OPEN JOINT-STOCK COMPANY
“ T E P L O P R O E K T ”

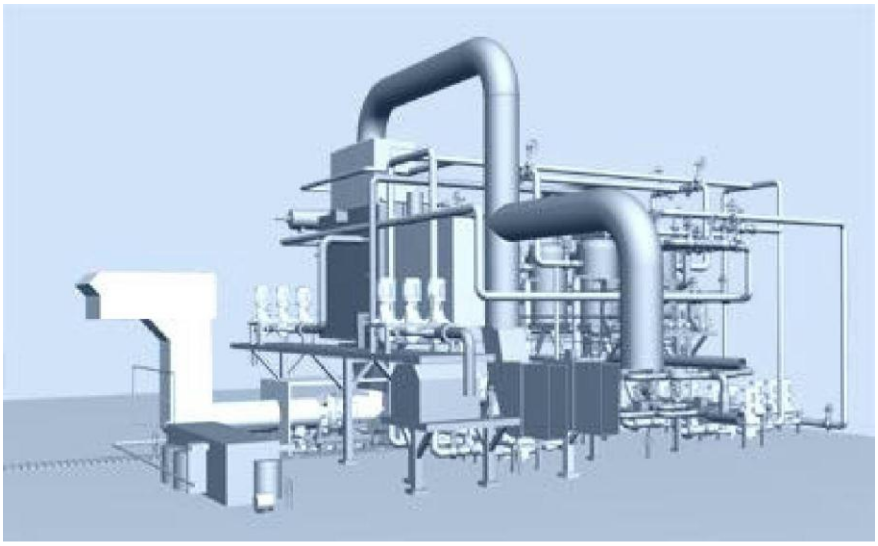
Pre-Feasibility Study

for

Investment Project “Construction of the Second CCGT Unit with a Capacity of **450** MW at Navoi TPP”

Volume **IV.** Book **1**

Draft Impact Statement **(**DRAFT EIS**)**



Tashkent

2011

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Explanatory Note

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Tashkent
2011

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Introduction

The goal of this statement is to evaluate the environmental impact from construction of the second combined cycle gas turbine (CCGT) unit with a capacity of 450 MW at Navoi TPS.

Pre-feasibility study of the 450 MW CCGT unit construction design at OJSC "Navoi TPS" was developed by OJSC "Teploelektroproekt".

Protocol Instruction No. 439 dated 21 March 2011 of the Cabinet of Ministers of the Republic of Uzbekistan and Terms of Reference issued by SJSC "Uzbekenergo" in May 2011 were the basis for the assessment.

This draft EIS has been revised in accordance with requirements of the State Environmental Expertise Committee (Opinion No. 18/978з as of 23 November 2011):

- bring the site layout plan in compliance with reality based on the field study findings in partnership with representatives from the State Inspection of Navoi Regional Nature Protection Committee;
- to elaborate options for alternative site for the deployment of the second CCGT in accordance with requirements of Sanitary Regulations and Standards (SanPiN) No. 0246-08 of the Republic of Uzbekistan;
- to take into account the sequence of operations during dismantlement of functional boiler units and commissioning of planned CCGT units to prevent a sudden increase in the environmental load during their joint operation for calculation of emissions generated by stationary sources at the station upon its reconstruction;
- to calculate the impact area and maximum concentration of pollutants for most common scenarios of emergency situations with regard to the location of residential areas;
- to calculate environmental assessment of accident consequences;
- to develop measures aimed at reducing the concentration of pollutants in the impact area of TPS emissions down to prescribed allowances (quotas);
- to hold public hearings regarding the construction of the second 450 MW CCGT unit with residents of "Yangiabad" and "Uyrot" village community assemblies and representatives of local self-governing bodies.

Navoi TPS provides electric power to Navoi, Samarkand, and Bukhara Regions and heat to Navoi Region and city of Navoi.

The operating life of 12 power generating units is 27-45 years leading to continuous deterioration of equipment and its reliability resulting in low cost-performance ration and greater likelihood of accidents with possible negative environmental consequences.

OJSC "Navoi TPS" falls into Environmental Impact Category I (highest risk, para.37 The List of Activities Subject to State Environmental Expert Review, Annex No. 2 to Resolution No. 491 of the Cabinet of Ministers dated 31 December 2001).

The construction of the second 450 MW CCGT unit in addition to the earlier designed 478 MW CCGT Unit at Navoi TPS will enable an increase in generating capacity of the station from 1,250 to 1,817.75 MW, a reduction in operational costs, more efficient energy conversion and reliable supply of electric power to customers, improvement in the environmental situation in the impact area of the station through replacement of two power generating units st. No. 3 and No. 8 with the new combined cycle units.

The main objectives for this statement included:

- assessment of the extent of negative impact of the TPS on the environment before and after construction of the CCGT unit;
- environmental analysis of the design solution including identification of types, targets, and nature of the impact; and
- a comparative environmental analysis of alternative options.

Environmental impact assessment of the second CCGT unit at Navoi TPS was grounded on the analysis of the current environmental status, functional technological equipment, identification of sources of emissions, wastewater, and waste.

The level of air pollution with emissions of Navoi TPS after the implementation of the proposed technological solution was calculated and compliance with State Committee for Nature Protection of the Republic of Uzbekistan was verified.

"Regulation on the State Environmental Expert Review of the Republic of Uzbekistan" approved by Resolution No. 491 of the Cabinet of Ministers (CoM) of the Republic of Uzbekistan dated 31 December 2001 and stipulating the structure and scope of the environmental impact assessment as well as Resolution No. 152 of the CoM of the RUz dated 5 June 2009 "On Amending and Recognizing Some Decisions of the Government of the Republic of Uzbekistan as Invalid".

1. Environmental Status in the Location of Navoi TPS

1.1. Description of Physiographic and Climatic Properties

OJSC "Navoi TPS" (mailing address: "Yangi-arik" village community assembly, Karmana District, 210600, Navoi Region) is located 6 km northwest of the city of Navoi. The nearest residential buildings are located to the west of the TPS boundaries at a distance of 650m, while this distance decreased to 400m after construction of a 478MW CCGT unit (Figure Item 1,2).

Areas bordering the TPS include:

- in the north: agricultural land and summer cottages;
- in the south: integrated energy service of NMMC, Tashkent-Bukhara highway and residential holdings of "Uyrot" village community assembly;
- in the east: holiday village "Michurin", the Zerafshan River and Navoi-Uchkuduk highways;
- in the west: residential holdings of "Yangiabad" village community assembly and agricultural land.

The station occupies an area of 100 ha stretching from north-north-west to south-south-east at an altitude of 334.2m above sea level.

The construction site for the new power generating unit 450MW CCGT is planned to be located in the western part of Navoi TPS area and 478 MW CCGT unit under construction. The site location has been determined taking into account the electric power output towards the existing Outdoor Switchgear (OSG)-220 kV of Navoi TPS, access road and connection of public utility communications (gas, water, and etc.). The site is configured as a rectangle with sides measuring 330mx270m.

The distance to the closest residential holding of "Yangiabad" village community assembly located to the west of the second 450MW CCGT unit construction site boundaries is 70m and 112m southward to the nearest residential holding of "Uyrot" village community assembly.

In relation to envisaged construction, Hokimiyat (district authorities) of Karmana District, Navoi Region, adopted a resolution on 20 December 2011 on relocation of 30 existing houses until 15 May 2012 (including 11 houses in "Uyrot" VCA and the rest in "Yangiabad" VCA (The Hokimiyat Meeting Minutes and the Relocation Schedule for the Residents are annexed).

After demolition of the existing residential holdings, the boundaries of 450MW CCGT unit site will include: in the north, the Zerafshan River at a distance of 200m; in the east, the site of 487 MW CCGT unit under construction; in the west, a preserved residential holding within "Yangiabad" VCA at a distance 200m; in the south, a preserved residential holding within "Uyrot" VCA at a distance of 300m.

Spacing between the boundaries of TPS after construction of the second 450 MW CCGT unit and residential holdings were confirmed through an on-site investigation attended by representatives of the State Inspection of Navoi Committee for Nature Protection, OJSC "Navoi TPS" and OJSC "Teploelektroproekt" (Operating Memorandum about Findings of the Visual

Inspection of the Site is annexed).

Public hearings and survey of residents in "Yangiabad" VCA and "Uyrot" VCA were held on the occasion of 450 MW CCGT unit construction at Navoi TPS with participation of makhalla (community) councils of "Yangiabad" and "Uyrot", and the chair of the rural council of "Uyrot" (The Minutes of Meetings with Residents and Survey Sheets are annexed).

The territory of the TPS is located in the western part of the Zerafshan Valley, which is a piedmont plain rising from west to east with a slight slope toward the Zerafshan River. The area in question borders sandy areas of southeastern Kyzylkum Desert in the west, spurs of Nurata Ridge in the north, spurs of Turkestan and Zerafshan Ridges in the east and south, Karnabkul and Kashi Steppes that approach from the south.

The mountain ranges that border the area in question in the north, east and south affect air currents and determine local climatic properties, particularly, the wind pattern.

Eastward direction prevails in the yearly wind rose, whereby emissions from Navoi TPS and other major enterprises in the industrial zone are carried in a direction that is opposite to the city, i.e., the industrial site of the station is positioned with regard to the wind rose.

The north-western wind is conducive to transportation of harmful substances towards the city, but average annual recurrence of such wind is below 8 % and as low as 4 % in winter. The industrial site of Navoi TPS is positioned taking the wind rose into account.

Within the area in question, wind speed varies from 1.9 to 3.5 m/s throughout the year. Their highest values occur in March and the lowest – in September. Average annual wind speed is 2.4 m/s.

Gentle winds predominate in the city of Navoi at 0-1 m/s and 2-3 m/s, while their recurrence amounts to 40.24 % and 39.23 %. The 4-5 m/s wind recurrence is around 12%, and strong winds (more than 8 m/s) are rare (from 1.98 to 0.1 %). The highest recurrence of gentle winds does not result in city air pollution, since additives accumulate in the vicinity of Navoi TPS. Frequently recurring higher wind speeds improve the dispersion of additives from hot sources, which carry them to far distances.

Windrose Diagram

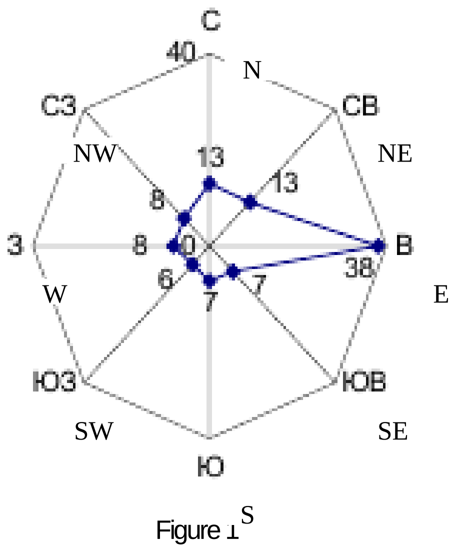

Figure 1

The wind from the south blows much less frequently, in winter the wind recurrence amounts to 7-11% and 1-3% in summer. Frequency of northwestern wind blowing towards the city is the lowest in winter at 4% and higher in summer at 14%, while average annual frequency does not exceed 8%.

The location of the area in question deep in the continent determines its climate: extreme continental climate, warm, very dry in summer and wet, relatively cold in winter in addition to significant yearly and daily air temperature fluctuations. Average yearly air temperature within the range of the Navoi city is 15.87°C. January is the coldest month (average temperature at 2.77°C) and July is the hottest month (average temperature at 28.78°C). Absolutely minimal air temperature in the cold season is as low as -17.4°C. The absolute maximum is observed from May to August and exceeds 40°C (43.8°C in 2007).

Annual distribution of precipitation is marked by most humidification in winter and spring and the least in summer. Monthly maximum of precipitation occurs in March and April, while the minimum occurs in September. Average annual precipitation amounts to 205.68mm. Fogs are rare; average annual number of foggy hours is 41.4 a year. Fogs most often occur in winter months with average fog frequency not exceeding 0.5%.

Thus, the analysis of physiographic and climatic properties of the Navoi TPS location shows that high air temperature, scanty precipitation, increased solar radiation are condusive to environmental pollution, while high frequency of high wind speeds is favorable for diffusion of emissions away from hot sources and their transportation to considerable distances.

1.2. Existing Sources of Impact

The site of Navoi TPS is located in the northern edge of Navoi industrial zone.

In the industrial zone, which occupies the area in the western southwestern, and southern directions of the city, all industrial giant enterprises – major emitters of pollutants – are located: enterprises of the Uzbek National Concern “Uzstroymateriali” (OJSC “Kyzylkumtsement”), SJSC “Uzbekenergo”

(OJSC “Navoi TPS”), associations of “Uzkhimprom” (PA “Navoiazot”, Navoi Electrochemical Plant), of “Kyzilkumredmetzoloto” (Navoi Mining and Metallurgical Complex), “Uzgoskhlopkopromsbit” (cotton gin plant). Along with major production enterprises, there are smaller scale enterprises: bulk plant petroleum depot, automotive enterprises, Concrete Goods Plant (CGP), Repair-Construction-Assembly Department(RCAD), Rock Crashing Plant (RCP), АБЦ, meat and dairy factories, bakeries, timber dealer depot, tare repair factory including enterprises in Karmana District: winery, Manufacturing and Trade Association “Hlebproduct”, automobile operating company (ATP-22, ATP-2, Avtovaztehobsluzhivaniye), construction enterprises (ELUABS, PMK-2, HRU). There are a total of 19 large facilities with more than 450 stationary emission sources into the environment.

According to the State Forecasting and Statistics Committee of the Republic of Uzbekistan in 2010, emissions from stationary sources in the city including enterprises in the industrial area amounted to 36,261 tons of harmful substances including: 19,802 tons of solid substances, 2,913 tons of sulfur dioxide, 5,002 tons of carbon monoxide, 2,146 tons nitrogen oxide, 4,522 tons of hydrocarbons (without VOC), 231 tons of volatile organic compounds, and 1,644 of other gaseous and liquid substances.

The largest share of gross emissions from all stationary sources of enterprises accounts for Navoi TPS, OJSC “Kyzylkumtsement” and PA “Navoiazot”.

According to the statistics of 2010, Navoi TPS emitted 2,546.027 tons of harmful substances into the air. There are 36 sources of harmful substances and 29 emission sources at the station. Twenty-five different pollutants are emitted into the atmosphere. The largest emitters are 5 chimneys of boiler units, which emit 99.37% of the station’s gross emissions. Nitrogen dioxide composes the largest share of emissions (73.77 %).

The main harmful substances entering the atmosphere of the city from OJSC “Kyzylkumtsement” include cement, lime and gypsum dust; from PA “Navoiazot” - oxides of nitrogen, carbon, ammonium nitrate, ammonia, acrylonitrile, hydrocyanic acid, and ammonium sulfate. Pollutants emitted by sources NMMC include ore dust, ammonia, carbon oxides, nitrogen, inorganic and wood dust.

A total of 78 different pollutants end up in the atmosphere of Navoi city and the suburbs including pollutants occurring at in multi-tonnage amounts and more common for the city such as carbon monoxide, nitrogen oxides, sulfur dioxide, dust, hydrocarbons, nitrogen oxide, ammonia, ammonium nitrate, acrylic nitrile, hydrocyanic acid, and ammonium sulfate. Key environmental pollutants such as carbon monoxide and hydrocarbons result from auto-transport and all other harmful substances come primarily from sources of industrial plants and energy facilities.

Because all large enterprises in the industrial area are located along the perimeter, their emissions at dominant wind directions (east and north-east) will be carried in the direction opposite from the city without reinforcing each other. Southerly wind turns PA “Navoiazot” and NMMC into main impact sources in the vicinity of Navoi TPS. During the south-west wind, emission of OJSC

"Kyzylkumtsement" and NMMC form a common field of concentration, which covers the area of the city.

The background factors, which aggravate the condition of the area in question, are tall and hot sources of emissions of industrial enterprises and boiler houses in the central part of the city.

Sources of impact on soil and plants in the vicinity of the Navoi TPS include motor vehicle emissions, industrial enterprises, and power generating facilities, as described above. Contaminants end up in the soil and the plants come from the atmosphere through precipitation, deposition and direct absorption.

According to the scale of environmental impact, Navoi TPS, PA "Navoiazot", some production facilities of NMMC and OJSC "Kyzylkumtsement" appear to be the largest. These enterprises have powerful sources of emissions of harmful impurities, releases industrial wastewater into surface waters, and unrecovered solid waste.

Thus, the state of the environment in the location of the site in question is determined by the emission of high hot sources of enterprises in Navoi city, Navoi TPS, OJSC "Kyzylkumtsement", PA "Navoiazot", NMMC, motor vehicles, and dusty soil surface.

The functional sources of this enterprise cause the greatest human-induced impact on the natural environment in the vicinity of the station.

1.3. Analysis of Sources of Environmental Impact from Functional Enterprises

1.3.1. The Analysis of Hazardous Emitters

Navoi TPS, being one of the largest power plants in RUz, is part of the integrated energy system of Central Asia. Navoi TPS generates electricity for customers in Navoi, Samarkand and Bukhara Regions, steam, hot water for heating the city of Navoi and surrounding villages. The installed electric power capacity of the station is 1250 MW thermal power capacity is 758 Gcal/h.

The level of electricity and thermal power generation increases during the winter months and declines in the summer because of heating shutdown as well as equipment shutdowns for repairs.

Sources of hazardous emissions during heat and electric power generations include the main and auxiliary technological equipment of the TPS (Figure 2). The station consists of heating generation and condensation parts. The condensation part operates according to unit-based principle.

The description of boilers and turbines at the TPS and their main indicators and boilers operation modes are shown in Tables 1.3.1.1, 1.3.1.2, 1.3.1.3.

Table 1.3.1.1.

Properties of Navoi TPS Boilers at Rated Load

St.No. of the boiler	Boiler Type	Rates Steam Generation Capacity, t/h	Fuel Consumption, toe/h	Thermal Output, Gcal/h	Date of Boiler Commissioning
1	TGM-151	220	21.7	151.9	02.1963
2	TGM-151	220	21.2	148.4	05.1963
3	TGM-94	500	62.5	437.5	10.1964
4	TGM-94	500	62.7	438.9	10.1965
5	TGM-84	420	41.2	288.4	09.1966
6	TGM-84	420	41.4	289.8	05.1967
7	TGM-84	420	41.5	290.5	09.1967
8	TGM-94	500	62.5	437.5	07.1968
9	TGM-94	500	62.5	437.5	07.1969
10	TGM-84	420	41.2	288.4	03.1972
11	TGME-206	670	71.7	501.9	06.1980
12	TGME-206	670	71.7	501.9	07.1981
ИТОГО		5460	601.8	4,212.6	

Table 1.3.1.2

Properties of Navoi TPS Turbines at Rated Load

Steam Conduits and Units	Turbine Type	Number of Turbines	Rated Capacity, MW	Available Capacity, MW	St. No. of Boilers
TES-90	VPT-25-4	2	50	50	1,2
TES-130	R-50-130	2	100	65	5,7,10
	PT-60-130	1	60	60	6
160 MW Units	K-160-130	2	320	300	3, 4
	PVK-150-130	2	300	280	8,9
210 MW Units	K-210-130-3	2	420	305	11,12
TOTAL		11	1250	1060	

Table 1.3.1.3

Boiler Operating Modes

Pipe No.	Thermal Output, Gcal/h	Performance Indicators for Boilers Connected to the Pipe			
		αnn/αexhaust	t exhaust, °C	η, %	Fuel Consumption,
1	137.2	1.17/1.52	122	91.85	25
2	630	1.09/1.47	140	90.5	41
3	441	1.13/1.57	130	91.09	60
4	777	1.09/1.45	137	90.5	102
5	575.4	1.09/1.46	145	92.09	92
Total for the Station	2560.6				420

Steam from two boilers St. No. 1, 2 with steam conduit with pressure of 90 absolute atmospheres (TES-90) is fed into two 25 MW turbines and from four boilers St.No. 5, 6, 7, 10 with steam conduit with pressure of 130 absolute atmospheres (TES-130) is fed into two 50MW turbines and one 60 MW turbine. In addition, there are four modular boilers St.No. 3, 4, 8, 9 with four 160 MW and 150 MW turbines and two modular boilers St.No. 11, 12 with two 210 MW turbines.

According to performance reports, the actual operating of the TPS amounted to 885.7 MW in 2010. The reasons for gaps in capacity include:

- technical conditions of units K-160-130, PVK-150 - 130 and K K-210-130 MW;
- technical condition of cooling towers;
- insufficient consumers of heat power;
- capacities for repair.

Main technical and economic indicators of the station for 2010 are shown in Table 1.3.1.4

Table 1.3.1.4

Technical and Economic Indicators of the Station for 2010

Indicators	Dimensions	2010		2009
		Plan	Actual	
Operating Capacity	MW	856.2	885.7	844.4
Generated electric power	mln. kWh	7,158.200	7,376.492	6,999.743
Heat power supply	Gcal	2,138,600	2,329,477	2,235,040
Specific consumption of fuel equivalent: electricity supply, heat supply	g/kWh kg/Gcal	415.84 190.0	416.03 190.0	420.59 190.0
Consumption of electric power for own needs: electricity generation, heat generation	% kWh/Gcal	5.79 45.0	5.79 45.0	5.76 45.0

Average annual specific consumption of fuel for electricity supply according to 2010 data Navoi TPS is 416.03 g/kWh and 190.0 kg/Gcal of heat power, which is above average for the SJSC “Uzbekenergo” (383.6 g/kWh and 176.2 g/Gcal respectively).

Higher values of specific fuel consumption at TPS result from:

- shortage of cooling water in cooling towers;
- burning non-standard fuel in the boilers with reduced calorie capacity and high content of hydrogen sulfide;
- unsatisfactory technical condition of cooling tower for 210 MW unit;
- over-burning fuel because of uncontrolled air inflow into the boiler furnace and convective shaft as well as cross-flows of air in the regenerative air heater (RAH);
- the increased electricity consumption for own needs;
- deviations of steam and condensate loss value from design values;
- failure to comply with standard parameters of steam and feed water;
- increased consumption of electricity and steam for their own needs.

Elimination of these reasons for fuel over-burning will increase boiler efficiency and resulting lower fuel consumption and decreased volume of combustion products and pollutant emissions into the atmosphere.

Whirlwind type TKZ oil-gas burners are installed in all boilers at the TPS. In boilers St.No. 11, 12, the burners are installed in two tiers at the back of the combustion chamber with six burners in each tier.

On the remaining boilers (St.No. 1 - 10), burners are located on the front wall of the furnace evenly in three tiers. The scheme of furnace gas recirculation designed for modular boilers TGME-206 and TGM-94 was restored as a result of operational and adjustment works by UE “Uzenergosozlash” in 2010.

The status of main equipment at TPS requires the replacement of parts and components of turbines, boilers, steam pipes, pumps and electrical equipment due to long operation.

