consumed by the plant in the most severe environmental conditions. In addition to the backup storage required for the fire protection system the process and fire-fighting water storage facility will store the process water within 72 hours.

Water treatment

One of the ways to increase the reliability and efficiency of the equipment on the power plant is to reduce the rate of corrosion of structural materials and generation of deposits in the

steam-water path. For this, it is necessary to use process water of a certain quality with a minimum content of impurities at the CCGT.

The source water from the canal shall be treated for the technological needs of the CCGT, and for this, the water treatment unit will be constructed.

The pretreatment unit consists of coagulation and flocculation, clarified water storage system, clarified water pumping system, sludge treatment and removal system, and all related equipment and accessories.

The water treatment unit will treat the make-up feed water for waste heat boilers, water to replenish the losses in cooling towers, and drinking water for drinking needs of the power plant in question.

The water treatment system of the thermal power plant will consist of primary filtration, demineralization (with a reverse osmosis (RO) system and a mixed bed system) and drinking water treatment.

The process is as follows:

Make-up water → Activated carbon filter → Pump for filtered water → Reverse Osmosis cartridge filter → Reverse Osmosis high pressure pump → Reverse Osmosis device → Waste tank → SPRO Transfer pump → SPRO Cartridge filter → SPRO High pressure pump → SPRO device → SPRO Permeate reservoir → SPRO Permeate pump → mixed ion exchanger → demineralized water tank.

The water from the canal will be supplied to the filter for initial treatment consisting in removal of any loose materials, sand, debris, or suspended solids from the raw water. This is done to prevent damage to the treatment downstream equipment. A certain degree of subsidence in the intake head will be achieved. All bulk materials and some suspended solids will be removed before the raw water is supplied to the treatment facilities.

Then, the water will flow into the raw water reservoir (storage), then - into the clarifier and from where the water flow is further distributed for the needs of the cooling tower, for make-up of the cooling tower, for demineralization, for drinking and fire-fighting needs.

Water will be demineralized by using a two-stage reverse osmosis system. Cartridge filters are used at all stages of the demineralization process to prevent damage to fine cleaning equipment.

It is envisaged that the operation of the demineralized water unit will be fully automatic with possibility of manually starting backwash, regeneration, washing of the ion exchange unit and backwash of activated carbon filters, etc.

The water demineralization system is intended to meet the needs of the systems as follows:

- make-up water for steam-water cycle system of the waste heat boiler;
- flushing of the GT compressor;
- water for preparation of chemical solutions;
- make-up water for a closed CCCW system.

The reverse osmosis unit used in the process of water demineralization is capable to remove particles with a size of 0.001–0.0001 microns from the water. This range includes: hardness salts, sulfates, nitrates, sodium ions, bacteria, viruses, dyes. Water contains salts that cause

scale deposits. The driving force of the process is the pressure difference on both sides of the semipermeable porous membrane. Due to the features of the internal structure of the modules, the input stream is divided into parts as follows:

- permeate – purified water that has passed through the membrane;
- concentrate is dirty water with a high content of impurities that have not passed through the pores of the membrane.

Water is filtered through the pores of the material. The filtered stream contains water molecules, low molecular weight compounds and ions smaller in size than water molecules. All other components of the solution, both mechanical (certain molecules, viruses) and dissolved (metal ions, salts) are entrapped.

During operation, a large amount of contamination gradually accumulates on the surface and in the pores of the membrane. Such deposits reduce the performance of the unit. It is possible to restore the performance by a regeneration cycle (washing).

Most often, surface is cleaned by backwashing with a stream of water or purging with compressed air.

One of the advantages of reverse osmosis filters is the environmental safety of their cleaning. Reverse osmosis filters do not require the use of specialized chemical reagents;; therefore, no chemical compound is introduced into the treated water.

The recycling water system stipulates the use of cooling towers for cooling and reuse of the heated water (after cooling). The recycled water cooled at the cooling towers is supplied to the main and auxiliary equipment of the CCGT via circulation water ducts with using circulation pumps. After the condensers and other heat exchangers, the spent (heated) water is supplied to the cooling towers for cooling by similar circulating water ducts. Then, the cycle repeats.

The losses in the recycling system (evaporation and entrainment of water in cooling towers, purging of the circulation system) are replenished through supply of make-up water from the raw water tank, which is replenished with water from the canal.

The cooling towers are constantly purged to avoid generation of salt deposits on the walls of the equipment. Purge water is conditionally pure. After purging, the clean water is supplied to the canal.

An additional line of remineralization (dosing of $CaCl_2$ and $NaHCO_3$) and ultraviolet disinfection is provided for water purification to drinking quality. Dolomite filters are used to increase the amount of dissolved salts before supply of the drinking water for further use. Drinking water from the remineralization system will be stored in a drinking water storage tank (50 m^3) of a suitable capacity and will be distributed to all points of consumption through drinking water.

<u>Sampling and dosing of chemicals</u>

The plant will be equipped with a system of continuous sampling and control of selected samples from the steam-water circuit of the waste heat boiler.

The quality control of the boiler make-up water is given below:

Hardness≈0mcmol/l

SiO2≤ 20 μg/l

Conductivity (25℃)≤ 0.20 μcm/cm

The sampling sites and analyzers will be selected so that a proper monitoring and control of the limits of the chemical composition of steam and water will be ensured. The measurements of the analyzers will be recorded on the DCMS of the power plant. Manual sampling will be provided for each sample.

The plant will be equipped with chemical dosing systems to control the chemistry of the boiler and feed water. Each chemical dosing system will include all the equipment for safe, reliable and efficient operation of dosing systems, including containment, separate drains for chemicals, appropriate ventilation and devices for emergency eye washing and drainage shower.

Oxygen and carbon dioxide corrosion of the thermal system is reduced by adding an ammonia to pipeline for condensation by means of a metering pump. Ammonia and an oxygen absorber are also added to the feed water. The drums of high and medium pressure boilers should be treated with adding the phosphate to control the chemical stability of the boiler water and reduce pollution inside the boiler, arising from leaks of the steam condenser.

The consumption of oxygen scavenger is about 80 l/h (only for information purposes, that will be updated at the execution stage).

The consumption of solution of phosphate and ammonia is about 200 l/h (this is for information purposes only;; the data will be updated at the execution stage).

Water consumption

The operation of thermal power plants is always associated with use of a large amount of water. The main part of the water for production needs is used for the water-cooling system of equipment (turbine condensers, oil and air coolers, driving gears, etc.), as well as for the water treatment system (to replenish the losses of steam and condensate in the CCGT cycle), nitrogen oxides and moisture (Dry Low NOx technology).

A recycling water supply system is provided, the intake of fresh additional industrial water is provided in the amount necessary to replenish irretrievable losses and compensate the consumption for purging the recycling system. The rated consumption of additional water for the CCGT will be 1381.0 m^3/hour.

The consumption consists of as follows:

- make-up of cooling tower – 1220 m^3/hour;
- water supply for demineralization – 115.0 m^3/hour;
- water for the boiler room – 3.0 m^3/hour;
- water for steam replenishment at the steam unit in the engine room – 3.0 m^3/hour;
- water for cooling the equipment – 20.0 m^3/hour;
- unforeseen needs – 20 m^3/hour.

The flow rate and distribution of the water flow will be as follows.

Fresh process water is supplied from the Yuzhno-Golodnostep Canal to the pumping station, and from where it is supplied to the clarifier in the amount of 1381.0 m3/hour. Also, the sludge-free water from the retention basin in the amount of 17.0 m3/hour is added to the fresh water. From the clarifier, 15 m3/hour of water is supplied to the retention basin with the sludge. The clarified water tank receives 1 383 m3/hour. From clarified water tank, part of the water is

supplied to the recycling system, part - to the filtration system, and another part - to the tank for unforeseen needs.

In total, the recycling system uses 80 000 m3/hour. In total, 1 240 m3/hour of fresh additional water is supplied to the recycling system. Of these: 1 220.0 m3/hour from a clarified water tank, and 2.0 m3/hour from a water tank for lubricating pump bearings.

Water from the cooling water pump for the cooling tower is supplied to the mechanic traction cooling tower (80 000 m3/hour). After the cooling tower, water is distributed in the manner as follows: 3 m3/hour from the cooling tower, 8.0 m3 / hour for losses, 930 m3/ hour is evaporated, 30.0 m3/hour for periodic purging of the cooled water boiler, 272.0 m3/hour is a water flow from the cooling tower to the canal.

10.10 m3/hour of water from the clarified water pool is used for unforeseen needs of the enterprise. The filtration system receives 153.0 m3/hour from the pool. From the filter, water partially is supplied to the water tank for backwash of the filter (2.0 m3/hour) and to the water tank for drinking, process, and fire-fighting needs (151.0 m3/hour).

From the tank for drinking, process and fire-fighting needs, water is distributed and used in the manner as follows: 115.0 m3/hour for demineralization, 3.0 m3/hour for use in the boiler room, 3.0 m3/hour for steam unit in the machine hall, 20.0 m3/hour for lubrication of the circulation pump of cooled water, 10.0 m3/hour for other process needs.

115.0 m3/hour of water is supplied for demineralization. After demineralization, water is distributed in the manner as follows: for 2.0 m3 / hour for domestic needs, 60.0 m3/hour for the boiler, 12.0 m3 / hour is evaporated, 39.5 m3 / hour is drainage to the canal, 1.5 m3 / hour is discharge of water into the retention basin.

The retention basin is three-section, horizontal, of continuous operation. One section of the retention basin is in operation, the other one is in repair or cleaning, the third section is dried for sediments with subsequent removal by diggers and disposal of sediments by motor transport.

The approximate consumption of water from the surface watercourse for the needs of the power plant will be 1381.0 m³/h or 11201,291 thousand m³/year, of which - 2.0 m^3/hour or 16,222 thousand m^3/year for drinking needs.

Water discharge

Effluents of TPP consists of industrial and domestic effluents.

Effluent is any stream of water discharged from the power plant cycle.

The composition of the industrial effluent is determined by the type of the power plant and its core equipment, capacity, type of fuel, composition of the source water, method of water treatment in the core production and, obviously, the level of operation.

Industrial effluent is discharged to the Yuzhno-Golodnostep Canal. Water will be discharged through the discharge canal.

The plant will be equipped with EFB (effluent treatment block), which cleans all effluent streams before discharge, until it will comply with the design conditions of effluent disposal (standards). The system provides collection and treatment of all effluent streams. Effluent

streams are separated based on their origin and/or type of contamination and the type of treatment required.

Only effluents that have been treated in accordance with the regulations of the Republic of Uzbekistan will be discharged into the canal. Other effluent will be removed by a certified reclamation company.

The plant's drainage facilities include as follows:

• An online monitoring system for critical effluent parameters, such as pH value, electrical conductivity, residual chlorine, oil (to be finally determined by the competent authority). The remote access is provided via the OPC interface, and all measured data are transmitted to the control room.

• A composite sample, which is taken daily proportionally to the flow. A composite sampler with a refrigerator, i.e. a sample proportional to the flow, shall be removed for regular laboratory tests.

The effluent of the plant has the parameters as follows:

- industrial effluent, which includes purge water of the cooling tower, effluent from the water treatment plant (osmosis concentrate), oiled effluent (when equipment is cooled), insulated effluent from cooling the equipment;

- domestic effluent;

- storm drain.

The total approximate volume of industrial effluent is 357.5 m3/hour or 2 899.682 thousand m^3/year or 100 L/s.

The volume of industrial effluent is generated from:

discharge of purge water of the recycling water supply system – 30.0 m^3/hour,

discharge of purge water from the cooling tower – 272.0 m^3/hour,

discharge of water from the water treatment plant system (demineralization) – 39.5 m^3/hour,

discharge of water from the tank for process needs – 10.0 m^3/hour,

water from the boiler room – 3.0 m^3/hour,

discharge from the steam unit in the machine halls is 3.0 m^3/hour.

Considering the process and in order to avoid generation of salt deposits on the walls of the equipment, the cooling towers and the recycling system are constantly purged. Purge water is conditionally pure. The total salt content in this water does not exceed the salt content in the source water. After constant purging, water is directed to the canal.

The effluent of the water treatment plant is the water coming from reverse osmosis units – concentrate, dirty water with a high content of impurities (hardness salts, sulfates, nitrates, sodium ions, bacteria, viruses) which have not passed through the pores of the membrane. Purge water from the boiler and desalination unit shall be neutralized so that it has the required pH value. The effluent of the water treatment plant is transported by a pump after its mixing with air. With this, the environmental parameters of the established limits for effluent discharge are verified. After the neutralization process, the effluent of the water treatment plant is diverted to the Yuzhno-Golodnostep Canal at the permissible discharge rates.

Oily effluent is generated when the external heating surfaces of the equipment are flushed. Water after cooling of turbine condensers and air coolers, as a rule, carry thermal pollution only. This water is supplied to the cooling tower and returned for the recycling after cooling.

With this, oil coolers are also included into the cooling system, and deviation in their density can result to the penetration of petroleum products (oils) into the cooling water. A system for collecting and cleaning the oil-containing waters is provided, which is an integral part of the power plant. The system is intended to collect water from the areas that can be contaminated with oil, for its subsequent treatment. The oiled effluent will be separated from the oil by means of an oil separator. The separated oil will be transferred for processing to a special organization, while the treated water from the oil separator with acceptable parameters is returned for recycling.

Effluent from GT flushing processes will be collected separately, and a suitable device will be provided for their pumping into truck tanks for disposal at certain disposal sites.

Domestic effluent will be diverted either to the municipal effluent treatment plant or treated at own biological aerobic domestic effluent treatment plant (it is not finally established at this stage). The volume of domestic effluent to disposed is equal to the volume of water consumed for domestic needs and will amount to 2.0 m^3/hour or 16.2 thousand m^3/year. If, at the stage of the plant commission, it will be decided made to treat domestic effluent at own treatment plant, the treated water will be reused for watering the territory, with provision of a lifting station for removal of solid waste by loading into special vehicles.

The total drainage of the power plant is as follows:
Production runoff – 357.5 m^3/hour or 2899.682 thousand m^3/year
Domestic runoff – 2.0 m3/hour or 16,222 thousand m^3/year.
Water balance diagram of the power plant is given in the Appendix 8.

The volume of water consumption and disposal will be adjusted when all the properties of the equipment will be determined prior to commission of the TPP, during development of water consumption and sanitation standards, as part of the National EIA 3 stage.

Regulatory conditions for water discharge into watercourses

All effluents discharged to the Yuzhno-Golodnostep Canal shall comply with the requirements of the Sanitary Rules and Regulations No. 0318-15 of the Republic of Uzbekistan "Hygienic and anti-epidemic requirements for protection of water bodies in the territory of the Republic of Uzbekistan".

In particular, according to the temperature regime, the summer water temperature shall not increase by more than 3°C after discharge compared to the average monthly temperature of the hottest month of the year in the last 10 years.

3.4 Waste generation

The 1200-1600 MW power plant in question will generate approximately 38 items of industrial and domestic solid waste after commissioning.

The amount and mass of waste, and its composition is determined by the type and quantity of fuel burned, combustion process, water treatment process, operating conditions of the core and auxiliary equipment, availability of auxiliary operations. The quantitative properties of the generation of industrial and consumption waste given below, are taken on a high-level based on the production processes of similar thermal power plants. The hazard class of waste was determined as per the Waste Classification Catalog (the Appendix No. 15 to the Decree of the Cabinet of Ministers of Uzbekistan, No. 14 dated 21.01.2014).

Adjustment of all types of waste and quantitative parameters of its generation during the operation of the power plant, the plan for its temporary storage, transportation, processing, and disposal will be established and approved when all the properties of the equipment will be determined prior to commission of the power plant, when standards for its generation and placement will developed as part of the National EIA 3 stage.

The approximate types of waste to generated were adopted as per the "Methodological recommendations for development of the Draft standards for the maximum disposal of waste by thermal power plants, thermal power stations, industrial and heating boilers", St. Petersburg 1998, as well as per the practical activities of the similar thermal power plants.

Parameters of waste generation sites.

The main volume of waste is industrial and is generated at the production sites as follows: boiler, turbine, water treatment and water purification, repair and construction, mechanical repair, electrical workshop.

Also, the enterprise will have operating office space, a canteen, a medical center within its boundary limits, where non-industrial waste is generated.

It is planned to perform the landscaping and greening activities on the site of the of the 1600 MW power plant location.

Turbine site

The purpose of this site is to generate electric power by burning the gas. Turbine oil is poured into the turbines. Complete oil refill in turbines is carried out 1 time within 4-5 years, while partial replacement - depending on the condition of the oil. Permanent oil cleaning equipment is installed directly at the turbine generators for preventive oil regeneration, to keep the oil quality in the turbine generators at the level of operational standards.

All waste oil (compressor, turbine, transformer and motor) shall be regenerated. In case of own oil regeneration units to be provided, the waste oil can be regenerated at the enterprise itself. If not, the waste oil will be removed to the special enterprises.

Waste oil is poorly soluble in water (no more than 5%), flammable (the flash point ranges from 135 to 214 °C depending on the oil type and brand), and chemically inactive during storage.

The flow part of the steam turbine shall be cleaned regularly (1 time within 4 years) pneumatically. The scale is generated when the flow part of the turbines is cleaned.

Compressors are used to produce compressed air.

The waste is generated in the workshop due to use of oil and cleaning of the flow part of the steam turbines and oil tanks. Oil sludge accumulates in oil tanks during the operation of turbines.

The main wastes are as follows: waste turbine oil, compressor oil, scale. And also, oil regeneration sludge, waste regeneration materials (filters, silica gel) in case own oil regeneration plant is available. Oil regeneration sludge can be supplied to the enterprises producing the road surfaces as an additive. Spent oiled filters are burned in the boiler furnace, silica gel is removed to the landfill.

Scale is generated during the cleaning of natural gas filters (when natural gas passes through mechanical filters) and is collected during the filters regeneration. Composition (%): iron – 90-95; iron oxides – 5-10; Fe – 50-55; Fe_2O_3 – 5-10; SiO_2 – 45. It is temporarily located on the territory, and when accumulated – can be transported to the cement production enterprises as an additive. The waste is not flammable. Chemically inert.

Boiler site

The core production process of this site is the production of steam by means of heat recovery boilers.

The waste in the workshop is generated due to use of oil, sealants, cleaning of the internal and external surfaces of the core equipment.

The main wastes are as follows: waste oil, sludge from boiler cleaning, waste from use of sealant, waste insulation.

Waste oil shall be regenerated. In case of own oil regeneration units to be provided, the waste oil can be regenerated at the enterprise itself. If not, the waste oil will be removed to the special enterprises.

Sludge from boiler cleaning is generated when deposits (scale) are removed by their flushing with water. The water is neutralized and settled in a special container. The sludge generated in this case is characterized as sludge from cleaning equipment. Waste is not flammable, insoluble in water. It is temporarily placed in tanks. When moisture evaporates from it, it can be used to fill the territory.

The waste of the brickwork is generated during regular repair of boilers only. Such waste includes waste of refractory materials and thermal insulation. Thermal insulation waste is the residue after removal, reuse, and replacement of thermal insulation. Approximate composition of the waste (in %): mats – 19.8; mineral wool – 80.2. Non-flammable, insoluble in water. It is removed from the territory when accumulated as construction waste.

Waste is generated when sealant is used. It is generated during regular (1 time within 3-4 years) cleaning of equipment and consists of an anticorrosive "film". Waste from the use of sealant can be classified more generally as "Sludge from equipment cleaning".

Electrical workshop

The purpose of the workshop is to ensure the power supply of the core and auxiliary workshops and distribution of electric power among consumers.

The core structural unit of the workshop is a transformer substation. Oil transformers and oil switches are installed at the substations of the power plant.

Major repairs of transformers are carried out 1 time within 8-10 years. Oil is regularly added to the transformers during operation, as necessary. A complete oil refill in the switches is carried out 1 time within 5-6 years. Oil shall be regenerated when it is refilled.

The insulation of cables (underground and external), is regularly checked at the workshop and replaced and repaired .

The main wastes are as follows: waste transformer oil, cable trimmings.

Centralized repair shop

This workshop carries out repair activities, mainly in the boiler and turbine sites. In this case, ferrous and non-ferrous metals, welding electrodes, and paronite are used. The waste includes metal residues, electrode stubs, spent paronite gaskets.

Scrap of ferrous metals is generated during repair of boilers, turbine units, auxiliary equipment, replacement of gas ducts, pipelines and plumbing equipment when the operational life of the devices is expired (7-9 years). Typical composition (in %): iron – 95-98; iron oxides – 2-1; carbon – up to 3. Scrap of ferrous metals is transferred to the Vtorchermet company for processing.

Scrap of non-ferrous metals is generated during tool processing of metals, repair of instrumentation and control equipment, and is available in a damaged cable. The waste is not flammable, insoluble in water, chemically inactive during storage. Scrap of non-ferrous metals is transferred to the Vtorchermet company for processing.

Welding electrode stubs are the residues of electrodes when they used during welding for repair of core and auxiliary equipment. Composition (%): iron – 96.0-97.0; coating (type $Ti(CO_3)_2$) – 2.0-3.0; other – 1.0. They are transferred together with the scrap of ferrous metals to the Vtorchermet.

Paronite is trimmings of new paronite gaskets and old gaskets to be replaced. It is placed and removed together with industrial or domestic waste.

Repair and construction site

The purpose of this workshop is to repair the premises, to do minor repairs and utility work.

The main raw materials as follows: boards (edged and uncut), building materials, ferrous metal, pipes, batteries, glass.

For painting and other activities, the workshop receives varnishes, enamels, whitewash, pigments, adhesives.

Waste in the workshop is generated due to wood processing, application of paint and varnish materials, replacement of glass and linoleum, repair and replacement of thermal batteries, operation of transport, etc.

The main wastes are sawdust and shavings, lumpy wood waste, paint containers, glass cutting, industrial (construction) garbage, scrap of ferrous metals.

Industrial (construction) garbage is generated after the repair of premises and equipment, plastering and cladding works. The composition of the waste may include, for example, cement residues – 10%, sand – 30%, ceramic tile fight – 5%, plaster – 55%.

It is removed to the construction waste landfill.

The site of the water treatment plant and effluent treatment

The purpose of this site is to ensure the quality of the source water for process needs for treatment of effluent from suspended solids and to ensure the quality of effluent treatment upon its discharge to open water bodies.

The main wastes are filtrate, entrapped oils, sludge from tanks cleaning.

The water from the canal will be supplied to the carbon filter for initial treatment consisting in removal of any loose materials, sand, debris or suspended solids from the raw water.

The waste of water treatment is a filtrate (sediment from flushing water from the canal) and generated as a result of initial cleaning on a sand filter. It contains bulk materials, silt, sand, debris or suspended solids. The filtrate is dehydrated and removed. The waste is removed to the landfill.

Then, the water is softened at the reverse osmosis and electric deionization unit. The concentrate (water with a high content of impurities that have not passed through the pores of the membrane of the units) is discharged to the canal after neutralization. No waste is generated during this process.

Oiled effluent may generate when the external heating surfaces of technological equipment are flushed for cooling. It can generate when the density is deviated in the oil cooling system. Also, oiled runoff can be generated as a result of rain flushing from the surface of the power plant site, stormwater effluent is discharged into the storm sewer. The oiled effluent will be separated from the oil by means of an oil separator. Composition (in %): petroleum products is about 70, water – about 30. The oil separated from the water is diverted to the receiving tank and is transported to a specialized organization for processing when accumulated.

It is also possible the waste generation in the form of sludge from tanks cleaning, due to the deposition in tanks of conditionally pure water, receiving tanks and other equipment of sludge, filter and other materials removed from mechanical filters or other equipment. The composition of the waste can be determined by calculation, taking into account the process features of the flow to the tanks and generation of suspended substances in the tanks. Waste is not flammable, insoluble in water. It is temporarily placed in tanks. When moisture evaporates from it, it can be used to fill the territory.

Garage

In case own fleet available, waste in the form used batteries and used tires is generated.

Used batteries and tires are transported to special enterprises for their processing when accumulated.

Medical center

A medical center, if available, is intended to provide prompt medical care.

This center is characterized by such waste as disposable syringes after disinfection, used dressing material. The waste is directed for thermal disposal.

Canteen

A canteen, if available, is intended to provide meal for power plant employees.

The main waste of the canteen is food waste. Food waste is transferred to the local communities for the livestock feed.

Office space

The offices of the management and engineering staff are located in the office premises. Waste of such premises can be wastepaper and human waste. Wastepaper is transferred to Vtorsyryo company when accumulated.

In addition, during operation, such types of waste are generated as:

used LED lamps – when the territory of the power plant and premises is lighted;

oiled rags (more than 15%) – when equipment is wiped;

polyethylene and paper bags – when various reagents and materials are packed;

worn work clothes, spent PPE, solid household waste (MSW) – during the life activities of the working staff;

sweepings – when paved and landscaped areas are cleaned.

An indicative list of waste generated during the operation of thermal power plants is given in the Table 3.3.

Table 3.3. Indicative list of the power plant waste

No.	*Name*	*Hazard class*	*Indicative volume of waste generation, ton/year*
1	Used turbine oil	2	3.549
2	Used compressor oil	2	0.446
3	Used transformer oil	2	1.242
4	Used engine oil	2	0.178
5	Used oiled filters	3	0.008
6	Used silica gel	4	0.027
7	Oil regeneration sludge	3	0.541
8	Sludge from boiler cleaning	4	6.219
9	Cable trimmings	4	0.21
10	Scale	3	0.607
11	Waste from sealant using	3	0.630
12	Thermal insulation waste	4	60.85
13	Waste of refractory materials	5	107.623
14	Ferrous metal waste	5	50.361
15	Non-ferrous metal waste	3	0.455
16	Welding electrode stubs	4	0.054
17	Paronite	4	0.054

No.	*Name*	*Hazard class*	*Indicative volume of waste generation, ton/year*
18	Filtrate of water treatment plant (mechanical litter)	4	0.56
19	Sludge from tanks cleaning	4	1.078
20	Entrapped oils (petroleum products)	2	0.027
21	Wood waste	5	0.12
22	Broken glass	5	0.07
23	Containers from paint and varnish materials	3	0.102
24	Used batteries	2	0.147
25	Used tires	4	0.323
26	Used plastic bags	4	0.3
27	Used paper bags	4	0.32
28	Oiled rags	3	0.378
29	Worn-out workwear	4	0.456
30	Used PPE	4	1.589
31	Dressing material used by medical center	4	0.02
32	Used medical syringes	4	0.02
33	Used LED lamps	5	0.879
34	Wastepaper	4	0.050
35	Construction waste	4	1.138
36	Canteen food waste	5	7.7
37	Solid household waste	4	5.0
38	Sweepings from cleaning of the territory	5	3.85

At this stage, the list presented above by type and volume of waste is indicative, is based on the process technologies of similar thermal power plants and is not accurate.

All types of waste and their quantitative parameters will be adjusted prior to commission of power plant, when all the properties of the equipment are determined.

The plan for the temporary storage of waste, its transportation, processing, and disposal will be established and approved when standards for their generation and placement will be developed as part of the National EIA 3 stage.

4 Analysis of the types of impacts during the operation of the power plant

Impact on atmospheric air

Operation of a new 1200-1600 MW power plant in the Bayavut district of the Syrdarya region will be associated with emission of three types of pollutants into the environment – nitrogen dioxide, nitrogen oxide, and carbon monoxide.

The main sources of atmospheric pollution will be two chimneys:

- under a "simple cycle" (without use of a steam turbine) through bypass pipes (2 units) installed on the CCGT, with a height of 45 m and a mouth diameter of 9.84 m;

- under a "combined cycle" (with using a steam turbine) through the chimneys behind the waste heat boiler, with 60 m high and a mouth diameter of 9.55 m.

2 787.2133 tons/year of the pollutants will be emitted into the atmospheric air during the combustion of 1 049 819.50 thousand Nm^3/year of natural gas, regardless of the operational cycle.

The contribution of each pollutant to the gross emission is as follows:

carbon monoxide – 679,8081 t/year (24.39% of the mass of emissions),

nitrogen oxide – 294.5835 t/year (10.57% of the mass of emissions),

nitrogen dioxide – 1812,822 tons/year (65.04% of the mass of emissions).

Concentrations of harmful substances was calculated by means of the "Ecolog" software on an area of 9.0 × 9.0 km ^{2}, with 500 m increments to determine the level of impact of atmospheric air emissions from the new 1200-1600 MW power plant in the Bayavut district of the Syrdarya region, for two options:

- under a "simple cycle" of operation;

- under a "combined cycle" of operation.

The results of calculating the dispersion of pollutants in the atmosphere are given in the Appendix 7 in graphical form for two options of power plant operation.

Meteorological characteristics and factors determining the conditions of chemicals dispersion in the atmosphere were accepted as per the Table 1.1, Chapter 1 (see above).

In accordance with the hazard classes of emitted pollutants, quotas for emissions of pollutant emissions were established. The list of pollutants and the current standards for the level of atmospheric pollution are given in the Tables 4.1 and 4.2.

Table 4.1 Properties of pollutants emitted into the atmosphere during a "simple cycle" of operation

No.	Name of the substance	Maximum allowable one-time concentration or 500 mg/m3	Hazard class	Established quota (share of Maximum allowable con-centration (MAC)	Max. concentration outside the industrial area (MAC shares)	Compliance with the estab-lished quota (+/-)	Total discharged in the air, tons/year	Percentage of contribution to emissions
1	Nitrogen dioxide	0.085	2	0.25	0.12	+	1812.822	65.04
2	Nitric oxide	0.6	3	0.33	Tmc<0.01*	+	294.5835	10.57
3	Carbon monoxide	5.0	4	0.5	Tmc<0.01*	+	679.8081	24.39
	Total						**2787.2133**	**100**

* Tmc is the total maximum concentration generated by emissions of particular substance is less than the expediency coefficient E3 = 0.01 (the fields of generated concentrations were not calculated for this substance).