Main type of fuel used at Navoi TPS is natural gas from Zevardy and Kultak deposits with a calorific value of 8,150 kcal/nm and below, the amount of hydrogen sulfide is 0.06-0.1volume %. Fuel oil (mazout) is used as emergency fuel.

The gas is fed to the TPS through three pipelines: two 700mm and one 500 mm in diameter.

The presence of gas condensate in the fuel leads to significant distortion of the true gas consumption. In addition, the combustion of this gas causes corrosion and contamination of the cold layer of RAH fillers, the low temperature sections of flue ducts, clogged nozzles of gas distributing burners, which causes deterioration of the technical and economic indicators, shutdowns for preventive maintenance to clean heated surfaces and restoration of corroded heating elements.

“M-100” Grade fuel oil with sulfur content of 2.5% and lower operating heat of combustion at 9,365 kcal/kg is delivered to the station from Altyaryk and Fergana oil refineries.

When the equipment is operated at the station, nitrogen dioxide, nitrogen oxide, sulfur dioxide, carbon monoxide, benzo(a)pyrene, and mostly oxides of nitrogen and sulfur, are emitted into the atmosphere.

Flue gases are emitted into the atmosphere through five chimneys. St. No. 1-10 are connected to four chimneys that are 56m high, St. No. 11, 12 - to chimneys that are 180m high. Properties of chimneys in rated mode of boiler operation are given in Table. 1.3.1.6.

Table 1.3.1.6

Properties of Chimneys in Rated Mode of Boiler Operation

Pipe No.	Height, m	Diameter, m	Boiler St. No.	Thermal Output, Gcal/h	Fuel Consumption, toe/h	t of exhaust gases, °C	Excess Air Coefficient, αexhaust
1	56	6	1, 2	300	42.9	124	1.74
2	56	9,18	3, 4	876.2	125.17	142	1.55
3	56	9,18	5, 6, 7	867.7	123.96	136	1.63
4	56	9,18	8, 9, 10	1163.4	166.2	141	1.55
5	180	6	11, 12	1003.1	143.3	150	1.47
Total for the Station				4210.4	601.5		

Flue gas cleaning at Navoi TPS is nonexistent. The technique of staged combustion of gas through gas redistribution between tiers of burners was introduced in all boilers at the TPS in line with the design of the Scientific Research and Production Engineering Institute “Atmosfera”, which should provide a reduction in nitrogen oxide emissions by 30 percent or more. However, the designed effect of reducing nitrogen oxides emissions reducing is not achieved and maximum concentrations of nitrogen dioxide exceeds the maximum permissible values more than 3 times.

The value of emission intensity for each boiler depends on the amount and type of used fuel, boiler design, and the state of boiler equipment.

The weighted average concentration of nitrogen oxides in flue gases of boilers at Navoi TPS according to measurement data is shown in Table 1.3.1.7.

Table 1.3.1.7

Weighted Average Concentration of Nitrogen Oxides in Flue Gases from Boilers at Navoi TPS

Boiler No.	Boiler Type	Daily			Daily Average		
		Daily, t/h	αexhaust	Concentration of nitrogen oxides, m/m^3	Daily, t/h	αexhaust	Concentration of nitrogen oxides, m/m^3
1, 2	TGM-151	220	1.74	136	0.67	1.52	80
3	TGM-194	500	1.55	287	0.88	1.47	240
5-7	TGM-84	420	1.63	172	0.64	1.57	106
8, 9	TGM-94	500	1.55	250	0.80	1.45	230
12	TGME-206	670	1.47	287	0.76	1.46	220

There is a peak-load boiler house at the station equipped with one KVGM-100 boiler operating in heat-extraction mode in winter in case of increased heat supply load. Main fuel of the peak-load boiler house is gas. The boiler is connected to a separate 60 m high chimney. Currently, the peak-load boiler house is out of order, because it requires capital repairs.

In addition to main emitters, there TPS generates emissions during operation of auxiliary units and equipment.

There are two forging furnaces connected to two chimneys at repair units of the TPS. The furnaces operate on gaseous fuels and emit nitrogen dioxide and carbon oxide.

Emissions of the fuel oilfacility are discharged through vent valves of tanks for long storage of mazout, charging tanks and charging chutes. The fuel oilfacility Fuel oilfacility includes 4 tanks that are 3,750m^3 each and 3 tanks that are 15,000 m^3 each. The receiving and discharging device for liquid fuel is designed to receive the contents of 120-ton rail tank cars. The maximum number of discharge rail tank cars is 21 at average of 60 tons of fuel oilper rail tank car. Saturated and aromatic hydrocarbons and hydrogen sulfide are emitted into the air.

Hydrocarbons vapors are released during storage of petroleum, oil, lubricants (POL) at the TPS in the amount of 164 t/year (125t – benzene, 25t – diesel fuel and 14.4 – engine oil) through vent valves of 8 containers (3x25m^3 –

for benzene, 1x60 m^3 – for diesel fuel, 1x3.5 m^3, 1x5 m^3 – for engine oil) and during storage of turbine oil (118 t/year) and transformer fluid (228 m^3) in metallic containers (9 pieces) in the oil facilities of an electric shop.

Uncontrolled emission of pollutants includes:

- Emissions during loading and unloading and warehouse storage of sodium chloride, hard coal, lime, cement, inorganic dust, quicklime, sulfuric acid, caustic soda, hydrazine hydrate, ionitesand, polyacrylamide anionite and cation resins, ammonia, used as reagents in chemical shop;
- Emissions during electric welding and gas welding works. Nitrogen dioxide, carbon oxide, welding aerosols, iron oxides, and manganese and fluoride compounds are emitted into the air. At the station, there are 57 mobile and stationary welding points, but their simultaneous operation is excluded. Coincidence factor is 0.3-0.4. Consumption of electrodes at the station is 15 tons.

During the purging of gas conduits before boiler kindling, salvo emissions of natural gas are discharged through the purge vents. The duration of purging is about 10 minutes.

Properties and parameters of the main sources of pollution are given in Table P.3.

1.3.2. Water Consumption and Drainage

Navoi TPS uses water for technical and for utility and drinking purposes.

Water for utility and drinking purposes and water replenishment of the heat distribution network is fed to the TPS from the municipal water works. Water for the station's industrial purposes is taken from the Zerafshan River and used for:

- cooling turbine condensers;

- cooling auxiliary equipment of turbines and power generation units;

- the needs of the water treatment system (own needs and replenishment of boilers during the steam cycle);

- production needs (watering the territory, firefighting water conduit, washing production premises and others).

Cooling water supply layout for St. No. 11, 12 re-circulatory unit based.

Design capacity of cooling towers No. 1, 2 is 38,968 m^3/h and actual is 35,416.7 m^3/h. In 2007, water flow intensity through cooling tower No. 1 amounted to 121,880.05 thousand m^3 and cooling tower No. 2 – 149,212.06 thousand m^3.

In 2010, 652,940.117 thousand m^3 was extracted from the Zerafshan River for production purposes. The water use limit is 860.0 mln m^3. No water was consumed in excess of the limit in 2010. Water volume within the system of re-circulatory water supply of units No. 11 and 12 is 215,966.374 thousand m^3 (at designed capacity of re-circulatory water supply of 335,456.0 thousand/ m^3 a year).

Designed capacity of water recycling (admixing duct) is 28,500.0 thousand m^3/year. Actual capacity of water recycling is 337.824 thousand

m^3/year.

The main source of surface water course pollution is the equipment of water treatment systems (WTS):

- demineralizing unit with design capacity of 600 m^3/hour and actual - 500 m^3/hour;
- the sodium zeolite softening process scheme with design capacity of 600 m^3/hour and actual - 200 m^3/hour;
- WTS for replenishment of the central heating network with throughput of 700 m^3 /hour through increase in the number of filters and decarbonators;
- condensate purification unit to cleanse contaminated condensate returned from the Navoi Chemical Complex. Condensate purification from iron is done on three H-cation filters then sent through Na- cation exchange. After purification, the condensate is used for replenishment of steam generators. Design capacity of the condensate purification unit is 250 m^3/hour and actual – 200 m^3/hour.

Demineralizing unit operates according to the following pattern: pretreatment- lime treatment, coagulation, two-step mineralization. Operational scheme of WTS to feed vaporizers: pretreatment- lime treatment, coagulation, and Na-cation exchange. WTS for replenishment of water in the central heating network works according to the following operational scheme: Na-cation exchange in "blank" regeneration mode, buffer filters, and decarbonization. WTS for water replenishment of the central heating network with the throughput of 2,000 m^3/hour operates according to the following scheme: stepwise-countercurrent H-cation exchange, buffer filters, decarbonizers, partial Na-cation exchange.

Reduced productivity of existing listed WTS as compared to their design capacity is due to the following reasons: deterioration of water quality in the Zerafshan River, physical wear and tear of equipment, worn-out design life (major defects water treatment systems is the corrosive wear of the H-cationite filters, a large number of defects on the filter trimmings, massive violation of chemical protection).

Operation of ion-exchange systems using water with high mineral content requires the spending of large amounts of reagents, which are discharged into surface waters in the form of regenerative and washed off streams. Because of shortfall in delivery of filter materials, lack of automation of reagent dosing at the station, disruptions in the operation of dosing pumps, there are variations in pH level, content of oxides of iron and copper and hydrazine in the feed water. At the same time, highly mineralized source water coupled with undercharge of filtering materials leads to poor performance WTSs.

Reagent consumption for the station is as follows: H2SO4 – 27.5 tons/day, caustic - 12.5 tons/day, lime - 13.0 tons/day, salt - 9.0 tons/day, coagulant - 0.165 tons/day.

Wastewater from pretreatment units is polluted with salts, bases, and acids.

At the TPS, there are also streams of industrial wastewater contaminated with petroleum substances, wastewater resulting from water and chemical flushing of boilers and preservation of equipment, wastewater from flushing RAHs (acidulous and alkaline), from purging cooling towers, industrial and storm wastewater. Residential sewage is sent to wastewater treatment facilities of the city sewerage system, while industrial wastewater is discharged, through special outlets, to the Zerafshan River and "Sanitarniy" collector.

According to design, the industrial wastewater treatment complex (IWWTC) at the TPS includes:

- a building with a purification unit (neutralization, sedimentation) of wastewater from boilers and RAH flushing;
- filter hall of the unit for treatment of greased and oil contaminated wastewater and condensate purifier;
- pretreatment of greased and oil contaminated wastewater composed of receptacles, oil trap, flotators, fuel oilpump, and sedimentation;
- the premises of sedimentation tanks for condensate purification;
- wastewater transfer pump;
- pipe racks: from the main building, reagent warehouse to waterworks;
- waterworks are composed of a sludge disposal site, a lagoon – vaporizer and pumping units.

Presently, most of treatment facilities at TPS are inoperative, pumping equipment is out of order, there is observed corrosion of outdoor structures (support racks, insulation), cracks in pipelines, depressurization of systems with aggressive solutions. Presently, out of IWWTC facilities the following are operational:

unit for treatment of greased and oil contaminated wastewater with a throughput of 100 m^3/hour and with petroleum product content of no more than 100 mg^3/dm in inflow water.

unit for treatment of oil contaminated condensate with a throughput of 45 m^3/hour and with petroleum product content not exceeding 10 mg^3/dm in the incoming condensate. The scheme is in a standby mode because of absence of oil contaminated condensate.

unit for treatment of wastewater from boiler flushing and RAH with evaporation lagoons for neutralized effluent with an area of 18,050 m^2.

In 2010, the volume of effluents treated to standard quality at treatment facilities, which discharge the effluent into the Zerafshan River amounted to 489,502.94 thousand m^3/year including:

- physically and chemically treated – 781.340 m^3/year (sludge disposal site of IWWTC);
- mechanical treatment – 350.4 m^3/year (oil traps No.1,2).-

Seven wastewater outlets are operational at the station. They are described below.

<u>Outlet No.1.</u> Warmed (heated) water after cooling condensators and coolers of auxiliary mechanisms is discharged in the Zerafshan river. Actual discharge rate: 535,74.6 m^3/year, authorized discharge rate – 970,00 m^3/year. Salt composition of wastewater does not differ from the source water, increase in temperature by 7-10 C because of heating in heat exchangers I-II TPS line working according to straight-through system of process water supply.

Outlet No.2. Industrial and storm sewerage, drainage of units 8-12 through an oil trap No. 2 into the Zerafshan River. The effluents are polluted with petroleum productions, suspended particles, and high mineralization. Actual discharge rate is the same as the authorized rate of discharge at 35 m^3/hour.

Outlet No.3. Purge water from cooling towers is conditionally clean. Content of calcium and magnesium is increased. Discharge into "Sanitarniy" collector. Actual amount is 80 m^3/hour. Authorized amount – 97.5 m^3/hour.

Outlet No.4 industrial and storm water sewerage, the main building, drainage from units St. No.1-7. Discharge into the Zerafshan River after oil trap treatment No.1. Runoff is conditionally clean. Authorized and actual discharge rate is – 5.0 m^3/hour.

Issue No.5. Discharge to the Zerafshan River after IWWTC (from sludge collector serving all water treatment systems contaminated condensates related to ion exchange, where, after the exchange reactions, salts of hardness to be removed from feed water, accumulate in the filter material. In the process of recovery ionite filters retained ions pass into the wastewater contaminating them with salts of hardness, iron admixtures, silicic acid, sulfates, chlorides, etc.). The volume of actually discharged wastewater is 194.1m^3/hour and authorized wastewater discharge is 344.0 m^3/hour.

Emergency release from the WTS wastewater interception pumping unit in case of breakdown of transfer pumps used for interception of wastewater pumping (regeneration, filter washing) at a sludge disposal site. Actual and permissible discharge rate is 22 m^3/hour.

Emergency release of brightening agents using for purging from sludge pumping unit into the Zerafshan River from pumping unit ShN-3 in case of breakdown transfer pulp pump at the sludge disposal site. Actual and permissible discharge rate is 0.7 m^3/hour.

Wastewater flow for different outlets amounted to the following: No. 1 – 498,732.0 thousand m^3, No. 2 – 297.76 thousand m^3, No. 3 – 591,7.36 thousand m^3, No. 4 – 43.68 thousand m^3, No. 5 – 192,6.981 thousand m^3, No. 6, 7 – 192 and 192 thousand m^3.

Table 1.3.2.1. provides quantitative and qualitative characteristics of each outlet in comparison with permissible and maximum permissible concentrations and measurements of the station in Table 1.3.2.2. Temperature measurements of the station's wastewater have not been taken in recent years.

Thus the main sources of salt pollution of the Zerafshan River are outlets No.3 and No. 5 for wastewater discharged from water treatment systems including water settled in a sludge collector. It may be concluded from data in the tables that in relation to these outlets there is a higher salt concentration of general mineralization observed at the downstream river station. As compared to source water there is an increase in pollutants at the river station downstream of the outlet: petroleum products for outlet No.2 by 0.257 mg/dm^3, sulfates (outlets No.2, 3, 4) – maximum by 782-806 mg/ dm^3, and chlorides (outlets No.2,3) – by 150 mg/dm^3, while overall mineralization for outlet No.5 increases two times.

At the same time at all outlets, salt concentrations resulting from wastewater in surface watercourses is 1.13 - 3.76 times higher than standard values for fisheries mainly due to sulfates, and salt-induced hardness accumulating in chemical filters.

Thus, chemical and thermal pollution the Zerafshan River due to the existing condition of the IWWTC, where production exceeds the permitted effluent for the stations and standard concentrations of harmful substances discharged into watercourses used for fishery.

Table 1.3.2.1

Authorized Composition of Wastewater at Navoi TPS, (mg/dm^3)

No.	Indicator	MPC p.x.	Source Water	Outlet 1	Outlet 2	Outlet 3	Outlet 4	Outlet 5
1.	Suspended particles	30,0	487,0	490,0	200,0	200,0	200,0	250,0
2.	Mineralization	1000,0	1101,0	1110,0	1120,0	1101,0		1500,0
3.	Nitrite nitrogen	0,02	0,164	0,164				0,05
4.	Nitrate nitrogen	9,1	10,4	10,4				9,2
5.	Sulfates	500,0	453,0	462,0	480,0	500,0		1000,0
6.	Chlorides	350,0	71,5	80,0	75,0	220,0		100,0
7.	Calcium	190,0	107,0	107,0	110	148,0		190,0
8.	Magnesium	50,0	79,2	80,0	80,0	50,0		60,0
9.	Petroleum products	0,01	0,212	0,212	0,1		0,1	
10.	pH	6,5-8,5	8,3	8,3	8,25	8,5		8,3
11.	Iron	0,33	4,67	4,67				

Table 1.3.3.2

Composition of Wastewater at Navoi TPS, (mg/dm^3)

No.	Indicator	Supply canal (background)	Outlet No. 1	Outlet No. 2	Outlet No. 3	Outlet No.4	Outlet No. 5
1	Suspended particles	487,0	478,0	55,4	217,4	86,6	244,5
2	Mineralization	1101,0	1089,0	1116,2	2518,0		1740,0
3	Chlorides	71,5	71,0	71,0	256,0		102,0
4	Sulfates	453,0	438,0	414,0	1300		978,0
5	Petroleum products	0,212	0,204	0,435		1,03	
6	Calcium	107,0	102,0	100,8	154,0		202,8
7	Magnesium	79,2	83,64	76,8	225,7		61,24
8	Nitrites	0,02	0,156				
9	Nitrates	9,1	9,99				
10	Iron	0,33	4,58				
11	pH	6,5-8,5	8,29		8,7		8,2

1.3.3. Generation and Storage of Solid Waste

Solid waste is generated at the TPS during operation of chemical, electrical, boiler-and-turbine, fuel and transportation shops, and garage, repair and construction shops.

During preparation of feed water for power boilers at the demineralization facility, the process of coagulation with iron sulfate and filtration through a mechanical filter produces sludge directed to the sludge disposal site and containing 85% of suspended solids, 13% of iron hydroxide, and 2% of silicic acid

In the process of purifying water on cation filters for replenishment of water in the central heating network, the filters at WTS are restored using sodium chloride, which is discharged as solid waste to the sludge collectors.

Liquid sludge, in addition to industrial wastewater from the water treatment process, contains acid washings used for boiler equipment, runoffs after cooling auxiliary power units and equipment as well as industrial and storm wastewater. For the purpose of settling solids, the liquid slurry is sent to sludge collectors consisting of five sedimentation reservoirs:

a bisectional sludge disposal site, which is used for wastewater resulting from chemical water treatment (CWT) and waste lime, with slurry pipelines and water chutes to the Zerafshan River;

sludge disposal site for oil contaminated silt and sediments with slurry chutes and return water duct for settled water and a pumping station for the settled water; and

evaporating sedimentation reservoirs for wastewater from acid cleaning of boiler equipment and flushing fluids for RAH.

The bisectional sludge disposal site, which is used for wastewater resulting from CWT, was designed not to use filters, structural height is 4.5m and sloping is m=2.5.

The area of one section bottom is 11,800 m^2 (sludge disposal site No. 1), and the area of the second section bottom is 8,000 m^2 (sludge disposal site No. 2). The sludge disposal site was designed for 83,000 m^3 of solid residue. Water settled in the sludge collector flows into water intake shaft wells, whereby their height is increased by means of installing dam beams as the sludge disposal fills up with solid fractions. The water from intake wells flows by gravity along a 350mm pipe to tail water well. At present, both sections are at the point of exhaustion. The discharge technology is frequently violated. Due to breakdown of IWWCT equipment (CWT neutralization unit) the dump site receives alkaline and acidic wastewater separately. The environment is corrosive. Uneven reactions of interaction occur in discharge sites producing a negative impact on the impervious screen. In reality, the sludge disposal site partially percolates. There are cracks and ruptures in the bituminous concrete bed. Jacketing of the sections fails to meet technical requirements. Dam coatings are destroyed and mended through discharge of waste lime after clearing agents.

Intermittently, the sludge is dredged and shipped to designated sites within municipal landfills. Complete burial of CWT wastes requires an allotment of land plot with an area of 40,000 m^2. Considering the presence of chemicals in the composition of waste, their migration into soil and groundwater is possible. In 2002, sedimentation reservoirs No.1, 2 were cleaned from reed and other vegetation. Presently sludge disposal site No. 1 is closed for sludge cleaning, whereby about 20% of all sludge has already been removed. Sludge disposal site No. 2 is operation and is 50 % full.

Sludge disposal site for oil contaminated silt and residue receives thick sludge after from the unit for purifying greased and oil contaminated wastewater. Sludge disposal site was designed to be impermeable and bisectional. The height of the structure is 14.5 m and the area of each section is 1000 m^2. The capacity is 9,600 m^3. Presently, the sludge collector is 70 % full.

According to the design, impervious screen of the sludge disposal site for ЗИО is constructed from fine-grain bitumen concrete. The surface of the bottom and slopes of the evaporation lagoon are treated with long-lasting herbicides (douran, monuran) before coating them with bitumen concrete to prevent the development of vegetation. During earlier EIA for Navoi TPS, poor quality coating of ЗИО sludge disposal site pool was discovered in relation to multiple cracks, ruptures, through which reed was piercing out. Solid fraction is subject to burning in boiler furnaces. Water settled at the sludge disposal sitee flows to water intake shaft wells, the height of which is increased as the sludge disposal site is filled with solid fractions. The settled water flows from the well along a 200mm overflow pipe through the pumping station and returned to the IWWTC cycle.

Sludge containing metals (iron, nickel, copper, chromium, vanadium) and sulfuric acid, hydrochloric acid, ammonium compounds is generated periodically as a result of chemical cleaning of the heating equipment (steam generators) and surface cleaning of RAHs.

Two sections of the evaporation lagoons were designed to be impermeable with a structure similar to the one of the sludge disposal site for oil contaminated residue. Evaporation lagoons are located on a land plot sloped towards high-water bed of the Zerafshan River. The area of one section is ≈11,000 m^2 and the area of another trapezoid section is 6,000 m^2. The structural height is 1.5 m. The lagoon sections fit well into the relief in a terracing manner, whereby one bottom level point is higher than that of another by 1.5 m. According to the design, flushing water should be collected in acid-washing tanks for mutual neutralization of acidic and alkaline wastewater. Upon the completion of neutralization, the solution is to be treated with cream of lime to settle ions of heavy metals, decomposition of hydrazine, ammonium compounds and, then, discharged to the lagoon. In relation to toxicity of the sludge, the water component is to be fully evaporated (at 101 cm a year), the sludge settles and is compacted.

Estimated amount of flushing water is ≈43,000 m^3/year. Out of this amount, the solid component equals ≈2,000 tons/year.

According to earlier EIA findings for Navoi TPS, loss of containment of sludge collector was detected and resulting flow of acids, toxic metals, alkali, toxic solution of hydrazine, and ammoniums compounds into the pond was identified. Chemical reactions occur in place of inflow of the flushing solutions and produce gas pollution.

During the assessment, chemical analysis of aqueous extract and spectral analysis of CWT sludge and solid residue from evaporation lagoon were carried out.

The chemical analysis showed high mineralization level of the water solution of CWT sludge, whereby overall salt content was around 6,000mg/dm^3, pH level was 7.8, sulfates predominated among anions (3,939.759mg/dm^3), and magnesium prevailed among cations (657.598mg/dm^3).