Based on the calculated data, the following level of atmospheric air pollution outside the boundary limits of the enterprise was determined:

Nitrogen dioxide the maximum concentration in the atmospheric air outside the boundary limits of the site will be 0.12 MAC with the established quota of 0.25 MAC (Figure P.7.1).

Nitric oxide. The total concentration in the atmospheric air outside the boundary limits of the site is less than 0.01 MAC with an established quota of 0.33 MAC. Calculation is not advisable.

Carbon monoxide. The total concentration in the atmospheric air outside the boundary limits of the site is less than 0.01 MAC with an established quota of 0.5 MAC. Calculation is not advisable.

Table 4.2. Properties of pollutants emitted into the atmosphere during a "combined cycle" of operation

No.	Name of the substance	Maximum allowable one-time concentration or 500 mg/m3	Hazard class	Established quota (share of Maximum allowable con-centration (MAC)	Max. concentration outside the industrial area (MAC shares)	Compliance with the estab-lished quota (+/-)	Total discharged in the air, tons/year	Percentage of contribution to emissions

1	Nitrogen dioxide	0.085	2	0.25	0.18	+	1812.822	65.04
2	Nitric oxide	0.6	3	0.33	Tmc<0.01*	+	294.5835	10.57
3	Carbon monoxide	5.0	4	0.5	Tmc<0.01*	+	679.8081	24.39
	Total						**2787.2133**	**100**

* Tmc is the total maximum concentration generated by emissions of particular substance is less than the expediency coefficient E3 = 0.01 (the fields of generated concentrations were not calculated for this substance).

Based on the calculated data, the following level of atmospheric air pollution outside the boundary limits of the enterprise was determined:

Nitrogen dioxide the maximum concentration in the atmospheric air outside the boundary limits of the site will be 0.18 MAC with the established quota of 0.25 MAC (Figure P.7.2).

Nitric oxide. The total concentration in the atmospheric air outside the boundary limits of the site is less than 0.01 MAC with an established quota of 0.33 MAC. Calculation is not advisable.

Carbon monoxide. The total concentration in the atmospheric air outside the boundary limits of the site is less than 0.01 MAC with an established quota of 0.5 MAC. Calculation is not advisable.

Thus, based on the calculations carried out, it can be concluded that there will be no negative impact on the state of atmospheric air, since the concentrations of pollutants for all emission ingredients do not exceed their established quotas during operation of the projected facility (under any of the operating cycles).

The implementation of the project in question consideration will not worsen to a change in the state of atmospheric air by comparison with the current state: the state of atmospheric air will remain at the acceptable level.

Impact on soil and vegetation

After commissioning of the new 1200-1600 MW power plant, the introduction of nitrates into the soil and vegetation by migration from the atmosphere due to subsidence will be insignificant.

Impact on surface waters.

The introduction of pollutants and heat into the canal during the operation of the power plant is expected to be within the established standards due to the use of a recycling water supply system and constant monitoring of the quality of the discharged water.

Acoustic impact

It is generally recognized that silence is the most important component of a comfortable human stay. The negative impact of noise from power facilities has the aspects as follows: medical, social and economic.

The medical aspect is related to the fact that the increased noise of the equipment affects the nervous and cardiovascular systems, human reproductive function, causes irritation, sleep disturbance, fatigue, aggressiveness, contributes to mental illness. Occupational diseases associated with noise exposure occupy the first place among other diseases of employees of power companies.

The social aspect is related to the fact that large groups of the people are affected by the noise, including from the power facilities. According to some data, over 60% of the people lives in conditions of excessive noise. Noise from power facilities can be a source of excess of sanitary standards within a radius of several kilometers.

The economic aspect is related to the fact that noise affects labor productivity, and compensation of the consequences of diseases from noise means significant social benefits. An increase in the noise level by 1-2 dBA leads to a decrease in labor productivity by 1% (at sound levels greater than 80 dB). It has been proven that noise reduces visual response, which, together with fatigue, dramatically increases the likelihood of errors when operators work. This is especially unacceptable for power production, where reliability of operation is quite crucial.

Taking into account the proximity of the residential buildings, the level of acoustic impact from the installed equipment with a total capacity of 1200-1600 MW shall be calculated to make a forecast assessment of changes in the noise load on residential buildings located around the construction site after power plant commission, and during the construction phase.

Acoustic impact during operation

The main acoustic impact of the new power plant will be from the exhausts of the gas turbine, the gas turbine itself, the steam turbine, the generator, the chimneys, the gas booster station.

After the implementation of the project, it is envisaged that the noise standards (no more than 45 dBA at night and no more than 55 dBA during the day in residential buildings according to Construction code and regulations 2.01.08-96) and no more than 80 dBA in permanent workplaces according to Sanitary Rules and Regulations No. 0325-16 "Sanitary norms of permissible noise in workplaces" will be complied during the operation of the power plant.

The emergency purge valves will be the sources of the highest noise from the CCGT. The noise impact from such valves will be felt by CCGT personnel in the workplace, the impact will be regular and reversible.

An analysis of the parameters of the analog CCGTs indicates that the noise impact will not spread beyond the boundaries of the power plant. This is due to the use of various methods of noise control. Therefore, the noise from the very CCGT is expected to be attenuated by installing a casing. It is also expected to install a muffler at the outlet of the heat recovery steam generator. The installation of a muffler is not provided for the exhaust of a gas turbine since the exhaust gas is emitted to the atmosphere through a high pipe, which attenuates the noise in

terms of intensity and direction. In addition, although the exhaust of a gas turbine exerts a strong sound pressure in the low frequency band, it is weakened when the exhaust gas passes through the heat recovery steam generator. The noise from the suction of the gas turbine, which exerts pressure in the high frequency band, can also be relatively easily attenuated by means of sound insulation.

In general, the acoustic noise from the CCGT will not have a negative impact, since in addition to various methods of noise control to be used during operation of the equipment, the noise will also be attenuated by buildings, structures, and green spaces of the plant.

The expected noise level will not exceed the values standard for residential buildings, however, during the operation of the CCGT, the measurements will be required to identify compliance with the standards for acoustic impact.

The expected vibration level from the CCGT sources will not exceed 50 dB and will not be felt outside the boundaries of the work site.

The noise impact from the CCGT will not exceed the prescribed values, provided that the above-listed methods of noise control will be used during the installation of new combined-cycle gas units.

The work was performed with guidance by the building codes and rules of Construction code and regulations 2.01.08 –96 "Noise protection", which define the requirements for acoustic calculations and establish the norms of permissible noise levels.

The noise impact during the operation of the thermal power plant on nearby facilities was determined based on the four reference points as follows:

Point 1 – the nearest residential building No. 1 (north-west side);

Point 2 – the nearest residential building No. 2 (residential village Sarmich, north-west side);

Point 3 – the nearest residential building No. 3 (Shirin, south-east side);

Point 4 – the nearest residential building No. 4 (suburban structures, south-east side).

The acoustic was calculated based on the power levels of the outgoing sound of the equipment provided by the Customer taken as raw data (the Appendix 9).

The noise propagation levels on the territory were calculated by means of a special "Ecolog–Noise" software developed by the "Integral" company (Saint Petersburg), license agreement No. 010597.

The production release of the software considers the noise level from sources outside the building as raw data and does not take into account the shielding effect of green spaces and the ground surface.

The calculation results are given in the Appendix 9 in the form of tables and graphical representation of noise propagation zones during operation of power plant.

Standards for territories directly adjacent to the residential buildings (Source: Sanitary Rules and Regulations No. 0267-09 "On ensuring permissible noise in residential, public buildings and residential structures") in octave bands and equivalent in tables 4.3-4.4.

Tables 4.3-4.4 Standards for territories directly adjacent to the residential buildings

Nighttime from 11pm to 7am

Sound pressure levels, dB, in octave frequency bands with average geometric frequencies, Hz								Sound levels, La
63	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**	**La**
67	57	49	44	40	37	35	33	**45**

Daytime from 7am to 11pm

Sound pressure levels, dB, in octave frequency bands with average geometric frequencies, Hz								Sound levels, La
63	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**	**La**
75	66	59	54	50	47	45	43	**55**

The results calculated at the reference points for sound pressure levels, dB, in octave bands with mean geometric frequencies in Hz are given in the Table 4.5.

Table 4.5. The results at the reference points for sound pressure levels, dB, in octave bands with mean geometric frequencies in Hz

N	63	125	250	500	1000	2000	4000	8000	La
1	60.58	52.10	44.92	40.33	34.12	25.84	10.04	0.00	42.86
2	61.12	52.57	45.41	40.55	33.53	23.94	3.59	0.00	43.10
3	60.48	51.78	43.96	38.03	31.16	15.79	0.00	0.00	41.54
4	60.74	53.04	45.54	40.35	33.15	20.30	0.31	0.00	43.05

The values of the expected sound level in the residential buildings in relation to the established standard are given in the Table 4.6.

Table 4.6. Noise level from the core equipment of the new power plant in the reference points, dBA

Reference point	Noise level, dBA	Exceeding the standard (during the daytime, 55 dBA/ at night, 45 dBa)
1	42.86	n/a
2	43.10	n/a
3	41.54	n/a
4	43.05	n/a

Analysis of the obtained results of the noise level from the main sources of the new 1200-1600 MW power plant at the reference points did not reveal an excess of the established

norms (45 dBA for nighttime (11:00pm – 7:00am) and 55 dBA for day time (7:00am – 11:00pm) in the residential buildings according to Construction code and regulations 2.01.08-96), therefore, a plant operate around the clock.

However, to keep the sound pressure level from the new power plant after commissioning of a 1200-1600 MW CCGT at the standard values in the residential buildings (to avoid complaints from residents) and at permanent workplaces, it is necessary to establish the noise level control with the involvement of a special organization, and it is also recommended to strengthen the green zone around the perimeter of the power plant industrial site and install a noise barrier on the boundary of the power plant with the residential area.

5 Construction phase

During construction activities the impact on the environment is determined by as follows:

– pollution of atmospheric air by exhaust gases of motor vehicles and construction equipment used to deliver the equipment and building materials, welding aerosol, manganese compounds during welding operations; organic solvent vapors, paint and varnish aerosols during painting operations; inorganic dust when bulk materials is transported. That is, emissions are mainly done from the mobile vehicles and unorganized sources. There are no stationary organized sources of emissions during construction work;

– noise and vibration effects of construction mechanisms;

– impact of electric and magnetic fields, electric current;

– allocation of land for temporary placement of construction structures, sites for storage of construction materials and waste generated during construction work, as well as for permanent use during the construction of buildings and units of CCGT;

– impact on soil in case of its mechanical integrity loss due to excavation during construction activities;

– impact on soils and groundwater during spills of petroleum products used as fuel for mobile vehicles and construction machinery.

According to the Customer's data, the period of the construction phase is approximately 30 months. With this, the estimated fuel consumption for the equipment will be about 1.7 million liters. The volume of excavation will be 520,000 m³.

The indicative list of equipment to be used during planning and construction works (according to the Customer's data) is given below in the Table 8.1.

Table 8.1 – Indicative list of equipment to be used during the construction phase

EQUIPMENT	Equipment model	Quantity	Sound pressure level dB(A)
Site preparation			
Back shovel excavator	1m^{3}1m^3	20	80
Back shovel excavator	0,33 m³ _	1	80
Crawler bulldozer		2	80
Front loader	ZL50	1	86
Pavement roller	1818 tons	1	80
Pavement roller	1010 tons	1	80
Dump truck	1010 tons	40	85
Construction activities			
Piling machine		15	92

Concrete delivery truck	88 m^3	6	83
Concrete pumper	32 m	3	76
Concrete polishing machine	MG80-A	2	
Immersion vibrator		35	81
Front loader	ZL50	1	86
Truck crane 25t	2525 tons	5	78
Truck crane with a lifting capacity of 50 tons	5050 tons	2	78
Truck	1010 tons	3	90
Mechanical assembly and installation			
Crawler crane with a lifting capacity of 700 tons.	SCC7000A	1	68
250t crawler crane	LR1250	1	68
150t crawler crane	SCC1500A-2	1	73
Lifting frame	800800 tons	1	78
Truck crane with a lifting capacity of 50 tons	5050 tons	2	78
Truck crane 25t	2525 tons	2	78
Truck	4040 tons	1	90
Truck	2525 tons	2	90
Forklift truck 5T	CPCD5A2Z	1	94
Welding machine	ZX7-400ST2	65	69

Impact on atmospheric air

During the construction phase, the pollutants can be emitted into the atmosphere in solid (inorganic dust during excavation, soil movement, foundation installation) and in gaseous form (exhaust gases of mobile vehicles and construction equipment, painting works).

Emissions are temporary and of a short and unavoidable nature. The processes that are a source of atmospheric pollution during installation, operation of construction equipment does not occur simultaneously.

The main processes when pollutants are emitted into the atmosphere are as follows: excavation, welding, painting, loading, and unloading operations during the storage of equipment and containers, operation of engines of construction machines, mechanisms and vehicles.

We have made an approximate calculation of pollutant emissions into the atmosphere and calculated the fields of their dispersal in the surface layer of the atmosphere during construction.

Calculation of pollutant emissions into the atmosphere, parameters of sources of pollutant emissions during the construction period is given in the Appendix 10, results of calculation of emission dispersion fields – in the Appendix 11.

Meteorological properties and factors determining the conditions of chemicals dispersion in the atmosphere were taken as per the Table 1.1, Chapter 1.

According to the schedule of construction activities, the construction period is conditionally divided into stages:

Stage 1 – preparation activities.

Stage 2 – construction activities.

Stage 3 – installation of equipment.

Stage 1 – preparation activities.

It will be used the machinery as follows: excavators, crawler bulldozer, front loader, road roller, dump truck.

During operation of the equipment, flue gases from engines installed on the equipment and dust from excavation will emit into the atmosphere. The planned time of work is about 1 920 hours.

To determine the level of impact on the atmospheric air, the concentrations of pollutants were calculated by means of the ECOLOG software within an area of 9.0×9.0 km ^{2}, with 500 m increment.

The calculation results are summarized in the Table 5.2.

Emission quotas were established as per the hazard classes of the emitted pollutants.

Table 5.2. Properties of pollutants, emitted into the atmosphere during preparation activities

No.	Name of the substance	Maximum allowable one-time concentration or 500 mg/m3	Hazard class	Established quota (share of Maximum allowable con-centration (MAC)	Maximum concentration in a residential area (MAC shares)	Compliance with the estab-lished quota (+/-)	Total discharged in the air, tons/year	Percentage of contribution to emissions
1	Nitrogen dioxide	0.085	2	0.25	0.14	+	13.9776	14.99
2	Nitric oxide	0.6	3	0.33	0.003	+	2.2714	2.44
3	Soot	0.15	3	0.33	0.04	+	6.9888	7.49
4	Sulfur dioxide	0.5	3	0.33	0.01	+	8.7360	9.37
5	Carbon monoxide	5.0	4	0.5	0.01	+	43.6800	46.83
6	Formaldehyde	0.035	2	0.25	0.03	+	1.0920	1.17
7	Hydrocarbons	1.0	4	0.5	0.01	+	13.1040	14.05
8	Inorganic dust SiO_2 20-70%	0.3	3	0.33	0.27	+	3.4220	3.67
	Total						93.2718	100.00

Stage 2 – construction activities.

The foundations will be built for the GT under construction after the preparation activities. The following types of equipment will be used – a pile driver, trucks, concrete pump, concrete polishing machine, submersible vibrator, front loader, cranes.

During the operation of the equipment, flue gases from engines installed on the equipment will be emitted into the atmosphere. The planned time of work is about 1 920 hours.

To determine the level of impact on the atmospheric air, the concentrations of pollutants were calculated by means of the ECOLOG software within an area of 9.0×9.0 km ^{2}, with 500 m increment.

The calculation results are summarized in the Table 5.3.

Emission quotas were established as per the hazard classes of the emitted pollutants.

Table 5.3. Properties of pollutants, emitted into the atmosphere during construction activities

No.	Name of the substance	Maximum allowable one-time concentration or 500 mg/m3	Hazard class	Established quota (share of Maximum allowable concentration (MAC)	Maximum concentration in a residential area (MAC shares)	Compliance with the established quota (+/-)	Total discharged in the air, tons/year	Percentage of contribution to emissions
1	Nitrogen dioxide	0.085	2	0.25	0.19	+	13.9776	14.99
2	Nitric oxide	0.6	3	0.33	0.004	+	2.2714	2.44
3	Soot	0.15	3	0.33	0.05	+	6.9888	7.49
4	Sulfur dioxide	0.5	3	0.33	0.02	+	8.7360	9.37
5	Carbon monoxide	5.0	4	0.5	0.01	+	43.6800	46.83
6	Formaldehyde	0.035	2	0.25	0.04	+	1.0920	1.17
7	Hydrocarbons	1.0	4	0.5	0.02	+	13.1040	14.05
	Total						93.2718	100.00

Stage 3 – installation activities.

After the foundation is erected, the equipment will be installed and the buildings of the CCGT under construction will be contracted with use of machinery as follows: crawler cranes, truck cranes, trucks, lifting frame, forklift, welding machines.

During operation of the equipment, flue gases from engines installed on the equipment will be emitted into the atmosphere. In addition, metal oxides, metal dust and abrasive will be emitted from welding operations from stripping seams and surfaces before painting. The planned time of work is about 1 920 hours.

To determine the level of impact on the atmospheric air, the concentrations of pollutants were calculated by means of the ECOLOG software within an area of 9.0×9.0 km ^{2}, with 500 m increment.

The calculation results are summarized in the Table 5.4.

Emission quotas were established as per the hazard classes of the emitted pollutants.

Table 5.4. Properties of pollutants, emitted into the atmosphere during installation activities

No.	Name of the substance	Maximum allowable one-time concentration or 500 mg/m3	Hazard class	Established quota (share of Maximum allowable concentration (MAC)	Maximum concentration in a residential area (MAC shares)	Compliance with the established quota (+/-)	Total discharged in the air, tons/year	Percentage of contribution to emissions
1	Nitrogen dioxide	0.085	2	0.25	0.11	+	11.7350	15.54
2	Nitric oxide	0.6	3	0.33	0.003	+	1.9069	2.53
3	Soot	0.15	3	0.33	0.03	+	5.8675	7.77
4	Sulfur dioxide	0.5	3	0.33	0.01	+	7.3344	9.71
5	Carbon monoxide	5.0	4	0.5	0.01	+	36.6719	48.57
6	Formaldehyde	0.035	2	0.25	0.02	+	0.9168	1.21
7	Hydrocarbons	1.0	4	0.5	0.01	+	11.0016	14.57
8	Iron oxide	0.2	3	0.25	0.01	+	0.0675	0.09
9	Manganese compounds	0.005	2	0.2	0.02	+	0.0074	0.01
	Total						75.5091	

In total, approximately 293.7396 tons/year of 10 types of pollutants will be emitted during the construction activities, out of which

during excavation – 93.2718 tons/year;

during concrete works – 93.2718 tons/year;

during equipment installation – 75,5091 tons / year.

The Table 5.5 below provides a general list of pollutants to be emitted into the atmosphere during the construction period, including all stages of construction.

Table 5.5. General list of pollutants to be emitted into the atmosphere during construction period

No.	Name	Total discharged in the air, tons/year	Percentage of contribution to emissions, %

1	Iron oxide	0.0675	0.02
2	Manganese compounds	0.0074	0.003
3	Nitrogen dioxide	45.1520	15.37
4	Nitric oxide	7.3372	2.50
5	Soot	22.5760	7.69
6	Sulfur dioxide	28.2200	9.61
7	Carbon monoxide	141.1000	48.04
8	Formaldehyde	3.5275	1.20
9	Hydrocarbons	42.3300	14.41
10	Inorganic dust SiO_2 20-70%	3.4220	1.16
		293.7396	**100.00**

According to the calculations, it was identified that the greatest share to the composition of the pollutant emissions during the construction period is contributed by:

Carbon monoxide – 48.04%

Nitrogen dioxide – 15.37%

Hydrocarbons – 14.41%

Emissions during construction are temporary and their volume will be taken into account in the inventory of pollutant emissions by a subcontracting construction organization as actually accrued.

Water consumption and sanitation

Water consumption on construction sites is reduced only to the consumption of water for the drinking needs of working personnel and for hydro-spraying of construction sites for dust control.

Water for drinking needs and for dust suppression during construction work on the projected facilities will be consumed from imported water.

Water for drinking needs will meet the quality requirements of O'zDST 950:2011 "Drinking water. Hygienic requirements and quality control".

Water is transported to the construction site by water carriers with tanks.

Approximately up to 1 000 construction and engineering personnel will stay on the construction site during the construction activities. With this, the approximate required volume of drinking water (at the rate of 25 liters per 1 person) is 25 000 liters or 25.0 m^3 per day.

Domestic fecal runoff will be removed by means of bio-toilets.

For dust suppression, water will be transported by the water carriers. According to Construction code and regulations 2.04.01-98, watering of 1 ^{m2} of ground coat requires 3-5 liters of water.

The area of the power plant is 55.0 hectares.

Water consumption for dust suppression needs will be calculated as actually at actuals, since it is not known what area will be developed daily and is subject to watering, and there is also no information on the period (in days) required to develop one of the areas.

The norms of water consumption during the construction period are determined by the contractor as actually accrued.

Construction waste generation

The sources of waste generation are as follows:

– construction activities;

– cleaning of temporary premises and construction sites.

The number of construction workers is about 1000 people.

Temporary storage places in standard metal containers are provided to store the construction garbage. During the construction activities, the building materials, construction, and household garbage shall be stored in a strictly designated place within the boundaries of the construction site.

During the construction activities, the building materials, construction, and household garbage shall be stored in a strictly designated place within the boundaries of the construction site.

Temporary storage places in standard metal containers shall be provided to store the construction garbage.

Waste is removed when accumulated (or after completion of construction activities) to a licensed company that accepts, processes, and disposes of this type of waste.

For domestic waste, it is planned to install a separate container on the construction site, with regular removal to the SMW landfill.

Waste generated during construction activities:

- concrete and reinforced concrete waste – hazard class 5,
- sand waste – hazard class 5,
- construction rubble that has lost its consumer properties – hazard class 5,
- broken building bricks – hazard class 5,
- waste of steel electrodes (stubs and remnants of steel welding electrodes, hazard class 5),
- waste of solvents, paints – hazard class 3,
- waste mixtures of various hardened plastics (paint containers – hazard class 3),
- cleaning material contaminated with oil (oil content less than 15%, hazard class 4),
- construction debris – hazard class 4,
- Solid municipal waste (SMW) (unsorted garbage from temporary accommodations, excluding bulky, hazard class 4).

Waste from the operation of special equipment and vehicles is not generated directly on the site. Special equipment used in construction is maintained and repaired by a contracting organization.

The waste from motor vehicles (worn tires, waste from batteries, oiled filters, used oils, etc.) is generated by mechanized departments and disposed of by the general contractor.

The construction facility is supplied with basic materials centrally from the enterprises of the construction industry of Tashkent and the surrounding areas. The raw materials are delivered to the site by the suppliers' vehicles.

The materials are stored and placed within the boundaries of the construction facility based on the daily consumption volume.

We have shown the indicative volume of waste generation during the construction of thermal power plant.

The standard for waste generation during construction works was calculated based on the "Specific amounts of waste generation and irretrievable losses during construction" and the compendium of norms of material resources loss in construction industry (addendum to estimate and working document 82-202-96) M, 1998, as per the formula as follows:

$$W_{waste} = G \times n/100, \text{ t}$$

where: *Wwaste* is the weight of waste

G is the amount of material used, ton

n is the standard for waste generation from the mass of the material used, %

The specific amounts of waste generation (standard) and irretrievable losses during construction are as follows:

Construction rubble – 1% of the amount used;

Construction sand – 3% of the amount used;

Reinforced concrete, concrete – 1.5% of the amount used;

Wooden components from the formwork – 1.5% of the amount used;

Paint – 3% of the amount used;

Brick – 1% of the amount used;

Cement mortar – 2% of the amount used;

Fittings – 1% of the quantity used.

In addition, the following types of waste are generated (the amount is approximate):

electrode stubs – 0.17 ton

plastic paint containers – 0.05 ton

wiping rags – 0.1 ton

construction debris – 0.5 tons

SMW (solid municipal waste) – 50.0 ton

The amount of solid waste generated from the life activities of the working staff was calculated based on the norm of 50 kg per 1 person/year (Sanitary Rules and Regulations No. 0297-11).

There will be about 1000 personnel on the construction site. Based on this, the amount of SMW will be: 50 * 1 000 = 50 000 kg or 50.0 tons/year.

The exact amount of waste to be generated during the construction period will be determined based on the construction schedule, material consumption, etc.

Waste generation standards during the construction period are determined as actually accrued.

Waste will be collected and stored temporarily on specially equipped places and containers.

Solid waste and industrial waste generated during construction work will be collected and temporarily stored by the general contractor - construction company in specially equipped places with subsequent disposal to special organizations, based on the contract for construction and installation work. The general contractor bears full responsibility for the sanitary-epidemiologic and environmental situation against the customer and the inspection authorities. During the construction period, the general contractor shall prepare an inventory list of waste generated during the construction period.

The impact on the environment will have a low probability if the organization of waste collection and disposal during construction activities is involved.

Impact on watercourses and soil

The nearest watercourse is the Yuzhno-Golodnostep Canal. In general, no impact on surface watercourses is expected during construction, since the distance between the watercourse and the construction site is 530 m.

Soil contamination during construction works is possible in case of spills of petroleum products used as fuel for mobile vehicles and construction equipment. However, the pollution will be insignificant and local. Petroleum products will have a low migration capacity and will not pose a danger to groundwater Due to its low solubility. The probability of a fire due to fuel spills is also small. In general, soils and groundwater contaminated with petroleum products will have a negligible risk to the environment and the safety of personnel during the construction period.

To minimize further the environmental impact of soils contaminated with petroleum products, it is recommended to collect contaminated soil layers in a specially provided container with subsequent disposal.

Acoustic impact during construction

Noise impact during construction will occur when vehicles are moved and construction equipment is in operation.

All the noisiest construction operations, in particular, all work on the soil movement, will be performed during daytime hours only. Therefore, this temporary noise will not have any significant harmful impact on the staff. Thus, the noise from construction activities will be temporary and periodic, will not exceed the noise standards.

The level of acoustic impact from construction equipment during construction work shall be calculated to make a forecast assessment of changes in the noise load on residential buildings located around the construction site.

Based on the project implementation schedule, the construction period is conditionally divided into stages of construction activities. Construction activities will be carried out sequentially, therefore, simultaneous operation of all construction machinery will not often to occur.

Noise levels during construction activities were calculated for 2 options

1 – Excavation and preparation activities

2 – Loading and installation activities.

The noise impact during the operation of the thermal power plant on nearby facilities was determined based on the four reference points as follows:

Point 1 – the nearest residential building No. 1 (north-west side);

Point 2 – the nearest residential building No. 2 (residential village Sarmich, north-west side);

Point 3 – the nearest residential building No. 3 (Shirin, south-east side);

Point 4 – the nearest residential building No. 4 (suburban structures, south-east side).

Standards for territories directly adjacent to the residential buildings (Sanitary Rules and Regulations No. 0267-09 "On ensuring permissible noise in residential, public buildings and residential structures") in octave bands and equivalent in tables 5.6-5.7.

Tables 5.6-5.7. Standards for territories directly adjacent to the residential buildings

Nighttime from 11pm to 7am

Sound pressure levels, dB, in octave frequency bands with average geometric frequencies, Hz								Sound levels, La
63	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**	**La**
67	57	49	44	40	37	35	33	**45**

Daytime from 7am to 11pm

Sound pressure levels, dB, in octave frequency bands with average geometric frequencies, Hz								Sound levels, La
63	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**	**La**
75	66	59	54	50	47	45	43	**55**

The raw data on the noise to be created during construction activities used in calculations were taken from the article [The noise of construction sites, N.N. Minina].

The results calculated at the reference points for sound pressure levels, dB, in octave

bands with mean geometric frequencies in Hz are given in the Tables 5.8-5.9.

Tables 5.8-5.9. The results at the reference points for sound pressure levels, dB, in octave bands with mean geometric frequencies in Hz

1 – Excavation and preparation activities

N	63	125	250	500	1000	2000	4000	8000	La
1	60.00	55.58	47.25	42.65	38.45	33.14	26.76	15.56	45.76
2	58.55	54.12	45.63	40.72	35.92	29.36	20.42	3.68	43.79
3	54.74	49.90	40.83	34.83	27.88	17.15	0.00	0.00	38.41
4	56.00	51.79	43.02	37.58	31.72	23.08	10.11	0.00	40.77

2 – Loading and installation activities.