Sludge from the evaporation lagoon after chemical treatment of equipment contains fewer soluble substances. Overall mineralization of aqueous extract is within the range of 300-2,500mg/dm^3, pH level at 7.8, sulfates prevail among anions, while their content is 5 times less than in the sludge at CWT sedimentation reservoirs (783.750mg/dm^3), and magnesium cations prevail among cations (141.866mg/dm^3).

Spectral analysis showed increased content of magnesium, calcium, iron, sodium, and potassium in the sludge of CWT lagoons. Iron, copper, vanadium, chromium, and zinc predominate in the residue of evaporation lagoons.

Thus, the findings confirm supply of salts and metals, which are formed in the process of softening water and chemical cleaning of equipment.

Solid waste is also generated during regeneration of waste oil (transformer, turbine, and others).

Purification of waste oil is performed in the oil facility of the station. Contaminated oil is collected in a special 30-ton tank.

Oil is regeneration by means of centrifuging and infiltration through silica gel filters. Purified oil is collected in another tank and returned to the process cycle. The silt from the centrifuge is collected into a trough and manually carried to a fuel oil shop, and from there all waste is sent to IWWTC with oil contaminated wastewater.

Waste silica gel is placed into a trough to be dried in a furnace and then returned to the process.

Nonferrous metal waste is generated in the electrical shop vehicle garage, during repair of turbine and electrical equipment. Total amount on nonferrous scrap metal reaches 5 tons/year.

Used luminescent lamps are collected as waste of electrical shop in the amount of 500 pcs/year.

Ferrous scrap metal is generated during repair and preventive maintenance of vehicles, staion repair (replacement of sections of furnace tubes, steam superheaters, feed-water economizers due to their corrosion), and their estimated annual amount is 450 tons/year. Ferrous scrap metal is sent to Vtorchermet (Ferrous Scrap Metal).

Wood waste generated as a result of operation of repair and construction site include sawdust, waste flooring and construction waste with a total amount of as much as 20 tons/year. Wood waste is used for own needs of the TPS.

Electrical workshop generates waste composed of up to 1.5 tons of nonferrous metals and 500 pcs/year of luminescent lamps.

Thus, electricity and heat generation at the thermal power station leads to appreciable amounts of emissions and environmental pollution in the form of emissions, discharges and solid waste.

Household waste is generated in all parts of the TPS and consists of 47% paper, 1% wood, 1.8% leather and rubber, bone 0.5%, 4.5% metal, 29% food waste, 5% of textiles, and 4.9% of glass and stones, and 2% of plastics. The household waste is disposed of at municipal landfills in consultation with the State Center for Sanitary-Epidemiological Surveillance (SCSES).

Table 1.3.3.1 shows data regarding generation, movement and storage of waste at Navoi TPS.

Table 1.3.3.1

Data on Generation, Movement, and Storage of Solid and Liquid Waste at Navoi TPS

No.	Waste	Presence of toxic and nontoxic waste on the territory of the enterprise uncontaminated as of the beginning of reporting year, tons	Hazard Class	Physical State	Annual Amount of Waste, tons/year	Transferred to other enterprises	Used for own needs	Sent to organized storage facilities	Disposed of, tons	Present on the territory of the enterprise
1	Total of all classes of waste, including	7,713.342			4,290.783	5,871.829	300.0	3,842.638		
	Hazard Class I (mercury lamps)	0.307								
	Hazard Class II (petroleum products)	1,641			4.0	5.0				
	Hazard Class III	22.337			60.367	74.837				
	Hazard Class IV	7,689.057			4,226.416		300.0			
2	Sludge after CWT	7,002.63	IV	Solid	3,787.0	-	-	3787.0	500	10,289.63
3	Petroleum Products	1.641	II	Liquid	4.0	5.0	-	-	-	0.641
4	Petroleum Sludge	22.337	III	Solid	60.367	74.837	-	-	-	7.867
5	Heat Insulation	630.171	IV	Solid	438.809	-	677.0	-	300.0	91.983
6	Lime	798.2	-	Solid	813.6	-	-	-	72.0	1,539.8
7	Construction Waste	142.89	-	Solid	80.606	-	140.0	-	-	83.496

1.4. Atmospheric Air Condition

Pollutant concentrations resulting from emissions of the station were calculated for the purposes of the assessment of atmospheric air to identify the contribution of Navoi TPS in the level of air pollution and to evaluate changes in air conditions that will occur after the commissioning of the second CCGT unit at the station.

The calculation was performed using "Ekolog" software application on the area of 18x24 km with 1km increments with regard to parameters of emission sources (Table P.3), meteorological properties, and the factors that determine the conditions for dispersion of pollutants, which are outlined in Section 1.1.

Ingredients that will be exposed to the impact from construction of the second CCGT unit were calculated: nitrogen dioxide, nitrogen oxide, sulfur dioxide, carbon monoxide and benzo (a) pyrene.

The analysis of air pollution in the studied area showed that the highest concentrations outside the station's industrial site are formed by nitrogen dioxide (Figure P. 4.1) and comprise 1.59 of MAC. The authorized quota of SCNP RUz (0.25 MAC for Hazard Class 2 substances and businesses located in the Navoi Region) is exceeded by 6.36 times. Concentrations of the other ingredients do not exceed 0.1 MAC and do not disperse beyond the territory of the station.

Emissions from most worn down power generating units No. 3 and No. 8 create maximum concentrations of nitrogen dioxide at 0.79 MAC (Figure P. 4.4) in excess of quota by 3.16 times.

According to the observations at stationary posts of Glavgidromet in 2010, maximum concentrations of nitrogen dioxide in the city reached 1.3 Maximum One-Time MPC, Navoi TPS contributed 25-28% into these concentrations; content of sulfur dioxide and carbon monoxide in the city has not changed and does not exceed the MPC. Maximum concentrations of suspended solids comprise 1.0 MPC; there is no contribution of the station, into the concentration of suspended solids. Pollution results from motor vehicle emissions and dusty soil surface. Concentrations of sulfur dioxide, carbon monoxide, specific contaminants (ozone, phenol, ammonia) do not exceed the MPC. According to the observations over the past 5 years, the level of air pollution is a low, dust, carbon monoxide, sulfur dioxide, and nitrogen dioxide levels stabilized.

Thus, the condition of atmospheric air in the vicinity of Navoi TPS should be classified as moderately polluted causing concern for public health according to the "Methodological Guidelines for Environmental and Hygienic Zoning of the Territory of the Republic of Uzbekistan According to the Extent of Public Health Hazard".

1.5. Surface Waters

Navoi TPS is located on the bank of the Zerafshan River.

In the past, the Zerafshan River used to be a tributary of the Amu-Darya River. Presently, the Zerafshan River is drainless. The waters of the river are used in full for economic purposes.

Near Duguli village, the river exits to the desert and sandy plain. The catchment basin of the mountaineous part of the river extends for 11,722 km.

The Zerafshan River basin extends in a latitudinal direction from east to west and is bounded by Turkestan and Zerafshan Ridges. The river has a length of 750 km.

After leaving the mountains, the river divides into two arms: northern Akdarya and southern Karadarya. At the point of entering Zerafshan Valley, the arms again merged into one channel with , Navoi TPS water intake facility located 60 km downstream from the confluence of the arms.

The Zerafshan River is fed by glaciers and snow. It is formed through confluence of the Fandarya and Match Rivers.

The Zerafshan River is entirely used for irrigation in Tajikistan as well as in Samarkand and Bukhara regions of the Uzbek SSR.

The Zerafshan river flow is significantly regulated through Katta-Kurgan water reservoir built in 1947 with a capacity of 500 mln m^3.

Four irrigation channels take water from the Zerafshan River on the section from village Zaatdin to the city of Navoi: Kanimekh, Kalkon-Ata, Kasoba, and Hanim with a maximum total intake of 20 m/h. The remaining flow of the Zarafshan River is used is used for filling Kuyumazar reservoir located downstream of the TPS. The Zerafshan River falls into the group of shallow rivers in its lower reaches. Along the entire length of the river until the city of Navoi, water is abstracted intensively. The river flow depends on the seasons as with all glacier fed rivers. Low flow (minimum flow) occurs from October to May. In June and July floods occur and August-September see a slow decline in water level.

To date, the water balance in the river in terms of annual variation is closer to long-term observation data and specifically depends on the amount of precipitation during the year.

There is a tendency to a decrease in the minimum flow, which is associated with increased water pumping during low water periods for agricultural purposes.

The chemical composition of water in the Zerafshan River is formed under the influence of pollution coming from wastewater of industrial enterprises in the cities of Samarkand, Kattakurgan, Navoi as well as runoff from farmland. The qualitative composition of surface water also depends on the meteorological, hydrological and morphological properties of the watercourse. In recent decades, rapid developments of industry within the valley of the Zerafshan River and desertification have led to a change in the condition of river flow. Long-term observations of chemical composition of river water show an upward mineralization tendency (the content of sulfates, chlorides, hardness), which promotes the development of brackish water aquaculture that affect the performance of periphyton in aquatic ecological community.

The analysis of water condition in the Zerafshan River before wastewater discharges from Navoi city and after industrial discharge from businesses in the city showed the following.

The maximum water flow occurs in July - August. The maximum temperature of 24°C near the city was observed in June and July. Minimal runoff occurs in November and December, and October. Minimal water temperature is observed in January and February. With a decrease in river flow, there is a dramatic increase in mineralization level and related content of sulfates, chlorides, carbonates, salts of hardness (magnesium, calcium, and sodium). Chemical contamination of water increases in autumn and winter. Closer to the city, the water contains higher than permissible values of magnesium ions, calcium sulfate, phenol, chromate, and iron. In individual months, there is increasing nitrite, metals (copper, zinc, etc.).

The criterion of water quality is water pollution index (WPI). If the value of WPI is below 1.0 the water is considered clean. 4> WPI> 2.5 values indicate to moderately polluted waters Quality Class III. At measurements station before the city of Navoi, WPI is 8.5. This is due to production performance of industrial enterprises. Despite pollution, water in the Zerafshan River is used for utility and drinking purposes of Navoi city and region as the quality of groundwater does not meet the utility and drinking standards. Water quality deteriorates downstream of the city of Navoi. Concentration of suspended matter, magnesium, chloride, sulfate, total hardness, total nitrogen increases and content of oil, iron, copper, zinc, chromium, surface surfactants, phenols rises slightly, and water temperature increases by 2-4 ° C on average during maximum and average river flow and by 8 -9 ° C during minimal river flow (Table 1.5.1).

Table 1.5.1.

Chemical Composition of Water in the Zerafshan River

Indicator	Unit of Measure	1 km upstream of Navoi city	0.5 km downstream of Navoi city
1	2	3	4
pH		7,032	6,967
02	mg/l	10,065	9,386
BOD	mgO_2/l	1,561	1,433
COD	mgO_2/l	11,342	16,900
Ammonia Nitrogen	mg/l	0,072	0,165
Nitrates	mg/l	0,039	0,08
Nitrites	mg/l	5,746	9,026
Iron	mg/l	0,054	0,084
Copper	mg/l	1,600	2,345
Zinc	mg/l	3,350	4,209
Chromium	mg/l	4,367	5,864
Lead	mg/l	0,125	0,00
Phenols	mg/l	0,001	0,002
Petroleum Products	mg/l	0,034	0,104
1	2	3	4
SS	mg/l	0,023	0,048
Suspended Particles	mg/l	349,025	455,364
Hardness	meq/l	13,268	15,363
Calcium	mg/l	97,267	105,0
Sodium	mg/l	106,75	127,0
Potassium	mg/l	1,667	1,845
Chlorides	mg/l	96,167	142,091
Sulfates	mg/l	516,250	582,455

Hydrocarbonates	mg/l	237,250	234,091
Phosphates	mg/l	0,018	0,023
Temperature	°C	14,8	16,41

In the lower reaches, water in the Zerafshan River is described as having high content of suspended particles, especially, during flood period, a large mass of debris flows down the river generated because of cotton roots, bushes and other debris from plowed river slopes developed as agricultural fields.

Maximum river turbidity reaches 4,180 g/m^3 during spring and summer. The least – 32 g/m^3 is observed during autumn and winter.

Thus, the quality of the watercourse in the Zerafshan River bears evidence of changes in its chemical composition, temperature and hydrological regimes under the influence of industrial effluents. The waters of the river near the city of Navoi exceed MPC for the content of oil products, phenols, heavy metal elements, and nitrite. Year by year, salinity is increasing. Temperature is rising and water flow is decreasing somewhat. Navoi TPS is one of the main contributors to the chemical pollution and changes in temperature and hydrological properties of the watercourse Zerafshan River as described in Section 1.3.2.

1.6. Soils and Groundwater

Navoi TPS is located on the third terrace above the floodplain of the Zerafshan River bank. This is a flat plain with a slight slope towards the river and is classified as Golodnaya Step cycle of sedimentation.

Widely spread valley of the Zerafshan River is split by the modern riverbed in its axial part. The rivers are morphologically well defined by cusps of the first and third terraces.

Actual elevation varies from 328.27 to 335.0. The height of the terrace cusp above low water level in the river is 6-7 meters.

Within the area, a rock mass of Quaternary deposits is developed, which are underlain by continental Tertiary deposits throughout – rock mass of interbedded sands, argillaceous clays, sandstone and conglomerates. The older rocks of Paleozoic and Cretaceous periods spread far beyond the industrial site.

Quaternary deposits of the Golodnaya Step complex are represented by alluvial and proluvial loam and sandy loam of grayish-brown color, moist, dense, good plasticity, macroporous, positioned as a bed with that thickness of 5.6 to 10 meters or more, which decreases with increasing distance from the river. Gravelly soils with gravel and clay filler and interlayers and lenses of sand, gravel and , less frequently, conglomerates are positioned lower. Gravel stones are small in size, mostly of flat shape, formed from shale, sandstone, limestone and others. The gravel-pebble layer thickness is 20-25 meters and more.

Mineralization of soil is an average of 0.12-0.22%, the depths of high salt content show 0.5-0.6% of dry matter.

On the surface topography site is complicated by earth pilings, intersected with small irrigation ditches and notches for various waterworks facilities (sedimentation pools for different purposes).

According to the analysis of the literary sources for the chemical composition, the aqueous extracts from soil did not show sharp fluctuations of values of pH values (7.4-7.6), the total content easily and moderately soluble salts in hydrochloric acid extracts ranged from 1.461 to 3.3%, gypsum - from 1.401 to 2.799%, so the soils are classified as unpopulated.

Hydrogeological conditions of the area are complex due to geological, climatic and agricultural factors.

The aquifer system of Cretaceous-Palaeogene (Upper Cretaceous-Paleocene) deposits are represented by sandstones and lime stones with interbedded shale and siltstone. There is a group of streams of proluvial and alluvial deposits of piedmont plains with drawdown curve of structural and lithological damming. This is the region with a positive salt balance.

Hydrogeological conditions are characterized by the development of groundwater confined to the Quaternary sediments of the Zerafshan River valley. Within area in question, the groundwater is replenished through snow and rain precipitation in addition to infiltration of irrigation water. The genetic groundwater regime is irrigational and hydrological, riparian, discharge and drainage.

Because the station is located in an area that is classified as land for intensive development of irrigated agriculture, the groundwater level fluctuation is seasonal and depends on crops irrigation frequency. The maximum level observed during the summer season and is 3-5 meters and more as they get closer to the river.

Groundwater salinity is high and varies from 3.4 to 9.2 g/l. Type mineralization is sodium sulfate.

Filtration coefficient of argillaceous rocks varies from 0.0045 m/day to 0.2 m/day, pebble ration varies from 1.09 to 6.84 m/day.

The surface of the water table has minor slopes, in general, identical to the general slope of the relief. During the period of intensive irrigation groundwater level rises, the water flows down to the river and elsewhere in the drain channel. At lowering of the groundwater level, the reverse process occurs, thus groundwater in the area in question, is hydraulically connected to surface waters of the river, the flow of ground water varies according to seasonal conditions or discharges into the river or is replenished from it.

The lithological structure on the territory of the station is as follows: fill ground lie on the surface with a thickness from 1 to 7 m represented by a jumble of loam, gravel, and construction debris. Fill ground is underlain by loam with rare lenses of sand with granitic subsoil debris. Layer thickness varies from 4 to 9 m. This layer also contains sandy loam and sand with occasional gravel inclusions. Clay soils, as a rule, tend to lie above the water table.

They are underlain by gravel-pebble deposits, which form the aquifer. Exposed bed thickness of these deposits varies from 1.9 to 9 m. This layer contains lenses of conglomerates.

Groundwater in the vicinity of the station has high salt content. Solid residue ranges from 1,190 mg/l to 2,808 mg/l and less frequently -3,602 mg/l. Type of mineralization is sodium sulfate containing SO42 up to 2,164 mg / l. The depth to groundwater varies depending on the nature of the relief and the season of the year.

At the station, there is a network of piezometric wells installed in 1975. They are used to monitor groundwater levels and their composition. These observations are irregular for a number of reasons. The location piezometric station on the territory of Navoi TPS and their status is presented in Table 1.6.1.

Table 1.6.1

Location of Piezometric Wells on the Territory of Navoi TPS

No.	Location	Condition
1	Behind ХГШ-2	Operational
3	On the corner of OSG-110, near oil facility	Operational
3a	Near greenhouse of boiler inspection	Bridged
4	Beginning of the main building, near the railroad	Operational
4a	Between IWWTC sedimentation reservoirs	Operational
5a	Near IWWTC, at the corner of sludge disposal site	Bridged
10	Behind units No. 8 and T-8 along “A” centerline	Operational
12a	Behind a store	Operational
14	In the central are of OSG -220	Operational
14a	At the corner of IWWTC building	Operational
15	Behind unit No. 9	Operational
15a	Near discharge canal near IWWTC	Operational
22	Near OSG fence	Operational
22a	At the corner of CWT-2 building near road to Road Transport Shop	Operational
23	In the bank of No. 8	Operational
23a	At the corner of solid caustic warehouse near a road	Operational
24	In front of boiler No. 5	Operational
24a	Near fence around POL	Operational
27	Near daytime laboratory of CWT-1 and railroad	Bridged
29	Near old building of Sewage Treatment Unit	Bridged
31	Before the building of CWT-3 near a road	Bridged
32	Behind peak-load boiler house	Bridged
36	Behind diner No. 23 near an open site	Bridged
37	Before acid and salt warehouse	Bridged
39	Near storage tanks of the central heating network	Bridged
51	Near scrap metal collection site	Bridged
53	Near УС Supplies Storage Navoi TPS	Bridged
55	Near the duct of cooling tower No. 1	Bridged
58	Behind cooling towers near the perimeter	Bridged
59	At the second sedimentation reservoir of the cooling tower	Bridged

Thus, to date, there are 15 operational wells at the station.

Available data indicate that fluctuations in groundwater levels vary under different technology nodes stations.

Foundations of cooling towers, pumping, and the main body are constantly exposed to aggressive groundwater. The drainage system is inadequate and flooding of basements is not compensated.

In the area of the IWWCT and sludge collector, groundwater flow is directed away from the Zerafshan River. There are observations of increasing levels of groundwater along the bank of the discharge channel. This is because the concrete canal bank creates a barrier to groundwater flow. The lead channel is not such an obstacle.

In the rest of the area, groundwater flows toward the river, while near cooling towers groundwater is drained into the “Sanitarniy” reservoir.

In the central part of the station, groundwater table increases, especially, under the main building, supposedly due to an imbalance and flow from of the station.

The chemical composition of groundwater is presented in Tables. 1.6.2. and 1.6.3 and demonstrates the high salinity of groundwater and its classification as sulfate groundwater. It should be noted, and the significant addition of petroleum product into the groundwater is observed.

Thus, according to the analysis of groundwater and piezometric observation data, it may be concluded that there is infiltration from sludge collectors, sedimentation reservoirs and pallets of cooling towers.

Table 1.6.2

Chemical Composition of Groundwater in the Vicinity of Navoi TPS

Sampling Site, Sample No.	Depth, m	pH	Mineralization, mg/l	Hardness, mg-equ/l	Ion Content, mg/l					
					Na++K+	Mg2+	Ca2+	S042-	Cl-	HCO3-
Cooling towers, 1	3.7	7.0	4000	49.415	324	288	516	2325	252	488
Cooling towers, 2	4.5	7.2	1920	22.417	191	156	192	1017	140	342
Chimney	5.8	6.9	3164	32.210	366.3	103	476	1604.8	312.4	361.1
OSG, 1	5.2	7.5	1432	9.182	306	-	164	276.5	142	775.9
OSG, 2	6.0	7.5	2820	20.277	335.8	118	316	1288.8	136.3	256.2
OSG, 3	6.0	6.9	3164	32.219	366.3	103	476	1604.8	312.4	361.1

Table 1.6.3

Findings of Groundwater Table Measurements and Chemical Composition in Piezometers for Navoi TPS

Sampling Date	No.	Water Level Above Sea Level	Maximum permissible level of water	Excess of Permissible Water Level	Chemical Composition							
					pH	Alkali	Hardness	Ca	Cl	SO	Mineralization	Petroleum Products, mg/l
1	2	3	4	5	6	7	8	9	10	11	12	13
12.05.03	1	330.77	330.4	0.37	8.60	0.4/4.5	13.8	7.2	110	652	1536	0.44
	3	329.68	329.2	0.48	6.95	-/6.5	6.8	4.1	130	864	1278	1.5
	4	329.46	328.6	0.86	7.1	-/2.1	4.5	2.2	180	441	1094	1.1
	4a	327.73	328.2		7.6	-/6.5	16.8	9.1	115	748	1684	0.76
	10	329.83	329.2	0.63	7.4	-/4.8	38.8	10.0	130	921	3006	1.8
	12a	328.44	328.80		9.6	0.3/0.8	9.4	4.6	135	614	1944	0.35
	14	331.08	331.00	0.08	8.9	0.4/1.0	17.6	6.4	190	1228	1980	0.35
	14a	327.82	327.9		8.3	0.2/5.2	17.6	9.4	96	460	1430	0.68
	16	329.87	329.55	0.32	7.6	-/4.4	28.5	20.0	140	979	2425	1.2
	16a	327.41	330.3		8.4	0.4/1.6	23.6	13.6	180	3840	5600	0.33
13.05.03	22	330.23	330.45		7.2	-/0.9	17.1	9.8	170	864	1610	1.2
	22a	325.40	328.1		8.35	0.2/4.2	22.5	7.8	95	1478	3291	0.7

	23	329.71	329.00	0.71	8.9	-/2.2	12.2	6.6	80	700	2048	0.54
1	2	3	4	5	6	7	8	9	10	11	12	13
	23a	327.6	327.7		7.5	-/9.0	42.5	30.7	480	14.01	3912	0.42
	24	327.13	328.95		8.1	-/1.2	13.9	6.8	130	748	2188	1.2
	24a	327.11	327.80		7.8	-/6.8	36.2	9.8	155	1305	3072	0.95
	29	328.2	327.9	0.30	8.1	-/4.6	14.8	8.2	100	1056	1186	0.9
	31	327.41	327.3	0.11	7.75	-/5.4	18.2	9.4	145	806	1684	0.45
14.05.03	32	325.91	327.5		6.95	-/5.2	17.3	8.3	110	787	1750	0.4
	36	328.63	327.8	0.03	7.45	-/4.8	25.8	16.0	115	1824	2129	0.9
	37	327.25	327.8		7.7	-/4.5	24.6	6.1	250	1240	2500	0.78
	39	326.21	327.3		8.4	0.7/5.7	22.8	12.0	800	960	2428	0.37
	51	328.76	327.3	1.46	7.3	-/5.0	30.2	19.4	170	1612	2351	0.69
	53	327.02	327.1		7.75	-/4.7	22.4	6.7	140	1050	2203	1.9
	55	329.88	327.5	2.38	7.25	-/4.3	34.8	19.6	110	1036	2277	1.9
	58	326.23	326.9		7.6	-/5.1	23.5	7.8	160	1324	2351	0.36

1.7. Soils, Vegetation and Fauna

Industrial site at Navoi TPS is located on light sierozem soils. Sierozem soil is gypsiferous as they evolve on gypsum-bearing weathering crust. Around the TPS, sierozem is underlain with loess-like loams and alluvial and meadow soils. Neutral and weakly alkaline medium with a pH equal to 7.1-7.6 and a low content of humus content (1-2%) are intrinsic to soils in the area in question.