N	63	125	250	500	1000	2000	4000	8000	La
1	55.83	50.58	42.25	37.65	33.45	28.14	21.76	10.42	40.82
2	54.48	49.12	40.63	35.72	30.92	24.36	15.42	0.00	38.87
3	50.70	44.90	35.83	29.83	22.88	12.15	0.00	0.00	33.52
4	52.37	46.79	38.02	32.58	26.72	18.08	4.23	0.00	35.90

The values of the expected sound level in the residential buildings in relation to the established standard are given in the Tables 5.10 and 5.11

Table 5.10. Noise level from construction equipment during excavation and preparation activities at the reference points, dBA

Reference point	Noise level, dBA	Exceeding the standard (during the daytime, 55 dBA/ at night, 45 dBa)
1	45.76	n/a
2	43.79	n/a
3	38.41	n/a
4	40.77	n/a

Table 5.11. Noise level from construction equipment during loading and installation activities at the reference points, dBA

Reference point	Noise level, dBA	Exceeding the standard (during the daytime, 55 dBA/ at night, 45 dBa)
1	40.82	n/a
2	38.87	n/a
3	33.52	n/a
4	35.90	n/a

The results of calculations of the noise propagation level during the construction equipment operation at the reference points are given in the Appendix 12 in tabular and graphical form.

The calculations have shown that the noise generated during construction activities does not exceed the noise levels set for the daytime (from 7am to 11 pm) and nighttime (from 11pm to 7 am).

However, construction activities for implementation of the project in question shall be carried out during the daytime only to avoid complaints from the local communities. In addition, schedule will be managed in such a way to ensure the adjustment of the level of the construction activities scope to the extent possible with use of ultra-modern equipment with a low noise level. With this, efforts will be applied to minimize the noise impact.

Reclamation

The site may also contain soil excavated during construction activities. Upon completion of construction, the excavated soil will be reused on the site for the purposes as follows:

– for land grading;

– for landscaping of the territory of the power plant. Greening of the power plant site around the perimeter is planned.

Working issues

For construction activities, it is necessary to involve local labor force to the most possible extent for employment in construction, with this:

– to conduct training during the employment;

– to ensure, if possible, the employment of women.

All employees involved shall be of working age in accordance with the labor law of Uzbekistan.

Specific construction tasks will be performed within the age limit in accordance with the labor law of Uzbekistan.

In order to exclude possible cases of human trafficking and infringement of their rights, the Contractor shall perform as follows:

– maximize the involvement of local labor force for employment in construction activities, with constant check of the originals of passports;

– develop and implement a human trafficking prevention and awareness program (can be carried out simultaneously with HIV awareness/AIDS, infection with COVID-19).

In order to exclude/minimize complaints from the communities during construction work:

– to appoint a Complaint Coordinator;

– through the coordinator, to assume responsibility for receipt, registration, escalation of complaints with taking follow-up actions on all complaints received by the Contractor;

– meet regularly or upon necessity with the Customer and the Engineer to help the management in settling the complaints;

– maintain the Complaints log indicating the name and personal data of the applicant, review status and settlement of complaints;

– have the Minutes of the complaints review meeting and other complaints review reports.

6 Assessment of the types of impacts caused by the removal of natural resources from the environment

Operation of the new 1200-1600 MW power plant in the Syrdarya region will be accompanied with the seizure of land resources, minerals (gas) and water.

It is expected to allot 55.0 hectares of the land for the construction of the new power plant.

It is intended to preserve woody and shrubby vegetation **to a maximum possible extent when the pipeline from the coastal pump station to the power plant will be constructed, or excavate carefully the trees together with their roots and their transplantation to other places, or trees felling, if so necessary.**

The new CCGT will be operated with withdrawal of water from the Yuzhno-Golodnostep Canal named after Sarkisov. A single water supply system will be provided for industrial and drinking needs.

Thanks to the adopted recycling water supply system with cooling on the fan cooling towers, the water consumption of the power plant consisting of two CCGTs from surface watercourses will decrease compared to the once-through system.

Withdrawal of water from the Yuzhno-Golodnostep Canal will amount to 11201,291 thousand m^3/year.

Consumption of natural gas during the operation of the CCGT will be 1049819.50 thousand Nm^3/year.

7 Emergency situations

A priori, accident rates at thermal power plants can be estimated as 10^{-5}.

Emergency risks at the new power plant in Bayavut district after the project implementation are minimized by means of use of a modern (microprocessor) automated management and control system. The automated control system is designed to perform the functions of logical control, regulation in automatic and manual modes, emergency and restrictive protections, warning and alarm systems, monitoring, display and archiving of process parameters, high-speed registration of major events and indicators during emergency situations.

A certain risk in terms of fire hazard is referred to the systems and sections of a combined-cycle power plant listed below:

- gas compressor station;
- fuel gas units (gas line cut-off valve and filter);
- pipeline system for gas supply;
- gas distribution valve blocks (in a separate compartment of the GT auxiliary equipment);
- gas distribution system on combustion chamber burners;
- turbine/generator lubricating and power oil systems;
- electrical systems.

In order to prevent the propagation of fire and by-products burning, the plant is divided into fire-hazardous zones. Those zones are protected from fire through use of either passive (structural, complex and operational measures), or active measures (portable fire extinguishers, fire protection systems) or a combination of such measures when the fire risk is high.

Areas with an increased fire risk are separated from each other by means of enclosures made of fire-resistant materials. Similar enclosures are used in the areas as follows:

- thermal block (module) of a gas turbine;
- GT auxiliary equipment.

The enclosures on those areas will be equipped with an automatic fire extinguishing system.

Fire-hazardous areas are protected by fire walls. Fire walls are installed to protect the gas turbine from fires or explosions that may occur on the oil-filled main (boost) transformer.

Also, by means of such walls, the main control panel, the relay room and the cable floor are separated from the adjacent sections.

Openings in fire-fighting walls and fire-resistant enclosures (doors, openings for pipes or cables laying, ventilation ducts, etc.) are sealed to prevent the fire propagation.

Escape routes from all fire-hazardous areas and approaches to firefighting are carefully planned outward, not cluttered, properly marked and lead to a safe area or to the exit. There will be at least two escape routes outward the fire-hazardous areas of 1 and 2 category. Their length will not exceed the length established by the relevant rules.

Emergency lighting (with backup batteries to ensure at least 60 minutes of operation) will be installed along the escape routes in the manner as follows:

- with indication of the direction to the escape exit;
- with a sign indicating an exit to the outside is lit above the escape exit doors.

The emergency lighting system is designed and to be installed in accordance with the applicable standards.

Fire-fighting measures were designed to meet the requirements as follows:

- prevention of the fire source occurrence and its propagation;
- protection of technical personnel;
- early detection of fire, notification of personnel and fire extinguishing;
- reducing the damage caused by fire.

Those requirements are fulfilled through the optimal placement of equipment (passive measures) and by taking appropriate measures to prevent the fire and its extinguishing (active measures).

If, for any technical reasons, passive measures do not meet the requirements, the corresponding active measures will be applied as compensation.

An automatic fire-fighting system based on cylinders with high pressure carbon dioxide is intended to extinguish the fire in the protective casing of a gas turbine and in the fuel gas unit, and consists of cylinders with CO_2, temperature sensors, CO_2 spray nozzles and all necessary pipelines. The capacity of the CO_2 resource is sufficient to extinguish a fire in the mentioned casings. The carbon dioxide fire extinguishing system is activated within 30 seconds. It is assumed that each GT will be equipped with 24 CO_2 cylinders.

We considered the following scenarios for development of accidents on the new power plant.

Accident at the gas booster station and in the GT building. The gas booster station (GBS) will supply the fuel gas of the required pressure to the combustion chambers of the GT.

The gas booster station is intended to compress a mixture of hydrocarbon gases, (which is a fuel for a gas turbine), with constant operation of the CCGT (8 111 h/year max) with the necessary interruptions for preventive maintenance (oil refilling, filter cleaning, etc.). GBS consists of 2 (two) gas booster compressors, with one compressor in operation, while another on is backup and designed to operate when a gas turbine is operated with maximum gas consumption.

The radiuses of the impact areas were calculated for two options of emergency scenarios – a fire at the GBS and an explosion of a fuel-air mixture in a gas turbine building. Analysis of

the results has shown that in case of a fire at the GBS, the impact area with a radius of 25.5 m (irretrievable losses) and with a radius of 76.5 m (sanitary losses) will not go beyond the boundaries of the CCGT site.

In case of an explosion in a gas turbine building, the impact area is limited to the CCGT site.

Emergency on a gas pipeline. The use of natural gas as fuel makes it possible to predict the possible scenarios of emergency situations (fire) when a gas pipeline is broken. The gas transported by the pipeline is referred to the group of fire and explosive substances with a high degree of danger (Class 4). The impact area will have the shape of a concentric circle with a center at the spot of the gas leak, with a radius of the zone of irretrievable damage of 19 m. In this case, the maintenance personnel of the plant located on this territory will be within zone of irretrievable damage with an area of 1,134 m^2; according to calculations, one person will be within the zone of irretrievable losses, and seven people will be in the sanitary zone. Hospitalization may be required for people caught in the fire zone.

During a fire, nitrogen and sulfur dioxides, soot, carbon monoxide will be released into the atmosphere, their concentrations will exceed 20 MAC, which can worsen the general health of personnel, mainly - to reduce respiratory functions. However, this impact will be short-term.

In case of an emergency scenario with release of the oil during the wear of turbine parts with subsequent ignition from heated surfaces and sources of sparking, the personnel servicing the core equipment of the plant will be within the zone of irretrievable damage due to the use of a large amount of turbine oil during the operation of the core equipment of the power plant, the assignment of the room with the steam turbines to category B.

During the operation of the CCGT, the degree of those types of risks is reduced, thanks to the design features and the provision of an automated control system that ensures high operational reliability and provides operational control and management of the new unit, implementation of process protection and blocking, automatic regulation and alarm, performing the current calculations of modes and discrete logical control in normal situations, optimizing the operation of the CCGT according to specified criteria.

The gas turbine units are equipped with an automatic fire extinguishing system with carbon dioxide (CO_2) and are supplied in set with a gas turbine unit.

The purpose of the fire extinguishing system is to detect and automatically extinguish each fire that may occur in any of the protected compartments, that is, load compartment, turbine compartment, bearing compartment, lubricating oil/gas compartment.

The fire protection system with carbon dioxide extinguishes the fire by increasing the concentration of CO_2 inside the protected compartment, thereby reducing the oxygen concentration to a value below which burning is impossible (8% O_2 by volume). The system operates automatically and does not require intervention of an operator.

To ensure explosion and fire safety, the gas supply system of the two CCGT units is equipped with a light and sound alarm system displayed on the main control room and signaling that the concentration of gas in the indoor air is increased by more than 10% versus the lower flame limit concentration (LFLC).

Only steel fittings (class "A") shall be used on all gas pipelines.

The shut-off valves in the gas supply system are used remotely to automate the control process. The valves are equipped with redundant manual control.

Lightning protection systems and a grounding system are provided to increase the safety level from lightning strikes and electric current.

8 Analysis of alternative design solutions

The "zero" option. Without implementation of the project in question, there will not the benefits as follows:

– accelerated development and improvement of the competitiveness of the country's power industry;

– active attraction of foreign direct investment in construction of new generating facilities;

– satisfaction of growing demand for electric power and heat;

– reduction of specific fuel consumption parameters by comparison with conventional power units;

– increase in production efficiency;

– reduction in the negative impact on the environment.

An alternative to process solutions. Construction of the new 1200-1600 MW power plant in the Syrdarya region based on the traditional power units for generating electric power and heat will not provide an increase in efficiency and renewal of generating equipment of power sources of the Uzbek power system and will reject the use of power-efficient technologies with the most economical modern combined-cycle gas turbines (CCGT) with a net power generation efficiency of 60%.

Alternative to the location of the construction site.

There are no alternative location options for the projected power plant. Location of 1200-1600 MW power plant is optimal in terms of selection of the site of the planned power plant, due to the availability of sources of water consumption – the Yuzhno-Golodnostep Canal named after Sarkisov (530 m), and gas – a gas distribution station of 40 atmospheric pressure (217.4 m).

9 Nature of the environmental impact

Operation of the 1200-1600 MW power plant in the Bayavut district of the Syrdarya region will be accompanied by environmental impacts in the form of emissions, discharges, and solid waste generation.

With emissions from the main sources – two main stacks of the CCGT, three pollutants are expected to be emitted into the atmospheric air: nitrogen oxide and dioxide, carbon monoxide.

The maximum concentrations of all pollutants will not exceed the quotas allowed by the State Committee of the Republic of Uzbekistan for Ecology and Environment Protection (0.25 MAC for substances of hazard class 2; 0.33 MAC for substances of hazard class 3; and 0.5 MAC for substances of hazard class 4).

The impact will be insignificant in magnitude, but constant during the operation of the CCGT.

During construction work, short-term concentrations of inorganic dust, wood dust, and welding aerosol will be created that do not exceed the regulatory values for outside boundaries of the industrial site.

Thus, the impact on atmospheric air from the emission sources of the new power plant in the Bayavut district of the Syrdarya region after completion of construction will be constant, but insignificant in terms of the load on atmospheric air due to application of advanced combined-cycle fuel combustion technologies and use of technical solutions for nitrogen oxide suppression.

The impact on the environment in emergency situations will be strong, but not prolonged in time and will be periodic.

Impacts on surface water bodies and groundwater is not expected if the environmental measures adopted by the project will be observed.

The discharge of thermal waters will not cause a negative impact on the aquatic biota of the canal due to application of a recycling system of process water supply of the CCGT with using the fan cooling towers and constant monitoring of the quality and thermal indicators of the discharge water. It is known that fish die and the environmental regime of aqua life changes with a sharp increase in water temperature by 10 °C. According to the requirements for composition and properties of water of water bodies, the summer water temperature shall not increase by more than 3 °C after effluent discharge by comparison with the average monthly water temperature of the hottest month in the last 10 years.

Also, it is necessary to make control measurements in the below dam sites to review the parameters of water quality in the canal:

– at the point above the effluent discharge by 500 m – background parameters of the source water;

– at the effluent discharge point;

– at a point below the effluent discharge by 500 m.

The operation of the CCGT is associated with approximately 38 items of solid waste generation. Industrial waste will be stored temporarily in separate containers and specially equipped platforms provided. Generated solid municipal waste will be collected at the garbage containers provided. Negative impact on the environment from the stockpiling and storage of solid waste is not expected.

During the operation of the CCGT, the probability of emergency situations is practically eliminated due to the advantages of the thermodynamic data of the CCGT, its structural solutions and provision of an automated control system that ensures high operational reliability.

The personnel will be exposed to noise and vibrations from the sources of the CCGT, but the level of which will not exceed the regulatory values.

Summarized data on the residual environmental impacts from the operation of the power plant are given in the Table 9.1.

Table 9.1 Conclusions on the impact

	Impact	Magnitude of the impact	Comparison of CCGT with thermal power plants operating in Uzbekistan
In general	Application of cleaner and more efficient power production technology	Positive impact	Improvement: more power efficient
Air quality	Emissions of NO_x, CO	Insignificant: emission is within the standards	Improvement: reduced emissions compared to the existing boilers
Water quality	Discharge of thermal water into the canal	Insignificant	Improvement: lower discharge temperature thanks to a recycling water supply system with fan cooling towers
Soil and groundwater	Soaking of petroleum products into the soil and groundwater	Insignificant: measures have been taken to protect the soil and groundwater	Improvement: existing thermal power plants pollute soil and groundwater with petroleum products
Waste	Waste disposal	Insignificant: suitable disposal routes have been identified	Improvement: existing thermal power plants do not dispose of part of production waste

	Impact	Magnitude of the impact	Comparison of CCGT with thermal power plants operating in Uzbekistan
Noise and vibration	Noise during operation	Insignificant: meets the standards	Improvement: there are areas of workplaces at existing thermal power plants with exceeding noise standards
Ecology	Flora/fauna	Insignificant: limited to the boundaries of the industrial site	Improvement: existing thermal power plants impact on the aqua life of rivers
Social and economic	Jobs creation	Positive impact	More reliable and stable power generation, operation with fewer personnel

10 Measures to reduce adverse environmental impacts

Operation stage

1. To reduce NOx emissions from natural gas combustion, the project provides for combustion systems with dry low NOx emissions (Dry Low NOx) to control NOx emissions in exhaust gases. It is necessary to carry out constant online monitoring of the concentrations of pollutants (nitrogen oxides, carbon monoxide) in the flue gases of the CCGT, both by the own services of the ES, and with the involvement of specialized organizations of the State Committee on Ecology and Environmental Protection of the Republic of Uzbekistan.

2. With this, it is necessary to establish the noise level control with the involvement of a special organization to keep the sound pressure level from the new power plant after commission of the 1200-1600 MW CCGT within the standard values in the residential buildings (to avoid complaints from residents) and at permanent workplaces. It is also recommended to strengthen the green zone around the perimeter of the power plant industrial site and install a noise barrier on the boundary of the power plant with the residential area.

3. The project stipulates an application of a recycling water supply system with construction of fan cooling towers to cool the heated waters, as well as continuous monitoring of the discharge waters quality against all the parameters of pollutants according to the Decree of the Cabinet of Ministers No. 14, dated 21.01.2014, to preserve water resources and reduce the impact of thermal and polluted effluents on surface watercourses.

4. To establish permanent control of the chemical composition of the power plant effluent with involvement of an independent certified laboratory (once a month, control measurements in the dam sites: at the point above the effluent discharge by 500 m – background parameters of the source water; at the point of effluent discharge; at the point below the effluent discharge by 500 m).

5. To organize the temperature control of discharges at the water outlet of the cooling tower purge into the canal.

6. To prevent mixing of different types of waste during their storage and transportation, to prevent unorganized accumulation of waste within the territory of the power plant. To provide the containers for temporary storage of waste, including waste generated during repair work with subsequent delivery to special organizations for disposal and recycling.

7. To develop an action plan for transportation and disposal of waste generated.

8. To provide the personnel at permanent workplaces with individual protective equipment. To purchase the noise protection equipment (headphones, earplugs) and instruct the employees to use those in workplaces with an increased sound pressure level.

9. To reduce the likelihood of emergency situations, establish control over the installation of improved instrumentation and automation for monitoring the production process, equipping with fire alarm systems.

10. Prior to commissioning the facility, it is necessary to develop the environmental standards for emissions, discharges, generation and disposal of waste as part of National EIA 3 stage. To submit a Certificate of inspection of the power plant territory by a district inspector, and an inventory list in the context of types and quantity of waste generated during the construction period, the copies of contracts for removal and disposal of such wastes as part of the draft National EIA 3 stage.

If the recommendations and measures listed above and all the design solutions specified in the draft are complied with, there is no need to implement any additional measures to reduce the environmental impact at the operation stage of the power plant in question.

In addition to the measures stipulated in the technical design for reduction of the impact on the environment at the stage of construction work, it is proposed as follows:

Construction phase

1. Regular inspection and maintenance of motor vehicles.
2. Turning off vehicle engines while waiting.
3. Slowing down the movement of vehicles during the delivery of raw materials and equipment in a residential area and near the school areas.
4. Checking the traffic rules, installing road signs, teaching the safe driving, speed limits, inspection of vehicle equipment.
5. Use of low noise/vibration equipment.
6. Installation of temporary rain sewers.
7. Installation of a septic tank and a temporary toilet (bio-toilet) on a construction site.
8. Prevention of petroleum products spills.
9. Development of a waste management plan for the period of construction activities.
10. The solid waste generated during construction shall be collected and stored on concreted sites with subsequent transportation to special organizations and storage landfills in accordance with the concluded contracts.
11. Hydro-spraying by means of one washing machine is provided to reduce dusting during construction activities.

Environmental impact assessment of the 1200-1600 MW power plant construction has shown that no negative impact is expected upon compliance with the requirements of the technological regulations for operation of equipment to be introduced during the implementation of the project.

The environmental risk in the implementation of the technical solutions and environmental measures inserted into the design is minimized.

If the above recommendations and measures are observed, there will be no negative impact on atmospheric air, surface and groundwater, soil, vegetation, and people.

For the period of operation, the plant will develop an action plan for protection of the air and water basin, an action plan for reducing the amount of waste generation, the degree of danger of waste storage, improving the safety and efficiency of waste disposal facilities, which will

be fully complied during the operation of the power plant after implementation of the project and require constant observation.

Environmental quality management

The implementation of the power plant construction project requires that Environmental Management Plan (EMP) ensuring environmental protection to be prepared. The purpose of the EMP is to facilitate to the Investor to achieve the environmental goals and fulfill obligations on preservation of the environment quality. The EMP describes the methods and plans applied to reduce the impact on the environment, and also defines the parameters that can assess the progress of the EMP implementation.

Most of the impacts from construction and operation of the projected thermal power plant will occur during operation. Therefore, the EMP focuses mainly on this stage of the project. However, the recommendations on environmental management during construction were also taken into account, and included into the EMP.

The EMP is the basis for mitigation measures implementation at each stage of the project.

Implementation of the Environmental Management Plan

Prior to start the construction activities, a detailed draft environmental conditions and mitigation measures shall be approved and agreed with specialists of competent organizations.

The Contractor will be the primarily responsible party for proper execution and implementation of the plans, measures, controls, etc., in accordance with the terms and conditions defined in the relevant permits and Environmental Management and Monitoring Plans.

During construction, the Investor will monitor the implementation of the solutions defined in the project (author's supervision).

After commissioning, the Investor and the State Committee of the Republic Uzbekistan for Ecology and Environment Protection shall organize the environmental control.

Environmental Monitoring Plan

The Environmental Monitoring Plan consists of a monitoring schedule and institutional arrangements. The Environmental Monitoring Plan will show a way for taking the precautions during and after the construction of the power plant for taking the necessary actions to correct defects or shortcomings.

During construction, monitoring will focus on guarantees on the environmental mitigation measures implementation, with checking some performance indicators to record the environmental efficiency of the Project and to guide any remedial actions for unexpected impacts prevention. Monitoring of actions during the operation of the CCGT will focus on fixing the environmental efficiency and proposing the remedial measures to avoid unexpected impacts.

Institutional system

The responsibility for overall implementation of the EMP will be borne by the Investor.

Other stakeholders to be involved in the implementation of the EMP:

State agencies: such as the State Committee of the Republic of Uzbekistan for Ecology and Environmental Protection, regional bodies for nature protection (regional Department for Ecology and Environmental Protection of the Tashkent region), local government bodies and

municipalities (to the extent affected by the project). Being the regulatory authorities, the Environmental Protection Authorities will implement environmental protection policies during the construction and operation of the project at various levels, and will also be responsible for enforcement of laws, regulations, standards, and application of environmental practices by all organizations within their respective jurisdiction.

In particular, the State Committee of the Republic of Uzbekistan for Ecology and Environment Protection has an in-house regional committee for environmental control and project administration, with the roles and responsibilities as follows:

– supervision over the EMP implementation;

– enforcement of applicable laws, regulations and standards;

– coordination of environmental protection efforts between the departments concerned;

– inspection and supervision over construction, completion and operation of environmental facilities.

The investor shall be an ultimate responsible party for the environmental efficiency of the project during construction and operation stages. The Investor, being the direct management organization for managing all the aspects of preparation and construction of the project, is responsible for environmental management, including, without limitations the specific responsibilities as follows:

– assurance that all relevant EMP requirements (including mitigation measures) are properly included into the project documentation;

– obtaining the necessary permits and/or approvals, as needed, from the State Committee of the Republic of Uzbekistan for Ecology and Environment Protection and other relevant government agencies, with the necessary compliance with the condition that all necessary permits are received prior to start of any project construction activities;

– assurance that Contractors understand their responsibilities on mitigating the environmental issues in respect of construction and training their personnel for EMP implementation;

– monitoring of the Contractor's implementation of the EMP in accordance with the environmental monitoring plan.

Construction Supervision Engineers (CSE)

Construction Supervision Engineers (CSEs) are responsible for supervision over the project construction activities, and monitoring other work and actions taken by the Contractor to ensure compliance with the specifications and contractual requirements. The responsibilities of the CSE include as follows:

– ensuring the guarantees of compliance with the technical design of the project and the EMP in terms of mitigation and environmental protection. Construction can start after the CSE is satisfied with the environmental protection measures only;

– regular monitoring of the work of the Contractor's environmentalists with verification of the monitoring methodology and its deliverables. If the CSE considers that the Contractor's environmentalists do not fulfill their duties or do not fulfill contractual requirements, it is necessary to instruct the Contractor(s) to replace the Contractor's environmentalists;

– Instructing the Contractors on taking the measures to eliminate the consequences during the period specified by the CSE. In case of violation of the contractual terms or serious complaints from communities about the environmental efficiency of the Contractor, the CSE shall require for the contractor to correct, change or suspend the work, with simultaneous notification issued to the relevant agencies and the Customer;

– supervision over the Contractor's activities and ensuring that the requirements of the EMP and the technical requirements of the contract are met in full;

– Instructing the Contractor on taking the measures to reduce the impact and compliance with the required EMP procedures in case of non-compliance/discrepancy;

– compliance with the complaint procedures.

Contractor

The Contractor's responsibilities include without limitations as follows:

– strict implementation of the measures listed in the EMP;

– compliance with the requirements of environmental law;

– work within the framework of contractual requirements and other bid conditions;

– verifying that all construction materials suppliers have valid work licenses and any environmental permits required;

– assurance of the effective implementation of the EMP during construction;

– study and submission of proposals for mitigation measures and the corrective measures implementation in case of non-compliance or inconsistencies with the the EMP implementation.

Documentation and regulation

All environmental strategies, policies, responsibilities and procedures will be clearly documented for each Contractor.

Documentation is useful information for the management and staff and preferably to be in a form that can be provided to third parties, such as regulators and citizens concerned, as proof of the Investor's obligation on the environment protection.

The environmental quality management and environmental quality monitoring plan is given in the Appendixes 13 and 14.

11 Forecast of environmental changes

Assessment of environmental changes as a result of commissioning of the 1200-1600 MW power plant in the Bayavut district of the Syrdarya region has shown the results as follows.

The impact on the atmospheric air from the emission sources of the projected power plant in terms of the load on the atmospheric air will be insignificant, due to the use of advanced combined-cycle fuel combustion technologies, and combustion systems with dry low NOx emissions (Dry Low NOx) to control NOx emissions in exhaust gases. As a result, the state of atmospheric air will remain acceptable. When implementing the considered design solution, the concentrations of all pollutants contained in CCGT emissions from natural gas combustion (nitrogen oxide and dioxide, carbon monoxide) will not exceed the quotas allowed by the State Committee for Ecology of the Republic of Uzbekistan.

The introduction of harmful substances into the atmospheric air is much lower by comparison with the power units operated at the thermal power plants in Uzbekistan, which makes it possible to reduce the impact on the state of soil and vegetation by reducing the nitrates precipitation on those.

The chemical composition of surface waters will not change as well. Water is mainly used for cooling equipment. Due to the application of a recycling water supply system, introduction of heated effluents into surface waters is not expected.

The state of soil and groundwater will not change.

Conclusion

The first stage of the environmental impact assessment procedure for construction of the 1200-1600 MW power plant in the Syrdarya region has identified the results as follows.

The new 1200-1600 MW power plant is planned for construction in the Bayavut district of the Syrdarya region, northwest of the existing Syrdarya thermal power plant, on the right bank of the Yuzhno-Golodnostep Canal named after Sarkisov.

The territory of the planned construction is located close to a large power company – Syrdarya TPP JSC, which is the main source of environmental impact in the area in question.

The total area of the power plant construction site is 55.0 hectares. The site has a flat relief with a difference of elevations of 309.0 to 313.0 m above sea level.

The nearest residential buildings of the Sarmich village are located north-west at a distance of 76.0 m from the boundary of the project area. The minimum distance from the chimneys of the CCGT to the nearest residential buildings from the northwest (according to the plot plan) is 390 m from the bypass pipe and 406 m from the chimney after the waste-heat boiler.

The nearest watercourse to the construction site in question is the Yuzhno–Golodnostep Canal named after Sarkisov. This canal running south-east of the project area at a distance of 530 m, which is consistent with the requirements of the Decree of the Cabinet of Ministers No. 981, dated 11.12.2019 for the area of the water protection zone in terms of the water consumption from the canal.

The power plant construction site is located in an area with an acceptable ecological situation in terms of the state of atmospheric air, surface and groundwater, soil and vegetation.

The implementation of the proposed project will male possible to generate additional electric power in Uzbekistan in the average amount of 13 776 492 MWh per year.

A clear advantage of the CCGTs to be installed under this project is reduction of specific fuel consumption parameters by comparison with specific parameters for the power system: 265 goe/kWh versus 375.8 goe/kWh for electric power generation.

The operation of the new power plant in the Syrdarya region will be accompanied by environmental impacts in the form of emissions, discharges and solid waste generation.

The main volume of pollutant emissions during the operation of thermal power plants is formed as a result of burning natural gas. The gas consumption is 2,099,639.0 thousand (2 CCGTs) Nm^3/year.

The gross pollutant emissions from chimneys during the operation of thermal power plants will amount to 2787.2133 tons/year. The emission is generated by three pollutants: nitrogen dioxide, nitrogen oxide and carbon monoxide.

The contribution of each pollutant to the gross emission is as follows: carbon monoxide – 679,8081 tons/year (24.39% of the mass of emissions); nitrogen oxide – 294.5835 tons/year

(10.57% of the mass of emissions); nitrogen dioxide – 1812.822 tons/year (65.04% of the mass of emissions).

The maximum concentrations of all pollutants will not exceed the quotas allowed by the State Committee of the Republic of Uzbekistan for Ecology and Environment Protection for Syrdarya region (0.25 MAC for substances of hazard class 2; 0.33 MAC for substances of hazard class 3; and 0.5 MAC for substances of hazard class 4).

The maximum concentration of nitrogen dioxide (hazard class 2) in the atmospheric air outside the boundaries of site will be 0.18 MAC at the established quota of 0.25 MAC, nitrogen oxide (hazard class 3) is less than 0.01 MAC at the established quota of 0.33 MAC, carbon monoxide (hazard class 4) is less than 0.01 MAC at the established quota of 0.5 MAC.