Soil solutions are distinguished for excess content of calcium ions, sulfates and carbonates, the latter accumulate in the long dry season and increase because of emissions and discharges of industrial enterprises in the Navoi industrial zone. The elemental composition of soils exhibit not only increased content of calcium, sulfur, but also iron. These elements can bind toxic substances present in the emissions from industrial enterprises.

The soils around the Navoi TPS are noted for their high content of calcium, sulfur, iron, arsenic, lead, strontium and barium, compared with the regional background level of sierozems of Central Asia.

The geochemical anomaly of the abovementioned microelements is confirmed by an increase in trace element concentrations towards the depths rather than towards the surface as in the case of anthropogenic pollution. Besides, increased content of the strontium and barium (from 330 to 1,300 mg / kg) is parallel to the increase in calcium content in layers enriched with carbonates and sulfates at depths of 10-30 and 20-50 cm Thus, the concentration of many elements can be linked to alkaline carbonate barrier.

The content of phosphorus in soils is low (0.15 - 0.2%), in addition, due to strong carbonate content, it is found mainly in the form that is hardly soluble and insoluble calcium phosphate. Nitrogen deficiency (0.02-0.07%) is noted in the soils. Gross amount of calcium on irrigated sierozem soils reaches significant values of 2% or more. Main part accounts for silicates, while exchange and water-soluble potassium is less than 1%. The upper layers of soil enriched with water-soluble salts of calcium and magnesium.

In the study area, there is no clear delineation of soil layers due to the frequent displacement of the upper layers during land planning for construction of roads and communications.

Mechanic impact on the soil cover in the vicinity of the TPS is represented by shallow excavations, which either or serve as waste disposal sites for different kinds of waste. The greatest deformation of the soil cover is noted on uncontrolled passages contributing to disturbance of soils integrity and dust formation on underlying terrain.

Vegetation in the area of the Navoi TPS is represented by ephemeroid-sagebrush communities and agricultural plantings at the station.

Natural full communities of ephemeroid-sagebrush with significant representation of bluegrass, brome, annual astragalus, foxtail, iris remain in areas near limestone quarries. However, they are used for uncontrolled grazing of livestock, so they are significantly enriched with weedy species: harmala shrub and cousinia species.

Ephemeroid-weed-sagebrush communities predominate along access roads. Excavations are overgrown with grass and meadow groups with areas of sagebrush.

Exclusively weed communities with herbaceous saltwort are formed mostly around the TPS.

In the depressions, there are saline meadow coenoses with tamarisk and camel's-thorn with single inclusions of the common reed. The remaining space is occupied with a sparse group of annual thistle indicating to surface salinity.

On the territory of the TPS as well as along roads and numerous fields and vineyards in the vicinity of the TPS, there are plantations of mulberry, poplars, and sycamore trees. Woody species include a variety of gas resistant kinds: white mulberry, dwarf elm, Bolle poplar and Canadian poplar, narrow-leaved oleaster. Moderately gas-susceptible trees include ash-leaved maple, and white willow, from gas-susceptible ones include Pennsylvania ash, sycamore, English oak, and stone fruit trees such as peaches, cherries, apricots. In addition, there are cultivated plantations of grapes, roses and other ornamental flowers. Regular watering and maintenance has a positive impact on the conditions of plants, although, according to the information from literary sources, visual inspection detects a slight focal necrosis on leaves of trees growing in the TPS and samples of plants near Navoi TPS showed considerable necrotic areas indicating to the impact of atmospheric pollutants.

The most damage was observed in the surface of the leaves of ash, sycamore, acacia trees in artificial plantations in the immediate proximity of a TPS. The observed patches of cell wall destruction on both sides of the leaf epidermis and gray granules between the cells indicate to the impact of pollution gases and dust on the morphological and anatomical structure of leaves of trees, shrubs and grasses.

The analysis of literary sources also revealed that samples of vegetation taken from the four sides of the TPS near the area (200-300 m) and at a distance of 1 km from the station and analyzed using the method of spectral analysis in the vegetative parts such as the annual saltwort species and harmala shrubs had excess Cr concentrations as compared to the regional level by 10 times or more and 40 or more times excess of maximum permissible levels. They also revealed significantly excessive concentrations of Cu and Ni (2-4 times higher than permissible).

The analysis of samples revealed the following pattern: in the north and east of the TPS, the content of metals in plant samples is much higher near the area than at a distance, and in the south and west the situation is contrary, where near the area of the TPS, metal concentrations are lower than at a distance. This analysis allows to qualify the state of soil and vegetation around the TPS as characteristic of the zone with a strained ecological situation.

Animals inhabiting the vicinity of TPS – the area noted for significant dustiness and noise – only includes groups that can hide from the noise impact of the station in the ground such as are insects (winter and cotton scoop, beet borer, spider mites) and reptiles (desert lidless skink, fast lizard, water snake, Central Asian tortoise) or species that can quickly leave the hot spots such as birds (sparrow, a small turtle, the common starling, robin, dearie, red-rumped swallow, black swift, myna, magpie). Areas with stagnant or running water teem with amphibians, toads and frogs. Mammals are ubiquitous such as house mouse, northern mole vole, common pipistrelle, tamarisk gerbil, big-eared hedgehog, a small white-toothed shrew.

The modern pattern of aquatic fauna in the Zerafshan River includes 30 species belonging to 7 families with the most widely represented family of Cyprinidae (19 species). There are six species of loach family and one species of catfish, killifish, snakehead, perch, and gudgeon families. Fish fauna is represented mainly by local commercial species, but there are acclimatized commercial species (white and black Chinese carps, tench, eastern bream, goldfish, white and bighead silver carp, pike perch) and accidentally imported non-target species (rinogobius, Balkhash perch, spotted sloth, Korean and common sawbelly).

Thus, contamination of soils of this region is moderate and flora and fauna pollution is at permissible level.

1.8. Assessment of the Current Status of the Environment

Assessment of the current status of environmental components within the impact area of Navoi TPS identified a number of key environmental issues associated with emissions of harmful substances in the atmosphere, discharges into the Zerafshan River, migration of chemical compounds from the places of storage of solid waste. All identified problems result from wear and tear and breakdown status of equipment and facilities condition the TPS, and, above all, thermal mechanical equipment, water treatment systems and sewage treatment facilities.

The concentrations of harmful substances generated through emissions of Navoi TPS exceed the permissible level in a radius of 3 km and reach 1.59 MPC in terms of nitrogen dioxide, while the contribution of power generating units No. 3 and 8 to the pollution of the atmosphere emissions was 49.7%.

The level of air pollution in the vicinity of the station is characterized as moderate.

In the case of an emergency liquid fuels fuel oil fuel oil ash is emitted along with nitrogen oxides and sulfur dioxide from flue gas. The ash particles adsorb a highly toxic penta-vanadium oxide, carbon monoxide, benzo (a) pyrene. In this case, air pollution increases.

The level of atmospheric air pollution turns from moderate to increased pollution.

According to surface and groundwater according to “Methodological Guidelines for Environmental and Hygienic Zoning of the Territory of the Republic of Uzbekistan According to the Extent of Public Health Hazard”, the location of Navoi TPS is classified as the area with strained environmental status. Due to malfunction of equipment and treatment facilities mainly salts of strong acids, calcium salts flow from the station to the Zerafshan River, thermal pollution reaches a maximum of 10°C. The chemical composition of ground water is significantly affected by the emergency state of sludge collectors for CWT and sludge collectors for acid flushing wastewater. Due to ongoing environmental activities at the TPS related to cleaning the sludge disposal sites, oil separator cleaning, replacement and repair of the pipeline for acid washes of boilers, the impact on topsoil, soil and groundwater in the area of Navoi TPS is partially reduced.

According to the level of soil and vegetation pollution with heavy metals, the region can be attributed to the zone of intense ecological situation.

The condition of vegetative parts of plants within the location of Navoi TPS is generally satisfactory, except for, woody species near the station showing varying degrees of damage to leaves in the form of necrosis and chlorosis.

Thus, the assessment of the current environmental status showed that the level of air pollution, surface water and groundwater, soil and vegetation is moderate and causes concern for public health. According to the "Methodological Guidelines for Environmental and Hygienic Zoning of the Territory of the Republic of Uzbekistan According to the Extent of Public Health Hazard", the ecological situation of the area in question is assessed as strained.

2. Socioeconomic Aspects of the Second CCGT Unit Construction at Navoi TPS

Currently Navoi TPS provides electricity and heat to consumers in Navoi, Bukhara and Samarkand regions and the city of Navoi.

To ensure reliable and continuous electricity and heat supply to enterprises and to improve the ecological situation within the location of Navoi TPS, it is necessary to create own sources of power control. This problem can be solved by means of building a second combined-cycle gas turbine unit. The CCGT unit, compared to steam turbine plants currently operated at Navoi TPS, has advantages such as principal simplicity and almost full automation, which greatly simplifies the operation of facility. In addition, it is more compact than traditional units and high maneuverable (within range of 5-20 minutes per load compared with several hours for steam turbines). The transition to combined-cycle technology will increase fuel efficiency and this lead to improved environmental conditions in the area in question due to reduction in specific emissions of pollutants per unit of output. The implementation of the project on building the second CCGT unit at Navoi TPS will partially solve the problem of employment and training of qualified personnel.

The number of employees at the CCGT unit will be 106 people.

Thus, the construction of the CCGT unit at Navoi TPS will contribute to the improvement of the environmental situation in the region, higher energy conversion efficiency, and help to meet the projected demand for electricity of the republic's developing economies.

3. Environmental Analysis of the Design Solution

This project envisages construction of the second 450MW CCGT unit at Navoi TPS. It is planned to commission the CCGT unit in place of two most worn out boiler units No. 3 and 8 (TGM-94 boilers) at the TPS with a capacity of 150MW and 160MW accordingly.

After commissioning of the second CCGT unit, the generating capacity of the station will increase by 1,250MW during its current condition and by 1,817MW (with regard to the construction of 477.75MW CCGT unit under construction and decommissioning of boilers St.No.1 and No.2 and increased installed capacity up to 1677.75MW at the first stage of modernization of the TPS).

The schedule of the modernization project for Navoi TPS including the construction of two combined-cycle gas turbines and dismantlement of four existing boilers is shown in the Annex.

Technical and economic indicators of the 450 MW CCGT unit are shown in Table 3.1.

Table 3.1.

Technical and Economic Indicators of 450 MW CCGT Unit

No.	Indicators or Equipment	
1.	Number of Units	1 unit
2.	Composition of main equipment for one unit: - gas turbine unit, (pcs. x type, capacity of one GTU)	1×M701F4 N=312MW
	- exhaust-heat boiler, (pcs. x type)	1×EHB-800t/h
	- steam turbine, (pcs. x type)	1×ST-140/165-13 0/15-3 N=138MW
3.	installed electric capacity of CCGT, (MW)	450
4.	Hourly electricity output at N=100%, thousand kW x h:	450
5.	Total for CCGT unit, including	450
6.	GTU	312
7.	ST	138
8.	Outdoor air parameters according to ISO	
9.	Annual average load of CCGT unit, %	98
10.	Annual electricity output, (mln kW x h)	3528
11.	power consumption for own needs to generate electricity with ГДК, (%)	5.4
12.	Specific electricity consumption for own needs to thermal power supply, kW x h/Gcal	27
13.	Annual electricity consumption for own needs (mln kW x h)	250.1
14.	Annual electricity supply from CCGT unit, mln kW x h	3277.9

15.	Average annual electricity losses in transformers, mln kW x h	10.6
16.	Annual electricity supply to the grid, mln kW x h	3267.3
17.	Annual operation hours of the CCGT unit, hours	8000
18.	Electrical efficiency of the CCGT unit in condensation mode, (%)	50.8
19.	Electrical efficiency of the CCGT unit with regard to average annual supply of electric and thermal power, (%)	64.8
20.	Specific fuel equivalent consumption for electricity supply, (gfe /kW x h)	190
21.	Annual consumption of fuel equivalent per energy supply, tons of fuel equivalent	621.7
22.	Annual thermal power generation, thousand Gcal	2207.0
23.	Heat consumption on thermal power generation (own needs), thousand Gcal	22.1
24.	Heat losses in heating networks, thousand Gcal	4.9
25.	Annual thermal power supply to consumers, thousand Gcal	2180.0
26.	Specific consumption of fuel on thermal power supply, kg/Gcal	155.1
27.	Fuel equivalent consumption for heat supply, tons of fuel equivalent	338.2
28.	The rate of using thermal energy of fuel, %	74.8
29.	Annual fuel consumption of the CCGT unit, (thousand tons of fuel equivalent)	959.9
	Gas under normal conditions - Q_H^P =8,800 kcal/nm^3 , (mln nm^3) Gas at temperature of 20°C and pressure of 760 mm hg, (mln. m^3)	763.5 819.5
	Hourly consumption of natural gas for the CCGT unit under normal conditions, (nm^3/h) Hourly consumption of natural gas for the CCGT unit at temperature of 20°C and pressure of 760 mm hg	97389 104523

The site for construction of 450 MW CCGT unit has an area of 9.0 hectares and is marked on the western side of 478 MW CCGT unit under construction at Navoi TPS (Figure A.2).

The combined-cycle gas turbine consists of three main components: a gas turbine, a steam generator with recuperative heat exchanger (exhaust-heat boiler) and a steam turbine with a generator and auxiliary equipment.

This prefeasibility study adopted the following version of the basic equipment:

1 xGT+1 xEHB+1 xST+2xЭГ.

The EHB uses one steam generation circuit.

The power generating unit of 450MW CCGT unit is a one-piece CCGT unit with one steam pressure circuit without intermediate superheating designed to generate electricity in base-load operation mode with simultaneous coverage of the thermal schedule for industrial and heating loads.

The 450MW CCGT unit is composed of:

- one M701F4 gas-turbine unit with a “Mitsubishi” generator;
- one exhaust-heat boiler with one steam generating circuit witout intermediate superheating;
- one steam-turbine unit with a generator;
- deaerator unit;
- auxiliary equipment: gas-booster compressor stations with two gas booster compressors; CWT for water replenishment of the unit and central heating network, IWWCT, tankage; cooling tower with a pumping station to supply water to the STU; drummed oil store.

The new unit will run on natural gas. Natural gas consumption will amount to 97.389 thousand nm^3/h (763.5 mln nm^3/year). A clear advantage of the STU is the decrease in specific indicators of fuel consumption as compared to other specific indicators for the TPS (from 420.59 gfe /kWh of supplied electric power to 190.0 gfe /kWh and from 190.0 kg/Gcal on heat supply to 155.1 kg/Gcal Гкал).

Flue gases from the new unit will be disposed of via an individual chimney with a height of 60 m and a diameter of 8.5 m. Gas-air mixture parameters will amount to: the volume of flue gas – 736.13 m/sec, the rate of exhaust gases – 12.97 m/sec, the temperature of flue gases - 126°C (Appendix 3).

The main advantage of the design solution from the perspective of environmental protection is the reduction in emissions of nitrogen oxides compared to currently operating units, which is achieved through the use of the burning of natural gas in combustion chambers with dry low-toxic burners. This solution enables a reduction in emissions of nitrogen oxides from the new unit in terms of NO_2 down to 25 mg/nm^3, which is 2.6 times lower when compared with measurements of actual concentrations in the flue gas from existing boilers at TPS. In addition, concentration of nitrogen dioxide in the flue gas CCGT unit, guaranteed in the project, comply with the requirements of GOST 29328-92 for gas turbines. Low concentrations of NO_x are not only due to structural features of the combustion chamber CCGT unit, but also due to the set regime of combustion, whereby fuel is burned almost completely.

The new unit will be controlled by means of an ACS, which, along with , operation control, will ensure a high degree of operational reliability and decrease in risks of accidents, which are discussed in detailed in Section 8.

Water to CCGT unit for utility and drinking as well as firefighting purposes is designed to be supplied from existing networks at Navoi TPS (utility and firefighting water conduit and industrial and firefighting water conduit).

CCGT unit will use technical water from the Zerafshan River for production purposes and drinking water will be supplied from Integrated Power System of NMMC. Annual consumption of source supplementary water from the Zerafshan canal for the needs of the circulating system and CWT will amount to 7,600 thousand m^3. Annual potable water consumption for utility and drinking purposes and water replenishment for the central heating network will amount to 1,471 thousand $m^{3.}$

In order to make up for losses in the CCGT unit cycle, it is planned to build a new WTS.

Chemical water treatment consists of:

- water treatment equipment for thorough demineralization of supplementary feed water to compensate for loss of steam and steam condensate within the water-steam circuit;
- a facility for softening water for the central heating network with a deaerator for heating;
- technological equipment of the integrated wastewater treatment complex (IWWTC) with a neutralization unit for acidic and alkaline wastewater after regeneration, loosening, and flushing filters of the feed circuit of the water-steam unit as well as units for treatment of water contaminated with petroleum products. A drainage pit is located in the premises of the CWT unit for collection of industrial and storm wastewater contaminated with oil.

Water consumption for replenishment of the central heating network amounts to 178.5 m^3/h.

It is planned to use recirculation technical water supply system for 450MW CCGT unit due to water shortage in this region. Five fan cooling tower will be attached to the unit with 18x18m sections.

Circulatory water consumption for 450MW CCGT unit will amount to 15,900 m^3/h. With such circulatory water consumption, water concentration in cooling towers will amount to:

$$q = \frac{15{,}900\ m^{3/h}}{5 \cdot 18 \cdot 18\ m^2} = 9.82\ m^3/m^2\ hour$$

Circulation water cooled in cooling towers is pumped to condensers of the steam turbine and to all auxiliary equipment of 450 MW CCGT unit. After heat exchangers, the used (heated) water is sent to cooling towers for cooling. Then, the process repeats.

Replenishment of losses in the circulatory system (evaporation and water entrainment in cooling towers, bleeding of the system) is planned through supply of supplementary river water from the Zerafshan River. Supplementary water supply to 450 MW CCGT unit amounts to 950 m^3/h for summertime mode.

Supplementary water 450 MW CCGT unit is planned to be abstracted from the Zerafshan River with the help of an individual pumping station for supplementary water located in the beginning of the intake conduit of Navoi TPS. Two debris screens are located on intake mouth of the pumping station. Three horizontal pumps are installed on supplementary water pumping station (two operational and one standby pumps) with pump delivery rate of up to 500 m^3/h and pump thrust of ≅60 m. The complement electric drive is N=200kW, V=6,000V, n=1,450 RPM. Two drainage pumps are also installed at the pumping station of type PKVP 63/22.5 with pump delivery rate of 60 m^3/h and pump thrust of 22.5 m/s. One operational and another standby pump. The complement electric drive is N=15 kW; V=380V; n=1,500 RPM. Tentative dimensions of the pumping station for the superstructure are L=30.5 m, B=12.0 m, H=9.2 m. The pumping station capacity is ~ 950 $м^3$/ч.

The supplementary water for the 450MW CCGT unit (for the needs of the circulatory system and CWT) is fed in through two pipelines ∅ = 350 mm. Pipelines are routed partly underground for the length of 1,660m including a length of 160m of steel pipe and a length of 1,500 m of polymer tube. Further, the length of 1,640m of the pipeline is route along an racks. Steel pipes, 2∅373x8 mm.

At the beginning of the route (near the pump), the pipeline valve chamber is located to disable any string for repairs.

At the site of 450 MW CCGT unit, supplementary water pipelines are routed along racks with the water supply to the CWT and circulatory system, and cooling tours. The water is supplied to the circulatory system after pretreatment at CWT.

To prevent biological fouling and salt accumulation of feed ditches at cooling towers, condensers and pipelines, supplementary water supply is planned to be treated with chemicals. provide additional water treatment chemicals.

Chemical water treatment unit for 450 MW CCGT unit

Raw technical water treatment at CWT is planned for water supply of the CCGT unit and water replenishment for the central heating network of the city of Navoi.

Total water requirement of CWT (including own needs of CWT) in raw technical water is ~ 555 m^3/h.

Including water replenishment for the unit – 340.6 m^3/h
and central heating network – 214.2 m^3/h.

Wastewater of the 450MW CCGT unit

Wastewater from CCGT unit consists from cooling tower bleeding and industrial effluent.

Industrial wastewater of 450 MW CCGT unit-450 (similarly to 478 MW CCGT unit) are first sent for integrated industrial wastewater treatment (IWWTC) of the 450 MW CCGT unit. IWWTC consists of the technological part and sludge disposal sites. The technological part of IWWTC is designed to neutralize industrial effluent, while sludge disposal sites are designed to settle the water with possible consequent discharge into the Zerafshan River or return to the circulatory cycle of IWWTC:

CWT wastewater at discharge rate of 92.5 m^3/h (constant discharge) are sent to sludge disposal for CWT. After settlement (sedimentation), the water may be discharged to the Zerafshan River in compliance with standard requirements.

Wastewater from chemical cleaning of boilers from salt deposits is generated episodically and discharged at the rate of 104.2 m^3/h for 2-3 days once every two or three years. The wastewater is channeled to an evaporation lagoon.

Oily wastewater at the discharge rate of 5 m^3/h (constant discharge) is sent to sludge disposal site for oily wastewater (oil contaminated sludge or residue). After settlement, the water is pumped back into the circulatory IWWTC cycle.

Intended sludge disposal sites.

1. Evaporation lagoon for wastewater from chemical cleaning of boilers.

It is meant for natural evaporation of toxic wastewater. Estimated annual discharge with regard to preoperational washing is 7,500:2-3,750 m^3. Estimated annual evaporation layer is h=101-20=81cm.

where: 101cm is the rate of evaporation (Т.П. III оч. НТЭС, inventory No.76240)

20cm is average annual precipiration (Т.П. III оч. НТЭС, inventory No.75130). Estimated evaporation area will amount to:

$$S = \frac{3750м^3}{0,81м} = 4630м^2$$

There are two sections with 40x60m dimensions at the bottom, the section depth is Hconstr=1.5 m. Required area for the evaporation lagoon is ~ 0.90 ha (110x80m or 100x90m).