Thus, the impact on atmospheric air from the emission sources of the projected power plant after completion of construction will be constant, but insignificant in terms of the load on atmospheric air due to application of advanced combined-cycle fuel combustion technologies and use of technical solutions for nitrogen oxide suppression.

The impact of the facility under study on the environment will not significantly increase due to introduction of nitrogen dioxide and soot during emergency situations. During the operation of the CCGT, the probability of emergency situations is practically eliminated due to the advantages of the thermodynamic data of the CCGT, its structural solutions and provision of an automated control system that ensures high operational reliability.

Impacts on surface water bodies and groundwater is not expected if the environmental measures adopted by the project will be observed.

Yuzhno-Golodnostep Canal is the source of water supply of the projected power plant for process and domestic consumption. Water from canal will be treated at the water treatment plant for its further use. The total approximate water consumption will be 11201,291 thousand m^3/year, with 16,222 thousand m^3/year for domestic needs.

The approximate discharge of industrial effluent will be 357.5 m^3/hour or 2899,682 thous. m^3/year, household – 16,222 thousand m^3/year. The volume of industrial effluent is generated from the purge water of the cooling tower and the recycling system, runoffs from the water treatment plant, oiled effluent. Effluent treated as per the standards will be discharged into the Yuzhno-Golodnostep canal. The discharge of polluted effluents from the new power plant is not expected.

The discharge will not cause a negative impact on the water quality of the Yuzhno-Golodnostep Canal due to application of a recycling system of process water supply of the CCGT with fan cooling towers. According to the project, discharge of thermal effluents into the channel will not result to an increase in water temperature by more than 3°C and will not change the chemical composition of the water, since the discharged purge water of cooling towers is referred to conditionally pure water in terms of composition.

The operation of the new power is associated with approximately 38 items of waste generation. Industrial waste will be stored temporarily in separate containers and specially equipped platforms provided. Generated solid municipal waste will be collected at the garbage containers provided. Negative impact on the environment from the stockpiling and storage of solid waste is not expected. Adjustment of all types of waste and updated quantitative parameters of its formation during the operation of the power plant, the plan for its temporary storage, transportation, processing and disposal will be established and approved when all the properties of the equipment will be determined prior to commission of the power plant, when standards for its formation and placement will developed as part of the National EIA 3 stage.

Implementation of a project for the construction of the 1200-1600 MW combined power plant (with CCGT) in the Bayavut district of the Syrdarya region will not aggravate the negative consequences for the environment and public health, provided that environmental protection measures stipulated by the National EIA 1 stage.

List of sources used

1. Decree of the Cabinet of Ministers of the Republic of Uzbekistan No. 541 dated September 07, 2020 "On further improvement of the environmental impact assessment mechanism".

2. Decree of the Cabinet of Ministers of the Republic of Uzbekistan No. 14 dated 21.01.2014. "On approval of the regulations on the procedure for development and approval of draft environmental regulations."

3. Decree of the Cabinet of Ministers of the Republic of Uzbekistan No. 981 dated 11.12.2019. "On approval of the Regulations and the procedure for establishment of the water protection zones and sanitary protection zones of water bodies within the territory of the Republic of Uzbekistan".

4. Instructions for inventory of pollution sources and regulating the pollutant emissions into the atmosphere for companies of the Republic of Uzbekistan. Regulations No. 1553 of the Ministry of Justice dated 03.01.06, Tashkent, 2006.

5. Sanitary Rules and Regulations of Uzbekistan No. 0350-17 "Sanitary Rules and Regulations for protection of atmospheric air in the populated areas of the Republic of Uzbekistan".

6. Sanitary Rules and Regulations of Uzbekistan No. 293-11 "Hygienic standards. The list of maximum allowable concentrations (MAC) of pollutants in the atmospheric air of populated areas within the territory of the Republic of Uzbekistan".

7. Sanitary Rules and Regulations of Uzbekistan No. 294-11 "Hygienic standards. Maximum allowable concentrations (MAC) of harmful substances in the air of the working area".

8. Sanitary Rules and Regulations of Uzbekistan No. 0318-15. "Hygienic and antiepidemic requirements for protection of water bodies within the territory of the Republic of Uzbekistan".

9. Sanitary Rules and Regulations of Uzbekistan No. 0297-11 "Sanitary Rules and Regulations for cleaning the territories of the populated areas from solid municipal waste in the conditions of the Republic of Uzbekistan".

10. Sanitary Rules and Regulations of Uzbekistan No. 0157-04 "Sanitary requirements for the storage and disposal of solid municipal waste at special landfills in Uzbekistan".

11. "Methodological recommendations for development of Draft standards for the maximum disposal of waste for thermal power plants, thermal power stations, industrial and heating boilers", St. Petersburg 1998.

12. Sanitary Rules and Regulations No. 325-16 "Sanitary standards of permissible noise levels in the workplaces".

13. Handbook of an environmental expert. State Committee of the Republic of Uzbekistan for Ecology and Environment Protection, State environmental expertiseexpertise. Tashkent, 2011.

14. Construction code and regulations 2.01.08-96 "Noise protection" T: 1996.

15. The noise of construction sites, Minina N.N.

16. Construction code and regulations 2.04.01 – 98 "Internal water supply and sewerage of buildings".

17. Statistical compendium of the Ministry of Macroeconomics Statistics of the Republic of Uzbekistan. "Regional Statistical Yearbook of Uzbekistan". Tashkent, 2018.

18. Handbook of power chemical engineer. Moscow: Energiya, 1972.

19. OND-86 "Methodology for calculating concentrations in atmospheric air of harmful substances contained in the emissions by enterprises". Leningrad. Hydrometeoizdat. 1987.

20. Review of the state of atmospheric air pollution and emissions of harmful substances in cities within the territory of the Glavgidromet of the Republic of Uzbekistan for 2018. Part 1. The Main Department of Hydrometeorology under the Cabinet of Ministers of the Republic of Uzbekistan, Tashkent, 2019

21. Yearbook of surface water quality and efficiency of water protection measures carried out in the territory of Glavgidromet for 2018 Tashkent: Glavgidromet of the Republic of Uzbekistan, 2019.

22. Yearbook of soil pollution in the territory of the Glavgidromet of the Republic of Uzbekistan for 2018. Glavgidromet, Tashkent, 2019.

23. Methodological guidelines on ecological and hygienic zoning of the territories of the Republic of Uzbekistan according to the degree of danger to public health. Ministry of Health of the Republic of Uzbekistan, Tashkent, 1995

24. "Handbook on the assessment of the danger from possible accidents during the production, storage, use and transportation of large quantities of flammable and explosive substances."

Environmental Management Plan

Activity	Potential environmental impacts	Mitigation measures	Responsible party	
			Implementation	Monitoring
Construction stage				
Hydrology	To ensure proper implementation of all the requirements of the State Committee for Ecology and Environmental Protection (State Ecology Committee) for protection of surface and groundwater, especially in places of close occurrence of groundwater with spills and pollution taken into account.	• Consideration of weather conditions during construction stage to minimize the pollutant leaks into the soil. • Restrictions on the depth of digging in the supply are for use of materials or placement of excavated soil. • Minimizing the removal of vegetation cover as much as possible with subsequent rehabilitation where the construction sites have been cleared. • Landscaping, if necessary, as a measure to control the soil erosion.	Contractor	Power plant Management/ State Ecology Committee
Air quality	Efficient minimizing and avoidance of complaints occurred due to airborne particulate matter emitted into the atmosphere.	• All heavy equipment and machinery shall be tunes in full compliance with the state standards. Gasoline and diesel-fueled vehicles shall be pre-checked at one of several well-equipped inspection stations before use. Strict prevention of visible smoke in the exhaust pipes. • Fuel-efficient and well-maintained trucks shall be used to minimize exhaust emissions. Trucks shall also be checked at the inspection station. Trucks with visible smoke in the exhaust pipe shall be suspended from operation. • Soil and sand reserves shall be moistened before loading, especially in windy conditions. • Vehicles transporting the soil, sand and other building materials shall be covered. • Mandatory speed limit of the vehicles with bulk materials, which must be installed and monitored. • Transportation through densely populated areas, especially near schools, shall be avoided. • Plan of minimizing the dust occurrence near orchards and fruit farms. • Watering of dusty surfaces. • it is first necessary to assess the required amount of water and the availability of water on site to avoid overspending of water and resource scarcity in the area for the population for any sprinkling (watering) plan. • Cement plants (if necessary) shall be managed in accordance with the requirements established by the law and shall not be located close to the sensitive recipients.	Contractor	Power plant Management/ State Ecology Committee
Water quality	Prevention of adverse effects on water quality due to neglect of successful environmental	• Construction of a drainage system and its maintenance in working condition. • Proper maintenance, management, including training of operators and	Contractor	Power plant Management/ State Ecology Committee

	practice. To ensure effective management of unavoidable impacts. To ensure minimization of adverse impacts on water quality took place as a result of construction.	other workers, in order to avoid pollution of watercourses as a result of the construction machinery and equipment operation • Storage of lubricants, fuel and other petroleum products in separate special tanks at a distance of more than 50 m from water reservoirs (watercourses). • Proper disposal of solid waste from construction sites, prevention of any amount of construction waste flow to the reservoirs. • To cover the stocks of building material and soil with suitable material to reduce material loss and sediment deposition and avoid their accumulation near water reservoirs. • The cut topsoil shall be stored in the places with destruction of natural drainage. • Pits shall not be located close to drinking water sources.		
Soil erosion/ Landslides	Prevention of adverse impacts on water quality due to neglect of expected impacts and ensure efficient management of unavoidable impacts. Minimization of soil erosion occurred due to construction of foundations and creation of access roads for project vehicles	• Preparation of temporary erosion control plan one month prior to the commencement of work for special sensitive areas, especially in irrigation zones. • Proper installation of temporary drains and erosion control prior to commencement of work within 50 m of collectors and channels. • Monitoring of downstream and upstream water quality in any area of supports installation within the groundwater level and near the watercourses surface (collectors, canals, ditches) during construction (At least once a month – identification of soil erosion / landslides, or confirmation that such cases are not available; water quality – verification for the presence of suspensions and petroleum products) • Backfilling shall be in layers (as it was before the project was implemented) and compacted properly in accordance with the design standards and aligned to the original contours, where possible. • Backfilling areas shall be considered against the flow acceleration, while the filling areas shall be carefully designed to avoid inappropriate drainage. • Embankments shall not be created within such distances behind excavated or natural slopes that reduce the stability of the slopes. • Embankments shall be covered, if possible, drains around the embankments shall prevent spills and erosion. temporary or permanent drainage shall protect all areas subjected to erosion in short term prospective. • Measures shall be taken for prevention of surface water accumulation in the form of ponds and slopes erosion. • Contractor shall ensure that appropriate measures are taken to minimize the soil erosion during construction and soil erosion around foundations during the operation of the power plant facilities by means of appropriate drainage systems and vegetation protecting the soil. Regular monitoring of the soil during operation is necessary. Contractor shall consult with the local	Contractor	Power plant Management/ State Ecology Committee

		authorities concerned before applying the mitigation measures. • Grass surface cut will be minimized during the site preparation. • If it is necessary to cut or remove the trees, they shall be replanted before the site clearance and relevant trees (or other vegetation cover) shall returned to ensure rainwater harvesting and landslides hold.		
Ground noise /vibration	Minimization of increase in ground noise and vibration during construction.	• Construction activities shall be carried out during daytime only, shock works shall be prohibited during nighttime. • State-of-the-art equipment with low noise shall be used. • All heavy machinery and equipment shall be tuned in full compliance with national and local regulations with installation of effective mufflers to minimize the noise. If necessary, equipment with excessive noise shall be additionally sealed, with noise-damping screens installed to minimize the noise level. • Vehicles shall move with the speed limits within residential areas. • Contractor shall take appropriate measures to minimize the noise impact near construction sites by means of use of available acoustic methods. Observation and compliance with Sanitary Standards on noise standards at permanent workplaces and in residential areas during day and night time(Construction code and regulations 2.01.08-96. Noise protection. The State Committee of the Republic of the Republic of Uzbekistan for Architecture and Construction. Tashkent, 1996; Sanitary rules and regulations No. 0325-16 "Sanitary standards on permissible noise levels in the workplaces".	Contractor	Power plant Management/ State Ecology Committee
Construction waste disposal	Minimization of impacts from construction waste disposal.	• Plan for the construction waste disposal shall be developed. • Assessment of the volume and types of construction waste to be generated by the Contractor. • Separation of construction waste by type. Avoidance of different types of waste mixing during their storage and movement. • Avoidance of unorganized waste accumulation on the construction site. • Survey whether the waste can be reused in the project or by other stakeholders. • Identification of potentially safe landfills of solid municipal waste near the project area or waste storage sites defined in the contract. • Provision of containers for temporary waste storage, with subsequent delivery to the specialized organizations for disposal and recycling. • Survey of the environmental conditions of existing landfills and recommendation on the most suitable and safest locations. • Construction waste shall not be left where it can be washed away by water flows downstream to floodplains, dams, rivers, canals, etc. • Used oil and lubricants shall be delivered for regeneration and reused or removed from the site in full compliance with national requirements.	Contractor	Power plant Management/ State Ecology Committee

		• Waste oil shall not be burned! Location of the landfill will have to be agreed with local authorities and the State Ecology Committee. • Equipment shall be properly maintained to minimize oil spills during construction. • Solid municipal waste shall be collected and removed under an agreement with the Khokimiyat to the landfills agreed with the State Inspectorate of Sanitary and Epidemiological Supervision under the Cabinet of MInisters of the Republic of Uzbekistan. Open burning of any material is illegal and is strictly prohibited as contrary to the best environmental practices. • All liquid materials and lubricants shall be stored in closed containers or barrels.		
Operation and location of construction yards (if necessary)	Guarantees that no negative impact on the environment and people is available during the operation of temporary construction yards.	• Determination of the location of the construction yards after consultation with local authorities. Location shall be approved with the regional departments of the State Ecology Committee. • If possible, temporary construction yards shall not be located near settlements or drinking water intakes. • It is necessary to avoid trees felling, vegetation stripping shall be minimized - on the contrary, work camps shall be landscaped. Water supply and sewerage facilities (connected to septic tanks) shall be provided for workers. • The construction yards areas shall be rehabilitated by grubbing, vegetation planting after the site is vacated. Solid waste and effluents shall be managed as per the existing requirements, preferably within the existing official waste removal and disposal system. • Contractor shall organize and maintain a system for sorting, collecting, and transporting the waste. As a rule, solid waste cannot be dumped, buried or burned at or near the construction site. Waste shall be removed to the nearest landfill after obtaining the necessary permits from local authorities and the State Inspection of Sanitary and Epidemiological Supervision under the Cabinet of Ministers of the Republic of Uzbekistan. • Contractor shall ensure that all liquid and solid hazardous and non-hazardous waste is separated, collected, and removed in accordance with existing requirements and instructions. • Upon completion of the project, all construction waste and debris shall be removed. All temporary structures, including office buildings, cabins and toilets shall be removed, except for those that will be used during operation. • Open areas shall be planted with suitable vegetation.	Contractor	Power plant Management
Trees and vegetation cover stripping for supports and temporary work area	Avoidance of some negative impacts due to the removal of baulks, trees, as well as grassy green vegetation and topsoil.	• The contractor's personnel and workers shall be strictly instructed not to damage any vegetation, such as trees or shrubs. • Clearing of green surface cover for construction, trees felling and other vegetation stripping such as shrubs and grass during construction shall be minimized.	Contractor	Power plant Management