2. Sludge disposal site for oily wastewater (oil contaminated sludge or residue)

The site is planned for settlement of sludge and coagulant received along with oily wastewater.

The sludge disposal site is bisectional. The size of each section is 15x45m at the bottom and construction depth is 4.0m.

The area required for the oily wastewater sludge disposal site is 96x80m=0.77 ha (or 100x77m).

A pumping station for return of settled water is planned for the sludge disposal site and will be located on the separating dam.

This will be an intermittent action pumping station. Two pumps will be installed (one operational and one standby pump) with a discharge rate of 8-10m3/h and pump thrust of 20-22m.

The pump will switch on automatically depending on water level in shaft wells.

3.Sludge disposal site for CWT wastewater (and waste lime)

It is planned for settlement of sludge coming from CWT and waste lime and suspended matter in the source water.

The sludge disposal site is bisectional with construction height of 4.4m and slopes at m=2.5. The area of the section bottom (average) will be 30x60m. Required area for the sludge disposal site is 130x98m=1.3 ha (or 100x130m). These dimensions of the sludge disposal site are calculated for the volume of 10,170 tons of sludge for 10 years with deposition depth of ~ 3.0m.

Settled water will be sent from the sludge disposal site through shaft wells into the Zerafshan River in compliance with standard resuirements.

At all sludge disposal site, there is a plan for impermeable coating. All sections in sludge disposal sites will have access roads. The edges of sludge disposal site are planned to be coated with bitumen concrete with a width of 6.0m for vehicle passage.

Total required area for the sludge disposal site is SS=0.9+0.77+1.3=2.97ha.

Circulatory system bleeding.

The amount of circulatory system bleeding (cooling towers) is analogous to that of the 478MW CCGT unit under construction and amounts to
Qdes=200 m3/h (summertime mode).

In compliance with standard requirements, the bleeding wastewater can be discharged to the Zerafshan River.

After construction of the CCGT unit at Navoi TPS, the amount of discharge will remain the same or 7. The projected amount of treated effluent discharged through outlet No.1 will amount 5m3/h. The quality of effluent from the CCGT will differ from effluent at existing power generating unit due to lower conent of suspended matter (by 1.68 times).

A significant reduction in the discharge of thermal waters to Zerafshan River because of introduction of recycled technical water supply with cooling at fan cooling towers will reduce the addition of heat.

At present, the temperature of wastewater in the Zerafshan River according to chemical analysis ranges from 18 to 26 C in excess as compared to the temperature of water abstracted from the river water averaged at an average of 7-9 C. According to existing regulations, discharges must not lead to an increase in temperatures above 3°C at a 100m from the discharge point, if there are no sensitive aquatic ecosystems within that distance.

Impact assessment based on the analysis of similar options shows that at a distance of 100m from the discharge point from the point where the initial dilution occurs, the maximum increase in water temperature in the Zerafshan River is 0.5 ° C. These figures are within the limits of existing standards.

For other discharges, there will be virtually no change in comparison with the current state of discharge.

After commissioning of the second 450MW CCGT unit at Navoi TPS, the same types and quantities of solid waste will be generated, which are the same as during the current status (Chapter l.1.3.3).

4. Analysis of Impact Types Identified by Release of Harmful Substances into the Environment

Modernization of Navoi TPS through construction of the CCGT unit will be accompanied by the influx of environmental pollutants.

The calculation of emissions and air pollution was done with regard to phased introduction of new equipment and the dismantlement of the existing equipment according to the schedule provided by OJSC “Navoi TPS” in order to prevent a sharp increase in environmental load. The results calculating emissions are presented in Appendix 3 and the level of air pollution is shown in Annex 4.

The calculations took into account sources of emissions (boiler unit chimneys), which will change the impact on the environment when the second CCGT unit is commissioned and existing units art. No. 3 and 8 are dismantled. Six major sources will emit harmful substances: three chimneys of boiler units (No. 4-7,9,10) with a height of 56 m and 9.18 m in diameter, one chimney of two boilers (No.11, 12) with a height of 180 m and 6 m diameter in diameter, chimneys of

478MW CCGT unit 60m in height and 8.5 m in diameter and chimney of 450 MW CCGT unit 60m in height and 8.5 m in diameter.

Oxides of nitrogen will remain the main air pollutants during operation of the TPS after commissioning of second 450 MW CCGT unit.

Summary of total pollutant emissions at various stages of upgrading Navoi TPS compared with the current state and contribution of the existing, projected and dismantled equipment to air pollution is shown in Table 4.1, the contribution to atmospheric pollution by substances at different stages of modernization is shown in Table 4.2.

Table 4.1

Total Emission of Pollutants at Specific Project Implementation Stages

Boilers	**t/y**	%
Current Status	100,432	2,4
TGM Boiler-151 и St.No. 1, 2	794,542	18,9
TGM Boiler-94 St.No. 3, 4	618,530	14,7
TGM Boiler-84 St.No. 5 - 7	1025,291	24,4
TGM Boiler-94 St.No. 8, 9 Boiler ТГМ-84 St.No. 10	1663,319	39,6
TGM BoilerE-206 St.No. 11, 12	**4202,113**	**100**
Total		
Stage No.1	100,432	1,9
TGM Boiler-151 и St.No. 1, 2	794,542	15,3
TGM Boiler-94 St.No. 3, 4	618,530	11,9
TGM Boiler-84 St.No. 5 - 7	1025,291	19,7
TGM Boiler-94 St.No. 8, 9 Boiler ТГМ-84 St.No. 10	1663,319	31,9
TGM BoilerE-206 St.No. 11, 12	1007,115	19,3
CCGT unit - 478 MW	**5209,228**	**100**
Total		
Stage No.2	794,542	15,6
TGM Boiler-94 St.No. 3, 4	618,530	12,1
TGM Boiler-84 St.No. 5 - 7	1025,291	20,1
TGM Boiler-94 St.No. 8, 9 Boiler TGM-84 St.No. 10	1663,319	32,6
TGM BoilerE-206 St.No. 11, 12	1007,115	19,7
CCGT - 478 MW	**5108,797**	**100**
Total		
Stage No.3	794,542	13,1
TGM Boiler-94 St.No. 3, 4	618,530	10,2
TGM Boiler-84 St.No. 5 - 7	1025,291	16,9
TGM Boiler-94 St.No. 8, 9 Boiler ТГМ-84 St.No. 10	1663,319	27,4
TGM BoilerE-206 St.No. 11, 12	1007,115	16,6
CCGT unit - 478 МВт	952,117	15,7
CCGT unit - 450 МВт	**6060,914**	**100,0**
Total		

Stage No.4	397,271	7,5
TGM Boiler-94 St.No. 4	618,530	11,7
TGM Boiler-84 St.No. 5 - 7	664,273	12,5
TGM Boiler-94 St.No. 9 Boiler ТГМ-84 St.No. 10	1663,319	31,4
TGM BoilerE-206 St.No. 11, 12	1007,115	19,0
CCGT unit - 478 MW	952,117	18,0
CCGT unit - 450 MW	**5302,625**	**100,0**
Total		

Table 4.2

Contribution into the Level of Atmospheric Pollution Broken Down by Substances at Specific Stages of Modernization

Stage	**tons/year**	%
Current Status		
Benz(a)pyrene	0,001	3E-05
Nitrogen dioxide	3119,386	74,2
Sulfur dioxide	76,069	1,8
Fuel oil ash	0,001	3E-05
Nitrogen oxide	506,880	12,1
carbon oxide	499,776	11,9
Total	4202,113	100
Stage No.1	0,001	2E-05
Benz(a)pyrene	3606,065	69,2
Nitrogen dioxide	517,420	9,9
Sulfur dioxide	0,001	3E-05
Fuel oil ash	585,965	11,2
Nitrogen oxide	499,776	9,6
Carbon oxide	5209,228	100
Total		
Stage No.2	0,001	2E-05
Benz(a)pyrene	3543,053	69,4
Nitrogen dioxide	510,855	10,0
Sulfur dioxide	0,001	3E-05
Fuel oil ash	575,726	11,3
Nitrogen oxide	479,161	9,4
Carbon oxide	5108,797	100
Total		
Stage No.3	0,001	2E-05
Benz(a)pyrene	4003,154	66,0
Nitrogen dioxide	928,104	15,3
Sulfur dioxide	0,001	2E-05
Fuel oil ash	650,492	10,7
Nitrogen oxide	479,161	7,9
Carbon oxide	6060,914	100
Total		
Stage No.4	0,001	2E-05
Benz(a)pyrene	3454,792	65,2
Nitrogen dioxide	911,088	17,2
Sulfur dioxide	0,001	2E-05
Fuel oil ash	561,383	10,6
Nitrogen oxide	375,360	7,1
Carbon oxide	5302,625	100
Total		

After expansion of the TPS through the construction of two 478 MW and 450MW CCGT units and dismantling of boilers No.No.1, 2,3 and 8, the capacity of the station will increase from 1,250 to 1,817 MW and the total emission of pollutants will also increase from 4,202.113 tons/year to 5,302.625 tons/year. Boilers No.No.11, 12 (31.4%), 478 MW CCGT unit (19%) and 450 MW CCGT unit (18%) will be the main contributors into pollution.

To determine the effects of changes in the level of Navoi TPS on the atmospheric air after commissioning of the second 450MW CCGT unit and the range of pollution, concentrations of hazardous substances were calculated using "Ecologist" software application for an area of 18x24 km with 1 km increments.

Impact area of the station for nitrogen dioxide correlated with 0.3 MPC will decrease in relation to the current state by 3.0 km (Figure A 4.1 and A 4.6). Nitrogen dioxide pollution will decrease from 1.59 MPC to 1.04 MPC, that is, 1.53 times.

The impact on the air from operation of modern CCGT unit in comparison with the work of boiler units No.3 and 8 to be dismantled (Figure section 4.4, ris.P.4.7) was also analyzed.

The maximum concentration from CCGT unit of nitrogen dioxide in comparison with those of existing units St. No. 3 and 8 is reduced from 0.79 to 0.17 MPC.

To avoid the increase in the load on the atmosphere during the validation of input CCGT units from 1.59 MPC in the present state up to 1.82 MPC at the first stage (Figure A.4.2) new equipment should be tested when existing boilers are shut down (at least, boilers No.1 and 2, to be dismantled at the next stage).

Thus, the power of the second 450 MW CCGT unit impact on air is reduced by 4.6 times compared with that of the existing units St. No. 3 and 8 with a capacity of 150 and 160 MW each.

During operation of the entire station with St. No. 3 and 8 dismantled and the the second power generating unit 450MW CCGT unit introduced, the power generation capacity increased from 1250 to 1817 MW, while contribution of harmful substances reduces the air concentration by 1.53 times.

In addition, the significantly greater power generation, from CCGT units will not emit carbon dioxide into the air.

Addition of chemicals and heat in the Zerafshan River is reduced in comparison with the current situation through the use of recycled technical water supply with cooling at fan cooling towers.

The construction of a new WTS for the needs of 450 MW CCGT unit comprised of water pretreatment equipment for thorough demineralization of feed water to compensate for loss of steam and condensate in the water-steam cycle of the unit, installation of water softening unit for the central heating network with a deaerator and technological equipment of the integrated wastewater treatment complex (IWWTC) with a neutralization unit for acidic and alkaline wastewater after regeneration, loosening, and flushing filters of the feed circuit of the water-steam unit as well as units for treatment of water contaminated with petroleum products will enable a decrease in contribution of pollutants into soil and groundwater (chlorides, sulfates, calcium hydro carbonates and magnesium, heavy metals in moving form). At the same time, dismantling of boiler unit No.3 and 8 in addition to St.No.1 and 2 at the first stage of construction of CCGT unit will decrease the discharge of the mentioned pollutants to groundwater during infiltration of the existing sludge collectors.

Currently, the sources of noise and vibration at the Navoi TPS include forced-draft equipment, electrical equipment, turbines, generators, pumps, pipelines, compressors, and cooling towers. The noise and vibration that they generate exceeds standards of 2 and 15 dBA for acoustic noise, and from 3 to 12 dB of vibration according to the protocol of the results of measurements carried out by "Uzenergonaladka" enterprise in 2003. The maximum excess of standards for acoustic noise observed in blower fans (in excess of 15 dB A) and in the deaerator (in excess of 14 dBA) and for vibration - boiler-turbine plants pumping equipment (in excess of 12 dBA).

After commissioning of 450 MW CCGT unit, there will be additional the noise sources from the CCGT unit: exhaust outlet of gas turbine, the gas turbine itself, steam turbine, generator, and main transformer. The noise level must not exceed 80 dBA in the work zone at a distance of 1 m from the equipment on a solid foundation according to SanPiNNo. 0120-01.

Expected levels of noise at 1 meter from the CCGT unit will be:

for the gas turbine and steam turbine - <80 dB;

for the rest of the equipment - <80 dBA.

The largest sources of noise from the CCGT unit will emergency blow valves. The impact of noise from them will be felt by the staff CCGT unit in the workplace and the impact will be periodic and reversible.

In general, the acoustic noise from the CCGT unit will have no negative impact on health personnel as the generated noise will be absorbed by buildings, structures and vegetation at the station. The expected noise level will not exceed the standard values.

Sources of vibration at Navoi TPS include forced-draft machinery, pumps and turbines in the machinery hall and compressors. To reduce the vibration level at the station, fans, exhaust fans and pumps are installed on resiliently supported bases, pumps and pipelines are separated by flexible inserts, connection to the fan ducts are also done through flexible connectors. Air flue body is coated with special vibration and sound absorbing plaster. In addition to existing sources of vibration, the commissioning of the second CCGT unit will add new sources of vibration: a gas turbine and steam turbine generator. The expected level of vibrations from the sources of CCGT unit will not exceed 50 dB and outside the operating floor, no noise will be experienced.

The analysis of materials held before the environmental impact assessment revealed that the actual level of noise from Navoi TPS in residential area located 1 km away from the station is 54 dBA, the noise level of the induced-draft fan and fan units 5, 6, 7, 10 is 110 dBA, from units 10 and 12 is 113 dBA, which exceeds the standards by 1.3 times, and the engine room's is 88 dBA. However, given the proximity of residential development to the construction site of 450MW CCGT unit, it is necessary to measure the level of noise on the territory adjacent to residential buildings to ensure compliance with acoustic impact standards.

Thus, the expected level of acoustic noise and vibrations from 450MW CCGT unit will be much less than the established standard for the Republic, the analysis of analog STU shows that the effect of noise does not spread beyond the boundaries of the TPS. This is associated with the use of different ways of acoustic absorption. Thus, the noise from the unit itself can be expected to be minimized by setting casing. It is also planned to install a muffler at the outlet of heat recovery steam generator. No muffler is planned for the exhaust outlet of the gas turbine, because the exhaust gas enters the atmosphere through a tall chimney, while the noise is attenuated in terms of intensity and direction. In addition, although the exhaust gas turbine has a strong sound pressure in low frequencies, it is weakened by the passage of exhaust gas through the heat recovery steam generator. The noise from the suction of the gas turbine turns causing pressure in the high frequency band may also be relatively easily weakened by means of sound insulation. Noise contribution from the CCGT unit does not exceed standard values through fulfillment of the above measures to reduce noise during installation of the new unit.

5. Analysis of Alternative Design Solutions

In case the construction of the second 450 MW CCGT unit at Navoi TPS is cancelled and continued operation of the physically worn out equipment will reduce its reliability, technical condition, which in turn will lead to even lower technical and economic indicators. Increased accident risks with the potential negative environmental consequences are a reality. Ecological conditions in the impact area of the TPS on air will continue to remain tense.

Alternative placement of 450 MW CCGT unit.

Accommodation 450 MW CCGT unit in the northern industrial area of the TPS (on the garage area) was considered as the initial part of the project, placing CCGT unit as an alternative option is provided in Annex (Option 2).

Because this option has significant shortcomings, it was not considered further.

The essential drawbacks of alternative include:

- lack of a construction site mobilization zone (3 ha)
- lack of sites for warehouses.
- lack of automobile road on the existing station at bulky cargo of 240 tons and a large turning radius for a trailer with a length of 50 m. The construction of a new road that meets above requirements would entail the demolition of (transfer) of existing buildings and facilities serving the station as there is a very high building density. At the same time, the movement of heavy transport on the territory of the TPS will be associated with increased accident risk related to risk of fire.

In case of this location of CCGT unit, the existing station will be practically divided into two parts making it impossible to fulfill the conditions for safeguarding, where the number of builders can reach up to 700 people.

- the demolition of the holiday village and garage will be required.
- there will be a need to build two gas pipelines that cross half of the stations with operating equipment.

Thus, taking into account the issue of electric power supply in the direction of the existing 220 kV OSG of the Navoi TPS, driveway of the access road and access to utilities (gas, water, etc.), the design decision for deployment of 450MW CCGU unit to the west of the 478MW CCGT unit under construction is optimal.

The only drawback in relation to the chosen site is the proximity of residential buildings and ensuing demolition of 30 houses with authorization according to the decision of Hokimiyat decision and set timelines of resettlement.

6. Assessment of Impacts due to Withdrawal of Natural Resources from the Environment

The industrial activity of the second 450 MW CCGT unit at the Navoi TPS will be accompanied by withdrawal of minerals (natural gas) and water.

Additional 9.0 hectares of land will be acquired for the construction of the 450 MW CCGT unit on the border with the territory of the TPS and construction site of 478 MW CCGT unit in the west.

The introduction of the technical water recirculation system with cooling at fan cooling towers will reduce water consumption of CCGT unit from the Zerafshan River as compared with units St. No. 3 and 8 drops to be dismantled.

The annual water consumption from the Zarafshan River on the needs of the 450 MW CCGT unit will amount to 7,600 thousand m^3. The annual consumption of potable water for the needs of the 450 MW CCGT unit will amount to 1,471 thousand m^3.

During operation of 450 MW CCGT unit, 763.5 mln nm^3 of natural gas will be annually consumed from deposits Zevardi and Kultak, while in the gas consumption of the entire station will total 3,627.53 mln nm^3 . At present gas consumption of the station is 2,864.03 mln nm^3. The existing gas supply capacity is estimated to be 11,200 mln nm^3, i.e. will be quite adequate even after the introduction of the second 450 MW CCGT unit.

7. Emergency Situations

The long term of the TPS main and auxiliary equipment operation leading to its serious deterioration as well as the emergency situation with the heating network pipelines and communications and hydraulic structures are the risk factors causing various emergency situations.

The a priori emergency frequencies at the TPS according to [3] can be estimated as 10^{-5}.

The emergency risks in the Navoi TPS after the project implementation will be reduced due to introduction of a modern (microprocessor based) automated process management and control system. The automated process control system is designed to implement logic management, automatic and manual adjustment, emergency and restrictive protection, warning and alarm signaling, control, displaying and archiving of technological parameters, and speedy recording of major events and indicators in emergency situations.

Due to the close proximity of the residential area to the STU-450MW site the analysis of risk factors and destructive factors was undertaken considering possible accidents associated with the operation of facilities within the STU site.

The following systems and sections of the power station represent some risks in terms of fire hazards followed by explosions:

- gas compressor station;
- fuel gas unit (cutoff plate at gas line and filter);
- pipelines system for gas supply;
- gas distribution valves unit (in a separate compartment of the GT auxiliary equipment unit);
- gas distribution system at combustion chamber burners;
- lubricant and power turbine/generator oils system;
- electrical systems.

The major hazardous accidents are related to operation of gas facilities consisting of:

- gas metering unit;
- gas separation unit, where the mechanical cleaning and moisture separation from natural gas are done;
- gas separator pump unit (GSPU), which includes two gas separator pumps (1 operating, 1 standby);

The gas separator unit is used to supply fuel gas to the combustion chambers of the gas turbine unit (GTU).

The gas separator unit is designed to compress the hydrocarbon gases mixture (which can be uses as fuel for gas turbines) under continuous operation (7000 hours/year) with the necessary breaks for preventive maintenance works (adding oil, cleaning filters). GSPU includes two (2) gas separator pumps, one operating and one standby, and is designed for the gas turbine operation with a maximum gas flow.

The calculations of damage area radiuses for two accident scenarios were undertaken – in the event of a fire at GSPU or explosion of fuel-air mixture within the gas turbine building. The calculations and results are presented in Appendix 5.

The analysis of results shows that in the event of a fire at GSPU the damage areas of 25.5 m radius (permanent losses) and 76.5 m radius (medical losses) do not go beyond the STU territory.

In the event of an explosion in the gas turbine building the damage area is limited to the STU territory, not reaching the STU-478MW territory, the TPS territory and the residential area not affected during the STU-450MW construction.

The following activities are planned within the project in the sphere of fire prevention.

The principle of fire protection for the gas turbine (GT) is based on the use of jet water spraying in the areas with high fire risks.

This fire extinguishing system is a new development available at the fire-fighting equipment market. The system uses the minimum amount of water for fire fighting. The new water spray system of "fine mist droplets" type corresponding to the NFPA (National Association for hydraulic actuators) 750 standard was chosen as an alternative to carbon dioxide fire suppression system.

The following are the advantages of the new system:

- The system remains working during the routine preventive maintenance of GT.
- The system can be activated in 5-10 seconds, while the carbon dioxide

fire suppression system is activated in 30 seconds.

- Control over re-ignition during the GT cooling period.
- Safe evacuation in case of emission (better visibility compared to CO_2).
- Nontoxic and does not lead to asphyxia among the staff.
- No need to develop complicated procedures for safety engineering and staff alerting.
- GT body should not be hermetic.
- No harmful effects on the environment.

The fire prevention activities are designed to meet the following requirements:

- Prevention of fire origins and their spread.
- Protection of technical staff.
- Early fire detection, staff alerting and fire fighting.
- Reduction of damage caused by fire.

The implementation of these requirements is achieved through optimal placement of equipment (passive measures) and by taking appropriate measures to prevent fires and their extinguishing (active measures).

If for some technical reasons the passive measures do not meet the established requirements, the corresponding active measures are applied for compensation purposes.

To prevent the spread of fire and combustion by-products the station is divided into fire-hazardous zones. The protection of these zones from fire is implemented through application of passive (structural, integrated and operational measures) or active measures (portable fire extinguishers, fire protection systems), or through combination of these measures where the risk of fire is high.

The areas with high fire risks are separated from each other through housings made of fireproof materials. Such housings are used in the following areas:

- Thermal block of gas turbine.
- GT auxiliary equipment.

At these sites the housings are fitted with automatic fire-extinguishing system.

The fire-hazardous zones are protected with fire walls. The fire walls are installed to protect the gas turbine from fires or explosions.

Also these walls are used to separate the main control panel, relay room and cable floor from the adjacent sites.