		• Landscape and roadsides shall be rehabilitated upon completion of the work.		
Safety measures for employees	To ensure the safety of employees.	• Provision of appropriate warning signs. • Provision of protective helmets or hard hats for employees. • Contractor shall instruct its employees in respect of hygiene and safety issues and instruct the employees to use the provided protective equipment and equipment. • To take all appropriate safety measures in accordance with law and best technical practices. • Compliance with all guidelines and obligations related to the Building Safety Standards**,** by provision of detailed terms on hygiene and occupational safety of the construction worker. • Employees shall be trained in hygiene and safety issues and certain risks of their work.	Contractor	Power plant Management
traffic state	Minimization of traffic disturbances and pedestrians during transportation of construction materials, excavated soil, equipment, and machinery by blocking the access roads during work; damage / maintenance problems of roads and bridges used by trucks, inconvenience from dust near transportation routes, especially near schools and hospitals.	• To develop the plan for temporary access roads one month prior to commencement of work. • To formulate and implement the plan for alternate routes for trucks. • The proximity of schools and hospitals shall be taken into account. • Installation of warning road signs and compliance with traffic rules during transportation of materials, equipment, and machinery. • Condition of roads and bridges shall be taken into account. • Installation of culverts on canals and drains. • Expansion/renovation of access roads/roads. • To take into account the damage to rural houses from vibration (old houses made of clay bricks or raw materials) along narrow and unpaved rural streets.	Contractor	Power plant Management
Impact on flora and fauna during construction	To ensure minimal impact from construction workers and construction equipment on vegetation and wildlife.	• To prevent the stripping of vegetation. • To instruct the employees for them to carry out the construction activities without disturbance to the animals. Hunting shall be banned in general. • Vegetation shall be transplanted at the unused areas to prevent the weathering of sand and to exclude violations of the birds, reptiles and insects habitats.		Power plant Management
Social impacts	To ensure minimal impact from construction workers. To ensure minimal impact on public health. To ensure minimal consequences of indirect impacts from construction on people residing close to the CCGT under construction.	• It is necessary to avoid the possibility of the infectious diseases distribution from temporary construction yards (it is necessary to regularly inform the workers and maintain the appropriate hygiene). • Requests/complaints from people about inconveniences during the construction of the CCGT shall be considered and resolved by the Contractor at the earliest. • Contractor shall arrange the temporary access and make the alternative arrangements to avoid the impact on the local communities and avoid such short-term negative impacts.	Contractor	Power plant Management

	To minimize the impact from dust, noise, vibration. Minimization of problems with access for local communities during construction.	• Compensation plan shall be completed by the Khokimiyat in accordance with the requirements of National Law. • Logistics for the land acquisition and temporary withdrawal of land shall consider the provision of a temporary replacement. • Provision of compensation according to the schedule, taking into account the minimum concern of the people affected by the project.		
Operation stage				
Incomplete removal of project materials	Risk of waste exposure to soil, groundwater and surface water from the construction debris left after completion of the project.	• To clean all the work sites/work camps after completion of the project; • Rehabilitation of vegetation cover on all work sites.	Power plant Management	Power plant Management
Air quality	Minimization of the impact from emissions into the atmosphere.	• NO_x emission limits shall correspond to Uzbekistan` quotes. • In case of mechanical malfunctions, it is necessary to have critical components in stock to resolve the current situation in a timely manner. • To control of pollutants in exhaust flue gases once per month with involvement of a special organization. • Monitoring of compliance of gross emissions from CCGT with the emission standards established prior to CCGT commissioning (the final stage of the National EIA – National EIA 3 stage, the statement on the environmental consequences of the impact on the environment of the CCGT activities, approved by the State Ecology Committee)	Power plant Management/ State Ecology Committee	Power plant Management/ State Ecology Committee
Soil and groundwater pollution	Minimization of impacts from spills and leaks.	• To ensure the management of hazardous liquids • Preparation of the Plan for spills and leaks elimination.	Power plant Management	Power plant Management
Water quality, water conservation	Minimization of impacts from water withdrawal, from effluent and heated effluents.	• Compliance with licenses for water intake from Yuzhno-Golodnostep Canal. • Compliance with the requirements of the State Ecology Committee on the conditions of effluent discharge to the Yuzhno-Golodnostep Canal, established in the National EIA 3 stage prior to commission of the CCGT. • Compliance with the requirements of Sanitary Rules and Regulations No. 0318-15 "Hygienic and anti-epidemic requirements for protection of water bodies within the territory of the Republic of Uzbekistan" for thermal pollution of the Yuzhno-Golodnostep Canal as a result of the heated effluents discharge. • To ensure the management of hazardous liquids • Implementation of an inspection program to maintain the mechanical integrity of pressure vessels, tanks, pipelines, ventilation and discharge systems, automatic emergency shutdown systems, pumps and related process equipment. • Periodic monitoring to maintain the integrity (coatings and retention systems) of silt ponds, oil and chemical storages/containers to avoid the leaks. Where applicable, proper repairs will be carried out.	Power plant Management/ State Ecology Committee	Power plant Management/ State Ecology Committee

		• Entire infrastructure of water resources management will be constantly monitored and checked, if necessary, repairs will be carried out as soon as possible.		
Waste disposal	Impact minimization from waste disposal.	• It is necessary to develop a Waste Disposal Plan to be submitted to the State Ecology Committee and approved prior to the ES commission as part of the National EIA 3 stage. • Survey whether the waste can be reused in the project or by other stakeholders. • Identification of potentially safe landfills of solid municipal waste near the project area or defined waste storage sites. • Survey of the environmental conditions of existing landfills and recommendation on the most suitable and safest locations. • Bulk materials shall be accumulated in separate places to avoid the soil washout. • Used oil and lubricants shall be rehabilitated and reused or removed from the power plant area in full compliance with national requirements. • Waste oil shall not be burned! • Used transformer oil, which should be processed, restored or reused by the appropriate facilities upon permission and under state control. It is mandatory to control the used transformer oil for the content of PCBs with involvement of the special accredited laboratories. • Solid municipal waste shall be collected and removed under an agreement with the Khokimiyat to the landfills agreed with the State Inspectorate of Sanitary and Epidemiological Supervision under the Cabinet of MInisters of the Republic of Uzbekistan. Open burning of any material is illegal and is strictly prohibited as contrary to the best environmental practices. • All liquid materials and lubricants shall be stored in closed containers or barrels.	Power plant Management / State Ecology Committee	Power plant Management/ State Ecology Committee
Hazardous materials	Risks and hazards of leaks and spills.	• Health and safety plan for operation of the power plant shall include the management of hazardous materials leaks and pollution, including public consideration. • Appropriate PPE should be provided to all personnel working with hazardous materials. • Materials shall be stored in a safe place, free from cross-contamination and spill localization (or by other methods) up to 110% of the volume of the container. • Manager with appropriate qualifications will be appointed to manage the storage and processing of such materials.	Power plant Management	Power plant Management
Accidents	Risks and dangers from disasters.	• Power plant construction site, framework and foundation materials of the power plant buildings and structures shall be selected based on the detailed geological surveys. • To apply the relevant building codes and infrastructure design.	Power plant Management	Power plant Management

		• Awareness of the people about disasters and emergencies. • To conduct regular inspections and maintenance of the power plant equipment. • To prepare the emergency response plan.		
Occupational health and safety	Risks to the health of personnel.	• To prepare the personnel safety training program. • To develop the schedule for safety meetings. • To prepare the schedule of regular inspections, tests and maintenance of all equipment to ensure the safety. • To provide the procedures ensuring that all equipment that has been damaged, contaminated, improperly installed or is not in working condition shall be repaired or replaced immediately. • To Prepare the Recommendations on use of protective equipment and clothing. • All construction installations and equipment used on or around the power plant shall be equipped with appropriate safety devices. • Fully equipped first medical station shall be provided. • Assurance of coordination with local public health officials and achievement of a documented understanding regarding the use of hospitals and other public facilities.	Power plant Management	Power plant Management

Environmental Monitoring Plan

Issue	Parameter of monitoring	Location of monitoring	Type of monitoring	Time / intervals of monitoring	Organizations responsible for monitoring
CONSTRUCTION STAGE					
Air quality	Dust pollution, hydro dust control	On the north-western boundary of the construction site; next to the nearest private houses.	Inspections, observations.	Daily.	Contractor / Power plant Management
Water quality (surface water pollution)	- Suspended substances - Petroleum products - Visual check (presence of oil films, color, smell) - Other parameters upon the request of the State Ecology Committee.	Yuzhno-Golodnostep Canal (in places closest to the construction site).	Quality control of surface waters to prevent an increase in suspensions and petroleum products, when suspensions and petroleum products are visually detected, their content shall be measured by a special organization.	Upon visual detection of suspensions and petroleum products	Contractor / Power plant Management
Waste	Conditions for collection, storage and delivery for disposal and recycling	Construction site.	Inspections, observations.	Daily.	Contractor / Power plant Management
Hazardous materials	Records of incoming and outgoing hazardous materials and waste, including storage conditions, waste disposal sites, permits for use and burial, etc. Evidence of PPE use by employees when they work with, or near hazardous materials and waste.	Construction site.	Inspections, observations.	Daily.	Contractor / Power plant Management

Noise	Restriction of noisy work during daytime hours, use of PPE.	On the construction site (at permanent workplaces);	Inspections, observations.	Weekly.	Contractor / Power plant Management
Preservation of the topsoil	Storage of materials and protective equipment.	Construction site	Inspections, observations.	After the construction site preparation, after storage of materials, and after completion of the construction activities	Contractor / Power plant Management
Maintenance and refueling of vehicles and construction equipment	Prevention of oil and fuel spills.	Contractor's site.	Inspections, observations.	Snap inspections during construction.	Contractor / Power plant Management
Hygiene and safety of workers	Official approval of the location of the temporary construction yard. Availability of relevant personal protection equipment. Organization of traffic on the construction site.	Construction site and work camps.	Inspections, interviews, comparisons with the methods declared by the Contractor.	Snap inspections during construction and in case of complaints.	Contractor / Power plant Management
Protection of surface waters	Compliance by the contractor with its approved methods.	Activities near surface watercourses (canals, collectors, ditches).	Inspections.	Snap inspections during activities near rivers and water reservoirs.	Contractor / Power plant Management
Protection of trees	If applicable, i.e. preservation of trees near the construction site, installation of tree fences.	In areas where trees are planted along the construction site.	Supervision.	After the commencement of construction activities on the relevant site.	Contractor / Power plant Management/ State Ecology Committee
Air pollution from improper maintenance of equipment	Exhaust gases, dust.	On the construction site.	Visual check.	Snap inspections during construction activities.	Power plant Management/ State Ecology Committee

Drainage damage or uncontrolled erosion	Leaks into the drainage system and damage caused by erosion	Culverts and drainage facilities.	Visual check.	Measures shall be taken immediately to eliminate the drainage damage or erosion upon detection the same.	Power plant Management/ State Ecology Committee
Labor and working conditions	Compliance with labor law, legal norms, safety regulations. Not to use child labor,	Construction site	Inspection and periodic audit.	Constantly during construction state with a quarterly report.	Contractor / Power plant Management
Complaints	Number, content and results of complaints handling. Complaints review and decisions taken.	Construction site.	Registration. Minutes of meetings.	Constantly with a quarterly report.	Contractor / Power plant Management
Injuries	Compliance with labor low, legal norms, safety regulations and contract terms.	Within the entire area of the construction site.	Inspection and audit.	Constantly with a quarterly report.	Contractor / Power plant Management
OPERATION STAGE					
Air quality – emissions from chimneys	NO_x, CO	Chimneys of the CCGT.	Measurements by a special organization	Once per month	Power plant Management/ State Ecology Committee
Atmospheric air quality outside the boundaries of the company	NO_x, CO	Sensitive areas - the nearest residential buildings.	With involvement of special organization, as well as by calculation when standards for maximum allowable emissions (MAE) are developed.	As part of the National EIA 3 stage – prior to commissioning of the power plant (the validity period is 3 years), then – as part of the draft standards of the MAE to be updated every 5 years.	Power plant Management

Noise	dBA	• area of the power plant (at permanent workplaces); • on the boundary of the power plant; • next to the nearest private houses on the north-western and south-eastern sides of the power plant.	Instrumental measurements with the involvement of a special organization.	In case of complaints from residents .	Power plant Management
Water quality (thermal and chemical pollution of surface waters).	Water temperature; Suspended substances BOD; COD; pH; Mineralization; Nitrates; Nitrites; Sulfates; Chlorides; Calcium; Magnesium; Iron; Chrome $^{6+}$ Zinc; Copper; Petroleum products, Other parameters specified by the State Ecology Committee.	At the place of effluent discharge, 500 m above and 500 m below (before and after) effluent discharge). Three reference points.	Instrumental measurements carried out by special organization.	Once per month	Power plant Management/ State Ecology Committee

Waste	- Type, amount of waste, storage conditions, disposal. - Required permits. - Recycling / reuse/ disposal. - Compliance of the above parameters with the requirements established by the State Ecology Committee in the draft standards for waste generation and disposal.	Throughout the entire territory of the power plant.	Environmental Protection Department of the power plant	Constantly with a quarterly report.	Power plant Management/ State Ecology Committee
Hazardous materials	Records of incoming and outgoing hazardous materials and waste, including storage conditions, waste disposal sites, permits for use and burial, etc. Evidence of PPE use by employees when they work with, or near hazardous materials and waste.	Area of the power plant	Inspections, observations.	Daily	Power plant Management
Labor and working conditions	Compliance with labor law, legal norms, safety regulations. Not to use child labor, human trafficking, raise awareness about HIV, improve the gender and living conditions in accordance with the standards of the contract.	Inspection and periodic audit.	Throughout the entire territory of the power plant.	Constantly	Power plant Management

Complaints	Number, content and results of complaints handling. Complaints review with taking the decisions.	Registration, minutes of the meetings.	Throughout the entire territory of the power plant.	Constantly with a quarterly report.	Power plant Management
Injuries	Compliance with labor low, legal norms, safety regulations and contract terms.	Inspection and audit.	Throughout the entire territory of the power plant.	Constantly with a quarterly report.	Power plant Management