In order to prevent the flame spreading, all openings in the fire walls and fire-resistant housings (doors, holes for pipes or cables installations, ventilation channels, etc.) are sealed.

The evacuation routes from all fire-hazardous zones and access ways for fire fighting purposes are carefully planned with exits; they are not blocked and properly labeled. Their length does not exceed the length established in accordance with the rules, and they lead to a safe area or exit. It is envisaged to have at least two evacuation routes with exits from fire-hazardous areas of categories 1 and 2.

The emergency lighting (with backup batteries for at least 60 minutes of operation) is installed along the evacuation routes as follows:

- They indicate the direction to the emergency exits.
- Above the emergency exit doors there are the exit light signs.

The emergency lighting system design and installation correspond to applicable standards.

8. Exposed Facilities

When commissioning the second CCGT-450MW unit at the Navoi TPS, in addition to the currently being constructed CCGT-478MW and in substitution of two existing facilities, the impact on atmospheric air, soil, vegetation, station personnel, population of nearby residential areas will be reduced.

The impact of the enterprise on atmospheric air will be expressed in smaller total emissions of nitrogen oxides, sulfur, benzpyrene, carbon monoxide compared with existing conditions.

Surface waters will experience less impact through lower levels of thermal water discharge and less pollutants adding to surface water flow.

Soils and vegetation due to lowered inflow of harmful substances from atmospheric air under fallouts will experience little impact.

The personnel involved in the production process of the Navoi TPS and the population of nearby residential areas will be less affected due to inhalation inflow of less harmful substances, and the personnel additionally will be less affected because of equipment with lower noise and vibration levels as compared with existing equipment.

9. Nature of the Environmental Impact

The commissioning of the CCGT-450MW unit with the dismantling of the outdated installations No. 3 and 8 will lead to minimizing the impact on atmospheric air while increasing the production capacity.

The maximum concentrations of nitrogen dioxide caused by the CCGT emissions will be reduced by 4.6 times compared with the concentrations of NO_2 caused by the emissions of being dismantled power generating units.

According to the nature of the impact on human body, the harmful substances of the TPS emissions cause irritation of upper respiratory tract and mucous membranes of eyes, nose and throat.

The current significant impact of the station on adjacent dachas from its north and northwest sides, which are located in the area of the TPS flare emission, will be significantly reduced after the commissioning of the second TPS.

From a comparison of the TPS operation before and after the commissioning of the second CCGT-450MW unit it can be seen that the ecological situation with atmospheric air will greatly improve. The level of the TPS impact on atmospheric air after the completion of the second TPS-450MW construction will be reduced by 1.53 times. The construction of the second TPS is the second stage of entering the enterprise into the air pollution quota.

When operating the CCGT unit the probability of emergency situations is practically eliminated due to the superiority of the TPS thermodynamic data, its design solutions and APCS provision creating a high operational reliability. Therefore, the commissioning of the second TPS is quite justified.

The reduction of thermal water discharge after the commissioning of the CCGT unit through application of recycled technical water supply of the CCGT unit with usage of fan cooling stacks will reduce the negative impact on aquatic biota. It is known that the sudden increase in water temperature for 10°C causes the death of fish and results in changes of hydrobionts ecological regime. After the reconstruction the reduction in damage to fish stocks in the Zarafshan river will be observed.

The changes in negative impacts on the environment from solid waste warehousing and storage sites after the construction of the CCGT unit are not expected.

The impact on ground water due to migration of heavy metal ions contained in the evaporation pond sludge of RAH acid washing compared with existing situation will improve due to the decommissioning of 4 existing boiler units (No. 1 and No. 2 – within the construction of CCGT-478MW and No. 3 and No. 8 – within the construction of the second CCGT-450MW). With the subsequent transfer of the movable forms of these metals to the nearby dachas along the left bank of the Zarafshan river the impact will decrease.

The staff will be affected by noise and vibrations from the CCGT-450MW sources, the levels of which will not exceed the normative values. However, after the commissioning of the CCGT-450MW unit it will be necessary to make actual measurements of the noise exposure levels.

Thus, the construction of the CCGT-450MW unit at the Navoi TPS will not result in adverse changes to the environment and human health, but partially solve the existing environmental problems of the station.

The data on residual impacts on the environment from operating the CCGT-450MW are summarized in Table 9.1.

Table 9.1

Conclusion on impact

	CCGT Unit Impact	Importance of the impact	Comparison of CCGT Unit with existing station
On the whole	Utilization of much cleaner and effective technology of power production	Positive impact	Improvement: more energy efficient
Air quality	Emissions of NO_x, SO2, CO	Insignificant: emissions within the limited standards	Improvement: emission reduction
Water quality	Warmed water dumping to Zarafshan river	Insignificant	Improvement: lower temperature of dumping due to the reverse system of water supply with ventilation cooling towers
Soil and groundwater	Oil leakage to the soil and ground water	Insignificant: measures on soil and groundwater protection were taken	Improvement: existing Navoi thermal power station pollute oil and groundwater with oil products
Wastes	Wastes utilization	Insignificant: appropriates ways of utilizations are determined	Improvement: existing Navoi thermal power station does not utilize main part of produced wastes
Noise and vibration	Noise under operations	Insignificant: meet the standards	Improvement: existing Navoi thermal power station has working sites with higher level of noise
Ecology	Flora/fauna	Insignificant: limited by industrial site territory	Improvement: existing Navoi thermal power station impact on hydrobionts of Zarafshan river
Social and economic impact	Replacement of existing blocks	Positive impact	More reliable and stable energy production, operation with a lower quantity of personnel

10. Recommendations on the Reduction of Unfavourable Environmental Impact

Evaluation of Construction effect of the 450 MW Combined Cycle Gas Turbine Unit (CCGT Unit) at Navoi Thermal Power Station has revealed that the problems of the station, and the second combined-cycle gas turbine unit being put into operation are as follows: harmful substances emissions into the atmosphere, nonutilizable waste, high accident rate of the primary and auxiliary equipment that requires to conduct an additional (with respect to those foreseen in the project) activities to reduce the negative consequences of station operation.

As under the existing condition as well as after the construction of CCGT of 450 MWatt the problems of thermal power stations are emissions of nitrogen dioxide forming a concentration in the air that exceeds maximum permitted limits.

In order to reduce the environment impact when CCGT Unit of 450 MWatt is put into operation with the dismantling of the Station units No 3 and 8 it is recommended to reduce the power station units No 4 and 5 as their degree of wear is comparable with units No. 1,2,3, up to 30%. Emissions of the station in comparison with the calculated data of project solution will be reduced by 181.03 tons/year. The concentrations of nitrogen dioxide will be decreased by 0.31 of maximum permitted concentration, but nitrogen dioxide will exceed the permitted limits. Entering the allowable quota of pollution level is possible with the complete replacement of equipment on thermal power station for the advanced fuel combustion technologies installation.

At the stage of CCTU of 450MWatt testing it is recommended to cutoff for the boilers No 3 and 8 followed by their dismantling at the next phase of modernization.

The main problem of the existing water treatment systems at thermal power station is a lot of polluted wastewater produced in the regeneration of H-cation filters. To the salts contained in the initial water and water cleaned by ionite resins the chemicals for regeneration (H_2SO_4, NaOH, NaCl) are added. The sludge containing sulphates of calcium and magnesium enters the sludge storage.

Previously, under the development of EIS materials by Navoi thermal power station a patent search in order to identify the opportunities for recycling sludge of the enterprise as a secondary raw material in various industrial spheres, particularly under the production of construction materials and road surfacing was undertaken.

At the station there is a real possibility of sludge utilization, but the station does not undertake it.

Solid wastes from sludge dumps of equipment acid washing and surfaces of the regenerative air heater (RAH) can be disposed in the waste burial places in agreement with the MMC as due to toxicity, the sludge removal to the city dump is forbidden.

There is a need to reconstruct a sludge dump of thermal power station in order to recover a disturbed formation of antifiltering screens and technological operation regime.

It is recommended to use wastes of heat insulating surface of the station for the preparation of materials that is currently sent to the dump.

It is recommended to use worn tires as an additive to slag stones and concrete blocks, as well as rags and sawdust to manufacture cell (lightweight) concrete.

Issues of disposal of solid waste need to be addressed after the inventory.

There is a need to organize a monitoring of groundwater to the north and north-west of the station on a possible migration of toxic impurities as well as monitoring of surface waters from dumping station. Moreover, there is a need to control the chemical composition of wastewater from Unit 4 and 5.

Thus, the implementation of proposed recommendations to reduce the negative impact of Navoi thermal power station will facilitate environmental improvement.

11. Forecasted Changes in the Environment

Evaluation of environmental changes as a result of Construction of the Combined Cycle Gas Turbine Unit (CCGT Unit) of 450 MWatt at Navoi thermal power station has revealed the following results:

The atmosphere air status will be improved. Under the implementation of project solution, a harmful substance concentration (nitrogen dioxide) will be reduced by 4.6 times in comparison with disassembled units of the station No 3 and 8.

The state of air will be allowable.

Reduction of harmful substances into the atmosphere will improve the soil and vegetation through reducing the rate of nitrates.

A construction of the Combined Cycle Gas Turbine Unit (CCGT Unit) of 450 MWatt at Navoi thermal power station will provide a positive effect on surface water flows due to reducing of thermal water discharge to Zarafshan River and reducing of chemicals as a result of reverse water supply system with ventilation cooling tower utilization.

Condition of soil and ground water will not be subject to any changes.

Conclusion

The first stage of the environmental impact assessment procedure on Construction of the 450 MW Combined Cycle Gas Turbine Unit (CCGT Unit) at Navoi thermal power station has revealed the following results.

Navoi thermal power station is located in an area with intense environmental situation in relation to atmospheric air condition, surface and groundwater, soils and vegetation. Environmental problems of the existing stations are as follows: increased level of nitrogen dioxide pollution and wastewater pollution from the station of the Zarafshan River, waste storage, including toxic waste, in the sludge tanks as well as a high wear and accident rate of existing main and auxiliary equipment.

Implementation of the project on Construction of the Combined Cycle Gas Turbine Unit at Navoi thermal power station that consists of replacing of existing units No. 3 and 8 with the 450MW Combined Cycle Gas Turbine Unit will enable an increase in productivity of the station and simultaneous improvement of the environmental situation in the area of impact.

The advantages of 450 MW CCGT compared with the existing energy units of thermal power stations are as follows:

- reduction of specific fuel consumption indicators;
- reduction of nitrogen oxide emissions at an average of 2.6 times due to the structural characteristics of the combustion chamber of a gas turbine and the efficiency of combustion regime.
- reduction of air pollution emissions of 450 MW CCGT compared with dismantled units No. 3 and No 8 by 4.6 times;
- reduction of thermal wastewater discharge in Zarafshan river due to the adopted reverse water supply system with ventilation cooling tower;
- reduction of accident risks due to the automated systems of management for CCGT.

Thus, the Construction of the 450 MW Combined Cycle Gas Turbine Unit (CCGT Unit) at Navoi thermal power station with application of advanced fuel combustion technologies will increase the reliability of electricity supply for consumers in Navoi, Samarkand and Bukhara regions, reduce the specific fuel consumption and pollutant emissions into the atmosphere, thermal wastewaters discharge into the Zarafshan River as well as accident risks.

Construction of the 450 MW Combined Cycle Gas Turbine Unit (CCGT Unit) at Navoi thermal power station will not aggravate negative consequences for the environment and health of the population considering, in case environmental protection activities stipulated in this Draft EIS are duly implemented.

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Appendices

Appendix 1

Layout plan.

Diagram 1
S 1:2000

Layout plan

Russian name	English name
Дачные участки	Country cottages
Жилая застройка	Residential area
Пашня	Farm field
Водозаборные и очистные водопроводные сооружения	Water intake and treatment waterworks facilities
Склады	Warehouses
Теплицы	Greenhouses
Навои ТЭС	Navoi TPS
Ферма	Farm
р. Зеравшан	Zeravshan river
Площадка ПГУ	CCGT site
«Янгиобод»	Yangiobod
«Уйрот»	Uyrot

Diagram 2
S 1:7000

Layout plan

Russian name	English name
Навои ТЭС	Navoi TPS
р. Зеравшан	Zeravshan river
ПГУ-477,75МВт	CCGT-477,75 MW
ПГУ-450 МВт	CCGT-450 MW
ж/д	Railway
а/д	Automobile road
«Янгиобод»	«Yangiobod»
«Уйрот»	«Uyrot»
сносимые жилые и недостроенные дома	Residential and partially constructed dwellings to be demolished

Appendix 2

Navoi TPP. CCGT-450MW construction
General plan and transport
General plan
Diagram 1

Existing buildings and constructions legend

Number on the plan	Name
10	Main building
11	Chimney
13	Outdoor transformers plant
17	OS-110kV
19	OS-220kV
27	Peaking boiler plant
36	Fuel oil keeping facilities
41	Onshore pumping station
42	Water supplying pumping plant
44	Cooling towers
50	Open supply conduit

51	Open outlet conduit
51a	Warm water admixing conduit
65	Chemical water treatment
71	Goods shed
72	Central repair shops
73	Plant compressor house
81	Outdoor receiver plant
87	Engineering and utility building
88	Utility building
90	Administrative building
92	Entrance
93	Dining hall
94	Fire-station
96	Mineral-oil facilities
113	Locomotive facility
115	Garage
121	Fire pump station
124	Set of washing equipment
127	Evaporator installation
134a	Sedimentation basins
134б	Evaporation pond
134в	Sludge disposal sites

List of points of connections

Number of point	**Name of point**
1	Fuel gas supply system
2	Drinking water
3	Domestic sewage system
4	Cooling tower discharge
5	Rain water drainage
6	Field waste water
7	Field water addition
8	Output power
9	Centralized heating
10	Process steam supply
11	Automobile road
12	Fire water supply
13	Temporary power supply

Symbol legend

Name	**Symbol**	
	Existing	**Designed**
1. Building and constructions		
2. Automobile roads		
3. Railway		
4. Zeravshan river and canals		
5. Circulation pipelines		
6. Process pipelines on the rack		
7. Heating main		
8. Gas pipeline		
9. HV poles		
10. Navoi TPP area		
11. CCGT-478MW site		
12. OS-220 kV extension		
13. Existing OPDU-220 kV cell equipment replacement		
14. Gas boosting compressor station (GBCS) site		
15. Transfer to the circulating		

water system of the I-II stages		
16. New CCGT-450 MW unit		

Layout plan

Russian name	English name
Дачные участки	Country cottages
Жилая застройка	Residential area
Пашня	Farm field
Мобилизационная площадка	Mobilization site
Площадка для размещения ПГУ-478 МВт	CCGT-478MW site
Площадка для размещения ПГУ-450 МВт	CCGT-450MW site
ГДКС	Gas boosting compressor station (GBCS)
КОПС	Set of washing equipment
Шламоотвал	Sludge disposal site
Перенос ВЛ-220кВ	HV-220kV dislocation
Перенос жилой застройки	Residential area dislocation
ВЛ-220кВ	HV-220kV
ВЛ-110кВ	HV-110kV
Санитарный канал	Sanitary canal
Водозаборные и очистные водопроводные сооружения	Water intake and treatment waterworks facilities
Навои	Navoi
Бухара	Bukhara

Diagram 2

Layout plan

Russian name	English name
Район сносимых жилых домов	Area of residential dwellings to be demolished
Граница земель отводимых под строительство нового ПГУ и под перенос 4-х ВЛ 220кВ	Boundary of lands allotted for construction of new CCGT and shift of the 4 HV-220kV

Diagram 3

Existing buildings and constructions legend

Number on the plan	Name
10	Main building
11	Chimney
13	Outdoor transformers plant
17	OS-110kV
19	OS-220kV
27	Peaking boiler plant
36	Fuel oil keeping facilities
41	Onshore pumping station
42	Water supplying pumping plant
44	Cooling towers
50	Open supply conduit
51	Open outlet conduit
51a	Warm water admixing conduit
65	Chemical water treatment
71	Goods shed
72	Central repair shops
73	Plant compressor house
81	Outdoor receiver plant
87	Engineering and utility building
88	Utility building

90	Administrative building
92	Entrance
93	Dining hall
94	Fire-station
96	Mineral-oil facilities
113	Locomotive facility
115	Garage
121	Fire pump station
124	Set of washing equipment
127	Evaporator installation
134а	Sedimentation basins
134б	Evaporation pond
134в	Sludge disposal sites

List of points of connections

Number of point	**Name of point**
1	Fuel gas supply system
2	Drinking water
3	Domestic sewage system
4	Cooling tower discharge
5	Rain water drainage
6	Field waste water
7	Field water addition
8	Output power
9	Centralized heating
10	Process steam supply
11	Automobile road
12	Fire water supply
13	Temporary power supply

Symbol legend

Name	**Symbol**	
	Existing	**Designed**
1. Building and constructions		
2. Automobile roads		
3. Railway		
4. Zeravshan river and canals		
5. Circulation pipelines		
6. Process pipelines on the rack		
7. Heating main		
8. Gas pipeline		
9. HV poles		
10. Navoi TPP area		
11. CCGT-478MW site		
12. OS-220 kV extension		
13. Existing OPDU-220 kV cell equipment replacement		
14. Gas boosting compressor station (GBCS) site		
15. Transfer to the circulating water system of the I-II stages		
16. New CCGT-450 MW unit		

Layout plan

Russian name	**English name**
Дачные участки	Country cottages
Жилая застройка	Residential area
Пашня	Farm field
Мобилизационная площадка	Mobilization site
Площадка для размещения	CCGT-478MW site

ПГУ-478 МВт	
Площадка для размещения ПГУ-450 МВт	CCGT-450MW site
ГДКС	Gas boosting compressor station (GBCS)
КОПС	Set of washing equipment
Шламоотвал	Sludge disposal site
Перенос ВЛ-220кВ	HV-220kV dislocation
Перенос жилой застройки	Residential area dislocation
ВЛ-220кВ	HV-220kV
ВЛ-110кВ	HV-110kV
Санитарный канал	Sanitary canal
Водозаборные и очистные водопроводные сооружения	Water intake and treatment waterworks facilities
Навои	Navoi
Бухара	Bukhara

The Table of Parameters of Air Pollutant Emissions

Table 3.3

Parameters of Air Pollutant Emission Sources

Production Title No. of Shop, Site and etc.	Sources of Emission	Emission No. on the Map	Name of Emission Source	Height of Emission Source in m	Chimney Diameter or	Parameters of the Gas-Air Mixture			Coordinates of Sources on the Schematic Map					Pollutant Name	Emissions of Pollutants		
						Volume m^3/s	Speed, m/s	Temperature, ◦C	One End of Single-Point, Linear, Planar		Second End of Single-Point, Linear, Planar		Width, m				
									X1	Y1	X2	Y2			g/s	mg/m^3	t/g
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Navoi TPS (current status)																	
Boiler Shop	Boilers TGM-151, St. No. 1,2	Chimney	1	56	6	167.64	5.93	124	8,516	6,159				Nitrogen Oxide Nitrogen Dioxide Sulfur Dioxide Benz(a)prene Carbon Oxide	1.1450 7.046 2.368 2.5E0-06 1.3215	6.83 42.03 14.13 1.5E-05 7.88	10.240 63.012 6.565 3.8E-05 20.615
	Boilers TGM-94, St. No. 3,4	Chimney	2	56	9.18	500.98	7.57	142	8,425	6,142				Nitrogen Oxide Nitrogen Dioxide Sulfur Dioxide Benz(a)prene Carbon Oxide Fuel Oil Ash	4.7258 29.0820 2.3852 8.8E-06 3.8579 3.7050	9.43 58.05 4.76 1.8E-05 7.70 7.40	92.985 572.217 14.487 2.6E-04 114.852 0.00
	Boilers TGM-84, St.No. 5-7	Chimney	3	56	9.18	379.10	6.00	136	8,324	6,132				Nitrogen Oxide Nitrogen Dioxide Sulfur Dioxide Benz(a)prene Carbon Oxide Fuel Oil Ash	4.6068 28.3606 3.0862 8.8E-06 3.1622 3.6533	11.60 71.42 7.77 2.2E-05 7.96 9.20	72.401 445.545 17.738 2.3E-04 82.846 0.001
	Boilers TGM-94, St. No. -8, 9 Boiler TGM-84 St.No. 10	Chimney	4	56	9.18	646.80	9.77	141	8,159	6,101				Nitrogen Oxide Nitrogen Dioxide Sulfur Dioxide Benz(a)prene Carbon Oxide Fuel Oil Ash	7.6756 47.2347 7.1939 1.2E-05 5.0149 4.9238	11.87 73.03 11.12 1.9E-05 7.75 7.61	121.030 744.802 27.753 3.0E-04 131.705 0.001
	Boilers TGME-206, St.No. 11,12	Chimney	5	180	6	700.86	24.79	150	8,039	6,134				Nitrogen Oxide Nitrogen Dioxide Sulfur Dioxide Benz(a)prene Carbon Oxide **Total, Boilers**	15.2935 94.1138 0.9952 1.3E-05 5.1699 **286.1208**	21.82 134.28 1.42 1.9E-05 7.38	210.224 1293.810 9.527 3.8E-04 149.758 **4,202.113**
Stage 1 (commissioning of 478MW CCGT Unit)																	
	478 MW CCGT Unit	Chimney	40	60	8.5	691.23	12.18	126	8,500	6,273				Nitrogen Oxide Nitrogen Dioxide Sulfur Dioxide **Total, CCGT Total,** **Station**	17.1584 2.7882 15.5603 **35.5069** **321.6278**	24.82 4.03 22.51	486.679 79.085 441.351 **1,007.115** **5,209.228**
Stage 2 (decommissioning boilers 1 and 2)																	
	Boilers TGM-94, St. No. 3,4	Chimney	2	56	9.18	500.98	7.55	142	8,425	6,142				Nitrogen Oxide Nitrogen Dioxide Sulfur Dioxide Benz(a)prene Carbon Oxide Fuel Oil Ash	4.7258 29.0820 2.3852 8.8E-06 3.8579 3.7050	9.43 58.05 4.76 1.8E-05 7.70 7.40	92.985 572.217 14.487 2.6E-04 114.852 0.00
	Boilers TGM-84, St.No. 5-7	Chimney	3	56	9.18	397.10	6.00	136	8,324	6,132				Nitrogen Oxide Nitrogen Dioxide Sulfur Dioxide Benz(a)prene Carbon Oxide Fuel Oil Ash	4.6068 28.3606 3.0862 8.8E-06 3.1622 3.6533	11.60 71.42 7.77 2.2E-05 7.96 9.20	72.401 445.545 17.738 2.3E-04 82.846 0.001
	Boilers TGM-94, St. No. 8, 9 Boiler TGM-84 St.No. 10	Chimney	4	56	9.18	646.80	9.77	141	8,159	6,101				Nitrogen Oxide Nitrogen Dioxide Sulfur Dioxide Benz(a)prene Carbon Oxide Fuel Oil Ash	7.6756 47.2347 7.1939 1.2E-05 5.0149 4.9238	11.87 73.03 11.12 1.9E-05 7.75 7.61	121.030 744.802 27.753 3.0E-04 131.705 0.001
	Boilers	Chimney	5	180	6	700.86	24.79	150	8,039	6,134				Nitrogen Oxide	15.2935	21.82	210.224

	TGME-206, St.No. 11,12													Nitrogen Dioxide Sulfur Dioxide Benz(a)prene Carbon Oxide **Total, Boilers**	94.1138 0.9952 1.3E-05 5.1699 **274.2403**	134.28 1.42 1.9E-05 7.38	1293.810 9.527 3.8E-04 149.758 **4,101.682**
	478 MW CCGT Unit	Chimney	40	60	8.5	691.23	12.18	126	8,500	6,273				Nitrogen Oxide Nitrogen Dioxide Sulfur Dioxide **Total, CCGT Total, Station**	17.1584 2.7882 15.5603 **35.5069** **309.7473**	24.82 4.03 22.51	486.679 79.085 441.351 **1,007.115** **5,108.797**
Stage 3 (commissioning of 450 CCGT Unit)																	
	450 MW CCCGT Unit	Chimney	41	60	8.5	736.13	12.97	126	8,460	6,273				Nitrogen Oxide Nitrogen Dioxide Sulfur Dioxide **Total, CCGT Total, Station**	18.2728 2.9693 16.5709 37.8131 **347.5603**	24.82 4.03 22.51	460.101 74.766 417.249 952.117 **6,060.914**
Stage 4 (decommissioning boilers 3 and 8)																	
	Boiler TGM-94, St. No. 4	Chimney	2	56	9.18	250.49	3.78	142	8,425	6,142				Nitrogen Oxide Nitrogen Dioxide Sulfur Dioxide Benz(a)prene Carbon Oxide Fuel Oil Ash	2.3629 14.5410 1.1926 4.4E-06 1.9290 1.8525	9.43 58.05 4.76 1.8E-05 7.70 7.40	46.493 286.109 7.240 1.3E-04 57.426 0.000
	Boilers TGM-84, St.No. 5-7	Chimney	3	56	9.18	397.10	6.00	136	8,324	6,132				Nitrogen Oxide Nitrogen Dioxide Sulfur Dioxide Benz(a)prene Carbon Oxide Fuel Oil Ash	4.6068 28.3606 3.0862 8.8E-06 3.1622 3.6533	11.60 71.42 7.77 2.2E-05 7.96 9.20	72.401 445.545 17.738 2.3E-04 82.846 0.001
	Boiler TGM-94, St. No. 9 Boiler TGM-84 St.No. 10	Chimney	4	56	9.18	324.58	4.90	141	8,159	6,101				Nitrogen Oxide Nitrogen Dioxide Sulfur Dioxide Benz(a)prene Carbon Oxide Fuel Oil Ash	4.9729 30.6028 4.6608 7.8E-06 3.2491 3.1901	15.32 94.28 14.36 2.4E-05 10.01 9.83	78.414 482.548 17.981 1.9E-04 85.330 0.000
	Boilers TGME-206, St.No. 11,12	Chimney	5	180	6	700.86	24.79	150	8,039	6,134				Nitrogen Oxide Nitrogen Dioxide Sulfur Dioxide Benz(a)prene Carbon Oxide	15.2935 94.1138 0.9952 1.3E-05 5.1699	21.82 134.28 1.42 1.9E-05 7.38	210.224 1293.810 9.527 3.8E-04 149.758
	478 MW CCGT Unit	Chimney	40	60	8.5	691.23	12.18	126	8,500	6,273				Nitrogen Oxide Nitrogen Dioxide Sulfur Dioxide **Total, Boilers**	17.1584 2.7882 15.5603 **262.5021**	24.82 4.03 22.51	486.679 79.085 441.351 **4,350.508**
	450 MW CCGT Unit	Chimney	41	60	8.5	736.13	12.97	126	8,460	6,273				Nitrogen Oxide Nitrogen Dioxide Sulfur Dioxide **Total, CCGT Total, Station**	18.2728 2.9693 16.5709 37.8131 **300.3152**	24.82 4.03 22.51	460.101 74.766 417.249 952.117 **5,302.625**

Appendix 4

Level of atmospheric discharge by Navoi TPS
Nitrogen dioxide (current situation)
Diagram 4.1

Russian name	**English name**
Пашня	Farm field
пос.Бешработ	Beshrabot town
пос.Куйи-Бургут	Kuyi-Burgut town
пос.Калкан	Kalkan town
пос.Курама	Kurama town
пос.Супаркент	Supakent town
пос.Даврикурган	Davrikurgan town
пос.Арабхана	Arabhana town
пос.Мирзамумин	Mirzamumin town
пос.Ургенч	Urgench town
пос.Пахтакор	Pakhtakor town
р. Зеравшан	Zeravshan river
Уйрот	Uyrot
Янгиобод	Yangiobod
Вдх.	Water reservoir
пос. Дубатон	Dubaton town
пос. Кармана	Karman town
пос.Гулабад	Gulabad town
пос.Талкок	Talkok town
пос.Кахрамон	Kakhramon town
Канал	Canal
Отстойники	Sedimentation basins
Навоиазот	Navoi
г. Навои	Navoi city
промзона	Industrial area
ж/д	Railway
населенные пункты	Communities
Водозаборные и очистные водопроводные сооружения	Water intake and treatment waterworks facilities

Level of atmospheric discharge by Navoi TPS
Nitrogen dioxide (Stage 1 – putting CCGT-478MW into operation)
Diagram 4.2

Russian name	**English name**
Пашня	Farm field
пос.Бешработ	Beshrabot town
пос.Куйи-Бургут	Kuyi-Burgut town
пос.Калкан	Kalkan town
пос.Курама	Kurama town
пос.Супаркент	Supakent town
пос.Даврикурган	Davrikurgan town
пос.Арабхана	Arabhana town
пос.Мирзамумин	Mirzamumin town
пос.Ургенч	Urgench town
пос.Пахтакор	Pakhtakor town
р. Зеравшан	Zeravshan river
Уйрот	Uyrot
Янгиобод	Yangiobod
Вдх.	Water reservoir
пос. Дубатон	Dubaton town
пос. Кармана	Karman town
пос.Гулабад	Gulabad town
пос.Талкок	Talkok town
пос.Кахрамон	Kakhramon town
Канал	Canal
Отстойники	Sedimentation basins

Навоиазот	Navoi
г. Навои	Navoi city
промзона	Industrial area
ж/д	Railway
населенные пункты	Communities
Водозаборные и очистные водопроводные сооружения	Water intake and treatment waterworks facilities

Level of atmospheric discharge by Navoi TPS
Nitrogen dioxide (Stage 2 – Dismantlement of boilers 1 and 2)
Diagram 4.3

Russian name	**English name**
Пашня	Farm field
пос.Бешработ	Beshrabot town
пос.Куйи-Бургут	Kuyi-Burgut town
пос.Калкан	Kalkan town
пос.Курама	Kurama town
пос.Супаркент	Supakent town
пос.Даврикурган	Davrikurgan town
пос.Арабхана	Arabhana town
пос.Мирзамумин	Mirzamumin town
пос.Ургенч	Urgench town
пос.Пахтакор	Pakhtakor town
р. Зеравшан	Zeravshan river
Уйрот	Uyrot
Янгиобод	Yangiobod
Вдх.	Water reservoir
пос. Дубатон	Dubaton town
пос. Кармана	Karman town
пос.Гулабад	Gulabad town
пос.Талкок	Talkok town
пос.Кахрамон	Kakhramon town
Канал	Canal
Отстойники	Sedimentation basins
Навоиазот	Navoi
г. Навои	Navoi city
промзона	Industrial area
ж/д	Railway
населенные пункты	Communities
Водозаборные и очистные водопроводные сооружения	Water intake and treatment waterworks facilities

Level of atmospheric discharge by Navoi TPS
Nitrogen dioxide (CCGT-450 MW)
Diagram 4.4

Russian name	**English name**
Пашня	Farm field
пос.Бешработ	Beshrabot town
пос.Куйи-Бургут	Kuyi-Burgut town
пос.Калкан	Kalkan town
пос.Курама	Kurama town
пос.Супаркент	Supakent town
пос.Даврикурган	Davrikurgan town
пос.Арабхана	Arabhana town
пос.Мирзамумин	Mirzamumin town
пос.Ургенч	Urgench town
пос.Пахтакор	Pakhtakor town
р. Зеравшан	Zeravshan river
Уйрот	Uyrot
Янгиобод	Yangiobod
Вдх.	Water reservoir
пос. Дубатон	Dubaton town

пос. Кармана	Karman town
пос.Гулабад	Gulabad town
пос.Талкок	Talkok town
пос.Кахрамон	Kakhramon town
Канал	Canal
Отстойники	Sedimentation basins
Навоиазот	Navoi
г. Навои	Navoi city
промзона	Industrial area
ж/д	Railway
населенные пункты	Communities
Водозаборные и очистные водопроводные сооружения	Water intake and treatment waterworks facilities

Level of atmospheric discharge by Navoi TPS
Nitrogen dioxide (Stage 1 – putting CCGT-450MW into operation)
Diagram 4.5

Russian name	English name
Пашня	Farm field
пос.Бешработ	Beshrabot town
пос.Куйи-Бургут	Kuyi-Burgut town
пос.Калкан	Kalkan town
пос.Курама	Kurama town
пос.Супаркент	Supakent town
пос.Даврикурган	Davrikurgan town
пос.Арабхана	Arabhana town
пос.Мирзамумин	Mirzamumin town
пос.Ургенч	Urgench town
пос.Пахтакор	Pakhtakor town
р. Зеравшан	Zeravshan river
Уйрот	Uyrot
Янгиобод	Yangiobod
Вдх.	Water reservoir
пос. Дубатон	Dubaton town
пос. Кармана	Karman town
пос.Гулабад	Gulabad town
пос.Талкок	Talkok town
пос.Кахрамон	Kakhramon town
Канал	Canal
Отстойники	Sedimentation basins
Навоиазот	Navoi
г. Навои	Navoi city
промзона	Industrial area
ж/д	Railway
населенные пункты	Communities
Водозаборные и очистные водопроводные сооружения	Water intake and treatment waterworks facilities

Level of atmospheric discharge by Navoi TPS
Nitrogen dioxide (Stage 4 – Dismantlement of boilers 3 and 8)
Diagram 4.6

Russian name	English name
Пашня	Farm field
пос.Бешработ	Beshrabot town
пос.Куйи-Бургут	Kuyi-Burgut town
пос.Калкан	Kalkan town
пос.Курама	Kurama town
пос.Супаркент	Supakent town
пос.Даврикурган	Davrikurgan town
пос.Арабхана	Arabhana town
пос.Мирзамумин	Mirzamumin town
пос.Ургенч	Urgench town

пос.Пахтакор	Pakhtakor town
р. Зеравшан	Zeravshan river
Уйрот	Uyrot
Янгиобод	Yangiobod
Вдх.	Water reservoir
пос. Дубатон	Dubaton town
пос. Кармана	Karman town
пос.Гулабад	Gulabad town
пос.Талкок	Talkok town
пос.Кахрамон	Kakhramon town
Канал	Canal
Отстойники	Sedimentation basins
Навоиазот	Navoi
г. Навои	Navoi city
промзона	Industrial area
ж/д	Railway
населенные пункты	Communities
Водозаборные и очистные водопроводные сооружения	Water intake and treatment waterworks facilities

Level of atmospheric discharge by Navoi TPS
Nitrogen dioxide (Stage 4 – Dismantled boilers 3 and 8)
Diagram 4.7

Russian name	**English name**
Пашня	Farm field
пос.Бешработ	Beshrabot town
пос.Куйи-Бургут	Kuyi-Burgut town
пос.Калкан	Kalkan town
пос.Курама	Kurama town
пос.Супаркент	Supakent town
пос.Даврикурган	Davrikurgan town
пос.Арабхана	Arabhana town
пос.Мирзамумин	Mirzamumin town
пос.Ургенч	Urgench town
пос.Пахтакор	Pakhtakor town
р. Зеравшан	Zeravshan river
Уйрот	Uyrot
Янгиобод	Yangiobod
Вдх.	Water reservoir
пос. Дубатон	Dubaton town
пос. Кармана	Karman town
пос.Гулабад	Gulabad town
пос.Талкок	Talkok town
пос.Кахрамон	Kakhramon town
Канал	Canal
Отстойники	Sedimentation basins
Навоиазот	Navoi
г. Навои	Navoi city
промзона	Industrial area
ж/д	Railway
населенные пункты	Communities
Водозаборные и очистные водопроводные сооружения	Water intake and treatment waterworks facilities

Calculation Data for Accident Impact Area

Appendix 5

Layout plan of most large-scale and serious accident (Scenario 2- Explosion in the Gas Turbine Building)
S 1:7000
Diagram 5.1

Layout plan

Russian name	**English name**
Навои ТЭС	Navoi TPS
р. Зеравшан	Zeravshan river
ПГУ-477,75МВт	CCGT-477,75 MW
ПГУ-450 МВт	CCGT-450 MW
ж/д	Railway
а/д	Automobile road
«Янгиобод»	«Yangiobod»
«Уйрот»	«Uyrot»
сносимые жилые и недостроенные дома	Residential and partially constructed dwellings to be demolished
Полное разрушение здания	Building complete demolition
Тяжелые повреждения, здания подлежат сносу	Severe damages, buildings are not repairable
Средние повреждения, возможно восстановление здания	Moderate damages, buildings are repairable
Разрушение оконных проемов, легкосбрасываемых конструкций	Demolition of window apertures, light removable structures

Calculations were done for impact area radiuses for two scenarios of accidents, i.e., during fire at gas booster compressor station (GBCS) and explosion of air-and-fuel mixture within the building of a gas turbine.

Scenario No. 1. Fire at GBCS

The calculations were done using the “Guidelines for Assessment of Hazard Related to Possible Accidents during Production, Storage, Utilization, and Transportation of Large Amounts of Flammable, Explosive, and Toxic Substances” (M.: Interagency Scientific and Methodological Center “Informatika Riska”, 1992).

Substance Hazard Class: combustion gases under pressure.

Accidents associated with hazardous substances of this class are possible at main and distribution gas pipelines, where the key scenario is a fire.

The impact area has a shape of concentric circles with a center in the place of gas leakage.

The calculation of impact area is done using the following formula:

y=a*x+b

where x is the diameter of the gas pipe (0.7 m)

a – coefficients: areas of irreversible loss (38.9) and casualties (105)

b – coefficients: areas of irreversible losses (-1.7) and casualties (3).

The radius of the area of irreversible losses: y=38.9*0.7+(-1.7) = 25.53m

The radius of medical losses: y=105*0.7+3=76.5m

Likelihood of accident during a year is 10^{-6}(moderate)

Scenario No.2 Explosion of air-and-fuel mixture within the building of a gas turbine. Calculations regarding methane explosion are done according to “Methodology for Assessment of Consequences of Air-and-Fuel Mixture Explosions”.

As a result of destruction of a valve into the space obstructed with feed pipelines, 161 kg of methane was released. Next to the premises thick with gas, there are offices at a distance of 20m. Determine the extent of the extent of impact on the shop building and staff inside during explosion of the AFM cloud.

Solution:

Let us form baseline date for further calculations:

combustion gas – methane;

physical state of the mixture – gaseous;

concentration of fuel in the mixture C_g = 0.078 kg/m^3;

stoichiometrical concentration of methane and air C_{st} concentration = 0.079;

mass of fuel contained in the cloud, M_g = 161kg;

specific combustion heat of fuel gas q_g= 4.6913·10^7 J/kg

surrounding area = cluttered.

IDENTIFICATION OF KEY PARAMETERS FOR AFM EXPLOSION

Identification of Effective Energy Content in AFM

$E=M_g\, q_{g\,t}$ *at* $C_g \leq \ C_{st,}$ where

E – effective energy content of AMF, J;

Let us find the effective energy content of the combustible mixture *E.* Since $C_g = C_{st}$, then

$$E=M_g q_g = 161 \cdot 4.69134.6913 \cdot 10^7 = 7.55 \cdot 10^9 \text{ J}.$$

Based on classification of substances, methane falls under Hazard Class 4 (weakly sensitive substances). Geometric properties of the surrounding space falls under category 2 (heavily cluttered space: presence of semiclosed cavities, high density of location of technological equipment). According to expert Table 2, let us determine the range of expected mode of explosive transformation of the AFM cloud – 4, which corresponds to deflagration.

Range 4. Deflagration, speed of flame front 150-200 m/s (V_g).

For the given distance of R=20m, let us calculate dimensionless distance R_x:

$$R_x = R / \left(E / P_0\right)^{1/3} = 100 / \left(7,55 * 10^9 / 101324\right)^{1/3} = 0,475$$

P_0 is atmospheric pressure, 101,324 Pa.

Let us calculate parameters of explosion at burning speed of 200 m/s. Values of P_{x1} and I_{x1} will be determined for the calculated dimensionless distance

$$P_{x1} = \left(V_r^2 / C_0^2\right)\left((\sigma-1)/\sigma\right)\left(0,83 / R_x - 0,14 / R_x^2\right) =$$
$$= 200^2 / 340^2 \cdot 6/7 \left(0,83/0,475 - 0,14/0,475^2\right) = 0,334$$

$$I_{x1} = \left(V_r / C_0\right)\left((\sigma-1)/\sigma\right)\left(1-0,4\left(V_r / C_0\right)\left((\sigma-1)/\sigma\right)\right)\times$$
$$\times\left(0,06 / R_x + 0,01 / R_x^2 - 0,0025 R_x^3\right) = \left(200/340\right)\left((7-1)/7\right)\times$$
$$\times\left(1-0,4\left(200/340\right)\left((7-1)/7\right)\right)\left(0,06/0,475 + 0,01/0,475^2 - 0,0025/0,475^3\right) = 0,035$$

V_r is the speed of the visible flame front, m/s;

Co is sound speed in the air, 340 m/s;

σ is the extent of expansion of combustion products, 7;

Dimensioned values for P_{x1} and I_{x1} are calculated on the basis of the estimated dimensionless values of pressure and compression stage impulse P_{x1} and I_{x1}.

$$\Delta P = P_x P_0 = 0,334 * 101324 = 33855,55$$

$$I = I_x \left(P_0\right)^{2/3} E^{1/3} / C_0 = 0,035 * 101324^{2/3} * 4,6913 * 10^9 / 340 = 437,15$$

ASSESSMENT OF THE DESTRUCTIVE EFFECT AREA

Destructive factors such as duration of the blast pressure wave and related parameter, explosion impulse, play an important role during the explosion of AFM. The real division line on the plane of impact factors on the diagram of impulse, which is pressure on two parts (inside – area of destruction, and outside – area of resistance), is unclear. Upon approximation of the wave parameters to the boundary of the danger zone, the likelihood of the set level of impact increases from 0 to 100%. With the increase in the known level of the values of pressure and impulse amplitudes, the likelihood of destruction reaches 100%. This is a typical specific feature of impact diagram may be represented as likelihood of reaching a certain level of damage by means of a probit-function - Pr_i.

The assessment of likelihood of damage to industrial buildings from explosion of the AFM cloud

The likehood of damage to walls of industrial buildings, which allow for restoration of the buildings without their demolition, may be assessed using the following formula:

$$\mathrm{Pr}_i = 5 - 0,26 \ln V_1 .$$

Likelihood of damage to industrial buildings that will entail their demolition may be assessed using formula:

$$Pr_2 = 5 - 0,22 \ln V_2$$

In this case, V_2 factor is assessed using formula:

$$V_2 = \left(40000 / \Delta P\right)^{7,4} + \left(460 / I\right)^{11,3}$$
$$V_2 = (40000/33855,55)^{7,4} + (460/437,15)^{11,3} = 5,21$$
$$Pr_2 = 5 - 0,22 \mathrm{Ln} 5,21 = 4,64$$

The likelihood of the long-term loss of self-control in people (a condition of knockdown) within the area of the blast wave during AFM cloud may be assessed by the value of probit-function:

$$Pr_3 = 5 - 5,74 \ln V_3$$

Hazard factor, V_3 is calculated using formula: $V_3 = 4,2 / \overline{p} + 1,3 / \overline{i}$

Dimensionless pressure and dimensionless impulse are shown in a mathematical expression: $\overline{p} = 1 + \Delta P / P_0$ и $\overline{i} = I / \left(P_0^{1/2} m^{1/3}\right)$

where m is the mass of a living body, kg, assumed as 80 kg.

$$\overline{p} = 1 + 33855,55/101324 = 1,334$$
$$\overline{i} = 437,15/(101324^{1/2} * 80^{1/3}) = 0,319$$
$$V_3 = 4,2/1,334 + 1,3/0,319 = 8,818$$
$$Pr_3 = 5 - 5,74 \mathrm{Ln} 8,818 = -6,35$$

The likelihood of eardrum rupture due to pressure surge in the air wave $Pr_4 = -12,6 + 1,524 \ln \Delta P = -12,6 + 1,524 \mathrm{Ln} 33855,55 = 3,3$

The likelihood of thrusting of people with a wave of pressure may be assessed using the value of the probit-function:

$$Pr_5 = 5 - 2,44 \ln V_5$$

Here V_5 factor is calculated from the following formula:

$$V_5 = 7,38 \cdot 10^3 / \Delta P + 1,3 \cdot 10^9 / \left(\Delta P I\right)$$
$$V_5 = 7380/33855,55 + 1,3 * 10^9 / (33855,55 * 437,15) = 88,06$$
$$Pr_5 = 5 - 2,44 \mathrm{Ln} 88,06 = -5,9$$

The relation between Pr_i and likelihood of a certain extent of damage may be found from Table 1.

Table 1.

Relation between likelihood of damage with probit function

P, %	1	2	3	4	5
0	2,67	2,95	3,12	3,25	3,38
10	3,77	3,82	3,86	3,92	3,96
20	4,19	4,23	4,26	4,29	4,33
30	4,50	4,53	4,56	4,59	4,61
40	4,77	4,80	4,82	4,85	4,87
50	5,03	5,05	5,08	5,10	5,13
60	5,28	5,31	5,33	5,36	5,39
70	5,55	5,58	5,61	5,64	5,67
80	5,88	5,92	5,95	5,99	6,04
90	6,34	6,41	6,48	6,55	6,64
99	7,37	7,41	7,46	7,51	7,58

The table shows that:
Pr_1= 5,95 is the likelihood of wall damage at a distance of 20 m is close to 80%
Pr_2= ,64 is the likelihood of building all damage at a distance of 20 m is close to 40%
Pr_3= -6,35 is the likelihood of long-term of self-control in people at a distance of 20 m is 0%
Pr_4= 3,3 is the likelihood of eardrum rupture in people from a surge of pressure in the air wave at a distance of 20 m above 1%
Pr_5= 5,9 is the likelihood of thrusting of people with a pressure wave at a distance of 20 m is 0%.

Determining radiuses of the impact areas
They are calculated using the following formula:

$$R = KW^{1/3} / \left(1 + (3180/W)^2\right)^{1/6}$$

where
R is the radius of impact area, m
K is the coefficient chosen according to Table 2
W is the TNT equivalent of explosion calculated using the following formula:

$$W = \frac{0{,}4}{0{,}9}\frac{M_г q_г}{4{,}5 \cdot 10^6}$$

$$W = 0{,}4*7{,}55*10^9/0{,}9*4{,}5*10^6 = 746$$

Consequently:
R_A = $3{,}8*746^{1/3}/(1+3180/746)^2)^{1/6}$ = 21 m
R_B = $5{,}6*746^{1/3}/(1+3180/746)^2)^{1/6}$ = 31 m
R_C = $9{,}6*746^{1/3}/(1+3180/746)^2)^{1/6}$ = 53 m
R_D = $28{,}0*746^{1/3}/(1+3180/746)^2)^{1/6}$ = 155 m

Table 2

Extent of Structural Damage to Buildings

Damage Category	Characteristics of Structural Damage of Buildings	Excessive Pressure ΔP, kPa	K Coefficient
A	Complete destruction of a building	≥100	3,8
B	Severe damage, building to be torn down	70	5,6
C	Moderate damage, restoration is possible	28	9,6
D	Destruction of window apertures, relief panels	14	28,0

APPENDIX 6

Schedule of Phased Commissioning of 478MW CCGT Unit and 450MW CCGT Unit and Dismantling of Existing Equipment

Approved

Stamp here Director, OJSC Navoi TPS

________________K. H. Ganiev

______________________2012

SCHEDULE

of phased commissioning of 478MW CCGT unit and 450MW CCGT unit and dismantling of existing equipment

Reconstruction Stage No.	**Work Progress**	**Lead time**
1.	Decommissioning of boilers No. 1 and 2	2012-2013
2.	Construction and commissioning of 478MW CCGT unit	2009-2012
3.	Decommissioning of boilers No. 3 and 8	2015-2016
4.	Construction and commissioning of 450MW CCGT unit	2012-2015

APPENDIX 7

Materials of the 450MW CCGT Unit Construction Site Survey, Schedule for Relocation of Residents, Minutes of Karmana District Hokimiyat Meeting, and Results of Holding Public Hearings

Deputy Head of Main State Expert Review Board
State Nature Protection Committee of the Republic of Uzbekistan
N. V. Korolyova

OFFICE MEMORANDUM

We would like to inform you of the following in response to your oral inquiry regarding the matter of "Second 450 MW CCGT Unit Construction at Navoi TPS":

We, the undersigned commission composed of: from Navoi Regional Commission of Nature Protection: Heads of Regional Inspections R. Dushamov, M. Norkobilov, Head of Karmana District Inspections, I. Rajabov, leading Specialist of Navoi Regional States Environmnetal Expert Board, Z. Turakulova; from Navoi TPS: Head of Setting up Power Generation Equipment (SPGE), H. Bekkulov, Head of Department for Work Production Plan (DWPP), O. Saidov, representative of OJSC "Teploenergoproekt", Head of Environmental Department, T.V., Khomova, held a visual inspection of the site selected for construction of the second 450MW CCGT unit at Navoi TPS.

During the visual inspection, they identified the following:

According to the PFS developed by the institute OJSC "Teploelektroproekt", the construction of this project requires 9ha of land. In addition, to transfer four overhead transmission lines VL-220kV from the construction area of the second 450 MW CCGT unit and acces road to 478MW CCGT unit requires additionally 22 ha of land.

In line with abovementioned data, OJSC "Navoi TPS" sent letters to distric hokimiyat with an application to allot 31 ha of land area for construction and relocation of residential areas from the site for four transmission lines and the road.

The Decision of Karmana District Hokimiyat No. 1251 adopted 29 October 2011 on the prelimninary site slection for construction of the above project did not plan for the transfer of the four transmission lines and the access roads. However, it should be noted, that there is a shcedule for relocation of residential areas with the lead time of 15 May 2012 based on the decision of the commission in line with the Minutes as of 20 December 2011 approved by Karmana District Hokim.

Having verified the data for the site against the layour plan developed by the institute OJSC "Teploelektroproekt" and topographical mapping of the location by Navoi Branch of SUE "UzGASHKLITI", we have determined that the distance between the projected boundary of the project under construction and residential sites that are not subject to relocation will amount to: from the northern part to the Zerafshan River – up to 200 m; from the southern part – at a distance of 300 m; from the western part – 200-250m; in the east, the boundary adjoins the site of the 478MW CCGT unit under construction with regard to transfer of four transmission lines VL-220kV, the access road to 478MW CCGT unit, and thirty residential sites to be relocated.

There is a need to plan for compensation for losses due to relocation of residential houses and plantations within the construction sites with the view of the selected site and design planning.

Appendix: Minutes of Karmana Hokimiyat Meeting as of 20 September 2011 with approved schedule for relocation of the population.

Navoi Regional Committee for Nature Protection:
Signature R. Dushamov — M. Norkobilov
Signature I. Rajabov — Z. Turakulova

Navoi TPS:
Signature H. Bekkulov — O. Saidov

OJSC "Teploelektroproekt": — T.V. Khomova

10 January 2012

"APPROVED"
Karmana District Hokim
*Stamp Here/Signature*________Ch.B. Kanoatov
December 2011

Minutes of Karmana District Hokimiyat Meeting

20 December 2011 **Karmana District**

Chaired by: Ch. Kanoatov, District Hokim
Attended by: F. Nurullaev, First Deputy District Hokim, K. Ganiev, Director of OJSC Navoi TPS, K. Hafizov, Deputy Director of OJSC Navoi TPS. A. Gafforov, Head of District Department for Land Resources and State Cadaster, K. Muhamatkulov, Head of District Department for Architecture and Construction, A. Nurmatov. Head of State Unitary Enterprise for Land Planning and Property Servcices, chairs of relevant village and mahalla community assemblies.

AGENDA:

1. Review of the letter No. 9/186 as of 6 December 2011 regarding the transfer of four overehead transmission lines in relation to construction of the second 450MW CCGT unit at Navoi TPS on the territory of "Uyrot" Village Community Assembly in Karmana District.

(Ch. Kanoatov, F. Nurullaev, K. Ganiev, K. Hafizov, A. Gafforov, K. Muhamatkulov, A. Nurmatov, K. Inoyatov, N. Ergashev, G. Mamatov, Ch. Kanoatov),

District Hokim, Ch. Kanoatov, opened the floor with welcoming address and read off the Letter No. 9/186 as of 6 December 2011 regarding the transfer of four overehead transmission lines in relation to construction of the second 450MW CCGT unit at Navoi TPS on the territory of "Uyrot" Village Community Assembly in Karmana District. After that, K. Ganiev, Director of OJSC Navoi TPS, K. Hafizov, Deputy Director of OJSC Navoi TPS, K. Muhamatkulov, Head of District Department for Architecture and Construction, A. Nurmatov, Head of SUE for Land Planning and Property Servcices, A. Nurmatov, Chair of "Uyrot" Village Community Assembly Committee, and K. Inoyator reported to the group. At the meeting, it was ascertained that 33 households have to be relocated due to the construction of the 450MW CCGT unit and the relocation schedule was proposed.

The meeting based on views and suggestions from the participants resulted in:

DECISIONS

1. The Letter No. 9/186 as of 6 December 2011 from OJSC Navoi TPS shall be accepted as the justification.
2. SUE Karmana District Land Planning and Real Estate Cadaster (A.Nurmatov) shall be entrusted with preparation and approval of the relocation schedule of the households currently located in the place on the construction site for the second 450 MW CCGT unit and related transfer of four overhead high voltage transmission lines.
3. District Department of Land Resources and State Cadaster (A. Gafforov) and District Directorate for Architecture and Construction (K. Muhamatkulov) shall present proposals regarding allotment of land plots for relocation of households according to Article 37 of the Land Code of the Republic of Uzbekistan and Resolution No.97 of the Cabinet of Ministers of the Republic of Uzbekistan.
4. "Uyrot" village community assembly (K. Inoyatov) shall carry out explanatory activities among citizens, whose houses are to be relocated construction of the second 450 MW CCGT unit and related transfer of four overhead high voltage transmission lines.
5. First District Deputy Hokim, F.Nurullaev, shall assume responsibility for monitoring the implementation of objectives set out in the minutes of this meeting.

The Minutes have been prepared by: F. Ismoilov

Informed about the Minutes:

First Deputy District Hokim	F. Nurullaev
Head of District Department for Land Resources and State Cadaster	A. Gafforov
Head of District Department for Architecture and Construction	K. Muhamatkulov
Head of State Unitary Enterprise for Land Planning and Property Servcices	A. Nurmatov
Chair "Uyrot" VCA	K. Inoyatov
Chair of "Uyrot" MCC	N. Ergashev
Chair of "Yangiobod" MCC	G. Mamatov

The Minutes coordinated with:

Director of OJSC Navoi TPS	K. Ganiev
Deputy Director of OJSC Navoi TPS	K. Hafizov

“Approved”
Karmana District Hokim
____________Kanoatov Ch. B.
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No.	Names of property owners	Address	Site name	Total land area square meters	Including	Demolition start date	Completion date
					Number of living rooms		
1	Obloberdiev Khudoyberdi	“Uyrot” VCA	Living quarters	3647	7	15.04.2012	15.05.2012
2	Khamroev Iskandar	“Uyrot” VCA	Living quarters	1470	3	15.04.2012	15.05.2012
3	Ashurov Sevdiyor	“Uyrot” VCA	Living quarters	1650	4	15.04.2012	15.05.2012
4	Obloberdiev Sayfi	“Uyrot” VCA	Living quarters	6818	6	15.04.2012	15.05.2012
5	Tilavov Dilmurod	“Yangiobod” VCA	Building foundation	1018	0	15.04.2012	01.05.2012
6	Berdiev Quvondiq	“Uyrot” VCA	Living quarters	1066	2	15.04.2012	15.05.2012
7	Berdiev Ihtiyor	“Uyrot” VCA	Living quarters	1128	4	15.04.2012	15.05.2012
8	Berdiev Aziz	“Uyrot” VCA	Living quarters	1135	3	15.04.2012	15.05.2012
9	Qayimov Qobil	“Uyrot” VCA	Living quarters	1702	4	15.04.2012	15.05.2012
10	Allaberdiev Shuxrat	“Uyrot” VCA	Living quarters	1807	4	15.04.2012	15.05.2012
11	Berdiev Sevdiyor	“Uyrot” VCA	Living quarters	1037	4	15.04.2012	15.05.2012
12	Ramozonov Tuymurod	“Yangiobod” VCA	Living quarters	777	4	15.04.2012	05.05.2012
13	Asrorova Mohidil	“Yangiobod” VCA	Living quarters	916	3	15.04.2012	05.05.2012
14	Rahmatova Madina	“Yangiobod” VCA	Living quarters	617	2	15.04.2012	05.05.2012
15	Mamatov Gulom	“Yangiobod” VCA	Living quarters	745	4	15.04.2012	05.05.2012
16	Mamatov Said qizi	“Yangiobod” VCA	Living quarters	812	4	15.04.2012	05.05.2012
17	Kodirova Nigora	“Yangiobod” VCA	Living quarters	737	3	15.04.2012	05.05.2012
18	Shamsiev Rustam	“Yangiobod” VCA	Living quarters	856	2	15.04.2012	05.05.2012
19	Ahmedov Husniddin	“Yangiobod” VCA	Living quarters	839	2	15.04.2012	05.05.2012
20	Laylo	“Yangiobod” VCA	Living quarters	826	1	15.04.2012	05.05.2012
21	Toshov Sherzod	“Yangiobod” VCA	Living quarters	1640	3	15.04.2012	05.05.2012
22	Eshqobilov Khamza	“Yangiobod” VCA	Building foundation	601	0	15.04.2012	05.05.2012
23	Ochilov Tulqin	“Yangiobod” VCA	Living quarters	605	2	15.04.2012	05.05.2012
24	Qudaratov Aziz	“Yangiobod” VCA	Living quarters	735	2	15.04.2012	05.05.2012
25	Azamat	“Yangiobod” VCA	Living quarters	888	3	15.04.2012	05.05.2012
26	Yoqubov Kamol	“Uyrot” VCA	Living quarters	1969	4	15.04.2012	15.05.2012
27	Mamatov Gulom for 2nd	“Yangiobod” VCA	Living quarters	859	2	15.04.2012	15.05.2012
28	Jabbarova Shoira	“Yangiobod” VCA	Living quarters	710	3	15.04.2012	15.05.2012
29	Madatov Rashid	“Yangiobod” VCA	Living quarters	750	1	15.04.2012	15.05.2012
30	Elmurod	“Yangiobod” VCA	Building foundation	600	0	15.04.2012	15.05.2012
	Total			38960	86		

Minutes of the Meeting with Residents, who participated in public hearings on the issue of implenenting a project 450MW CCGT Unit Construction at Navoi TPS

Date and Venue: 10 January 2012, makhalla committee of the village community assembly (VCA) "Uyrot" in Karmana District of Navoi Region.

Meeting participants: residents of VCAs "Uyrot" and "Yangiabad", representatives of local authorities and self-governing bodies (chair of the "Uyrot" village council, chair of "Uyrot" mahalla committee, chair of "Yangiabad" mahalla committee), representatives of OJSC Navoi TPS and OJSC "Teploelektroproekt"

Agenda

1. Discussion of the implementation of implenenting a project 450MW CCGT Unit Construction at Navoi TPS

The chairperson of the meeting, chair of "Uyrot" mahalla committee, Mr. Ergashev Nurulla Ergashevich, thanked the residents, who joined the meeting and reside in the immediate vicinity of Navoi TPS, and passed the floor to the Chief Engineer of DWPP at Navoi TPS, Mr. Saidov Odil Kadyrovich.

Saidov O.K. spoke on the essense of the 450 MW CCGT unit construction project, which is a second CCGT unit in addition to 478MW CCGT unit under construction. The construction is planned to the west of the 478MW CCGT unit construction site. In this regard, according to the Decision of Hokimiyat, some houses, which appear to be in the construction area, are to be torn down and the residents of 11 houses in "Uyrot" VCA and 19 houses in "Yangiabad" VCA will be relocated.

A brief overview of the structure and operational principle of the CCGT unit and technological properties was given. The goal of implementing this project is to ensure stable electric power supply to consumers along with increasing the installed power of the station and its efficiency. Gas will be burnt in the gas turbine. Fuel efficiency use will increase after the implementation of the project.

Then, the chair lf "Uyrot" mahalla committee passed the floor to the Head of Environmental Department of OJSC "Teploelektroproekt", Ms. Khomova Tatyana Viktorovna.

Ms. Khomova T.V. reported the results of environmental impact assessment due to construction of 450MW CCGT unit. She emphasized that advantages from operating the new unit as compared to operation of existing wornout boilers at the TPS, especially, from the perspective of safety and accident risks taking into account the proximity of residential buildings. Specific indicators of burned fuel will decrease, generated emissions and environmental load on atmospheric air will also reduce. Irreversible environmental consequences as a result of accidnets will be excluded due to the use of automated control system of CCGT unit operation.

Hazards for health, social sphere and intactness of assets of residents, who live in the vicinity of Navoi TPS, are not anticipated despite close proximity of residential buildings as confirmed through calculation of impact areas in case of fires and explosions of possible hypothetical accidents during the operation of the CCGT unit.

At minimal sanitary buffer zones between residential buildings and the site for the CCGT unit of 200m, the impact area will not cover the residential buildings.

Questions and comments of the participants:

1. When is it planned to build and commission 450MW CCGT unit? (Hodiev Rakhmat Akramovich, "Uyrot" mahalla).

2. Will we hear noise around and in our houses during operation of the CCGT unit? (Yarolieva Narbibi, "Yangiabad" mahalla).

3. Will CCGT unit work in addition to available equipment or in place of it? (Inoyatov Kobul Namazovich, Chair of "Uyrot" Village Council).

4. What is the reason that CCGT Unit has higher environmental indicators than existing equipment at TPS? (Mamatov Gulom, Chair of "Yangiabad" mahalla).

5. How many old boilers will be decommissioned after construction of the two new CCGT units? (Mansurov Ohunjon Ahtamovich, "Yangiabad" mahalla).

Representative of Navoi TPS and ecologists, who were holding the meeting, provided complete and exhaustive answers to all questions asked.

Participants of the public hearing supported the implementation of the project.

No one spoke against the project.

The chair of the hearing, chair of "Uyrot" mahalla committee, Mr. Ergashev N.E., concluded the hearing and emphasied the importance and significance of the project, the importance of public awareness about the project and the results of economic and environmental studies.

The chairperson offered an opinion that similar public meetings were important, since they were an opportunity to ease the concern of the residents in relation to the ongoing construction of 478MW CCGT unit and planned construction of 450 MW CCGT unit.

The list of the meeting participants for the discussion of 450MW CCGT Unit Construction at Navoi TPS.

Chairperson of mahalla committee *stamp here/ signature* Ergashev N.E.

Secretary *stamp here/ signature* Ochilova G.K.

List of Participants of the Public Hearing Dedicated to Discussion of 450MW CCGT Unit Construction at Navoi TPS

10 January 2012

№	Full name	Position, Org. address(Permament address)	Phone number	Fax number	Signature
1	Ergashev Nurullo Ergashevich	Chair of makhalla community "Uyrot"		no objection	signature
2	Inoyatov Qobil Namozovich	Village council "Uyrot"		no objection	signature
3	Mardonov Ahmad Hasan ugli	Karmana, Uyrot Makhalla		no objection	signature
4	Beknazarov Utkir	Karmana, Uyrot Makhalla		no objection	signature
5	Sharipova Fotima	Karmana, Uyrot Makhalla		no objection	signature
6	Qaynarov A.	Karmana, Uyrot Makhalla		no objection	signature
7	Sharipov Farkhod Ibodovich	Karmana, Uyrot Makhalla		no objection	signature
8	Ochilova Gulamdom Karimovna	clerk		no objection	signature
9	Khudjaqulov Sayfiddin	Karmana, Uyrot Makhalla		no objection	signature
10	Mastafoev Elbek	Karmana, Uyrot Makhalla		no objection	signature
11	Mamatov Gulom	Yangiobod Makhalla		no objection	signature
12	Khodiev Akmalkhon Rakhmatovich	Karmana, Uyrot Makhalla		no objection	signature
13	Madieva Gulchekhra	Karmana, Uyrot Makhalla		no objection	signature
14	Bosriddinov Djavlon	Uyrot Makhalla, prevention inspector		no objection	signature
15	Khodiev Rakhmat Akromovich	Karmana, Uyrot Makhalla		no objection	signature
16	Madieva Dilrabo	Karmana, Uyrot Makhalla		no objection	signature
17	Shoninov Ilkhom	Yangiobod Makhalla		no objection	signature
18	Khodjaqulova Mavluda Naimovna	Yangiobod Makhalla		no objection	signature
19	Islomova Qadriya Ashurovna	Yangiobod Makhalla		no objection	signature
20	Ruzieva Nordjon	Yangiobod Makhalla		no objection	signature
21	Ergasheva Toshbibi	Uyrot Makhalla		no objection	signature
22	Karimov Shahriddin	Uyrot Makhalla		no objection	signature
23	Khamraev Ravshan	Uyrot Makhalla		no objection	signature
24	Kendjaev Olim	Uyrot Makhalla		no objection	signature
25					signature
26	Qurbonov Sahrif	Yangiobod Makhalla		no objection	signature
27	Khodjaqulov Rajab	Yangiobod Makhalla		no objection	signature
28	Yarashov Bakhtiyor	Yangiobod Makhalla		no objection	signature
29	Yarashova Norbibi	Yangiobod Makhalla		no objection	signature
30	Yarashov Otabek	Yangiobod Makhalla		no objection	signature
31	Yarashov Azizjon	Yangiobod Makhalla		no objection	signature
32	Mamatov Asliddin	Yangiobod Makhalla		no objection	signature
33	Mansurov Ohunjon Aktamovich	Yangiobod Makhalla		no objection	signature
34	Qarshiev Nurali Alievich	Yangiobod Makhalla		no objection	signature
35	Ruziev Sardor Alievich	Yangiobod Makhalla		no objection	signature
36					signature
37	Umarova G	Yangiobod Makhalla		no objection	signature
38	Saidov Odil Qodirovich	Engineer of OJSC Navoi TPS	7426966	no objection	signature
39	Bekkulov Hayrulla	Environmental engineer, OJSC Navoi TPS	+998935225714	no objection	signature
40	Hafizov Komil Rakhmatullaevich	Deputy director for capital repairs, OJSC Navoi TPS		no objection	signature
41	Khamraev Uktam Madjidovich	OJSC Navoi TPS	+998793734507	no objection	signature
42	Coliev Tuyqul Xayotovich	Head of PTD, OJSC Navoi TPS		no objection	signature
43	Fayziev Samad Khamidovich	Chief engineer, OJSC Navoi TPS		no objection	signature
44	Djumaev Dilmurot Khaydarovich	Head of the 2nd department for emergency situation and mobility preparation, OJSC Navoi TPS		no objection	signature
45	Mansurov Robert Khamdamovich	Chief specialist of environmental department, OJSC Teploelektroproekt	1764421	no objection	signature
46	Eliseeva Yana Viktorovna	Engineer, environmental department, OJSC Teploelektroproekt	9016718	no objection	signature

47	Proshin Sergey Mikhaylovich	Project engineer, OJSC Teploelektroproekt	2566488	no objection	signature
48	Khomova Tatyana Viktorovna	Chief of environmental department , OJSC Teploelektroproekt	+998977912620	no objection	signature
49	Sharipova Dildor	Yangiobod Makhalla		no objection	signature
50	Sharipov Karim	Yangiobod Makhalla		no objection	signature
51	Sharipova Sayyora	Yangiobod Makhalla		no objection	signature
52	Sharipov Bunyod	Yangiobod Makhalla		no objection	signature

SURVEY CHECK LIST
FOR THE RESIDENTS ON THE ISSUE OF CONSTRUCTION OF THE SECOND 450MW COMBINED-CYCLE GAS TURBINE UNIT AT NAVOI TPS

Full Name ____

Address ____

How do evaluate the environmental status in your residential district:

atmospheric air____

(good, satisfactory, bad)

water____

(good, satisfactory, bad)

vegetation____

(good, satisfactory, bad)

Do you think that the quality of the environment affects your and your children's health:________________________________

(yes, no, don't know)

Do you know about the forthcoming construction of 450MW CCGT unit construction at Navoi TPS____

(yes, no)

Do you know that environmental impact assessment of 450MW CCGT unit construction at Navoi TPS has been conducted

____

(yes, no)

Have you received information about the results of environmental impact assessment of 450MW CCGT unit construction at Navoi TPS has been conducted____

(yes, no, if yes, when, where and from whom)

Do you expect any environmental improvement (atmospheric air, soil, vegetation) and better health after 450MW CCGT unit construction at Navoi TPS____________________________

(yes, no, don't know)

Do you expect any improvements in your life after 450MW CCGT unit construction at Navoi TPS___________________________

(yes, no, don't know)

Do you object to 450MW CCGT unit construction at Navoi TPS

____

Your comments and wishes

____