Environmental Impact Assessment
(ANNEXES)

May 2013
Version: 1

UZB: TAKHIATASH POWER PLANT EFFICIENCY IMPROVEMENT PROJECT

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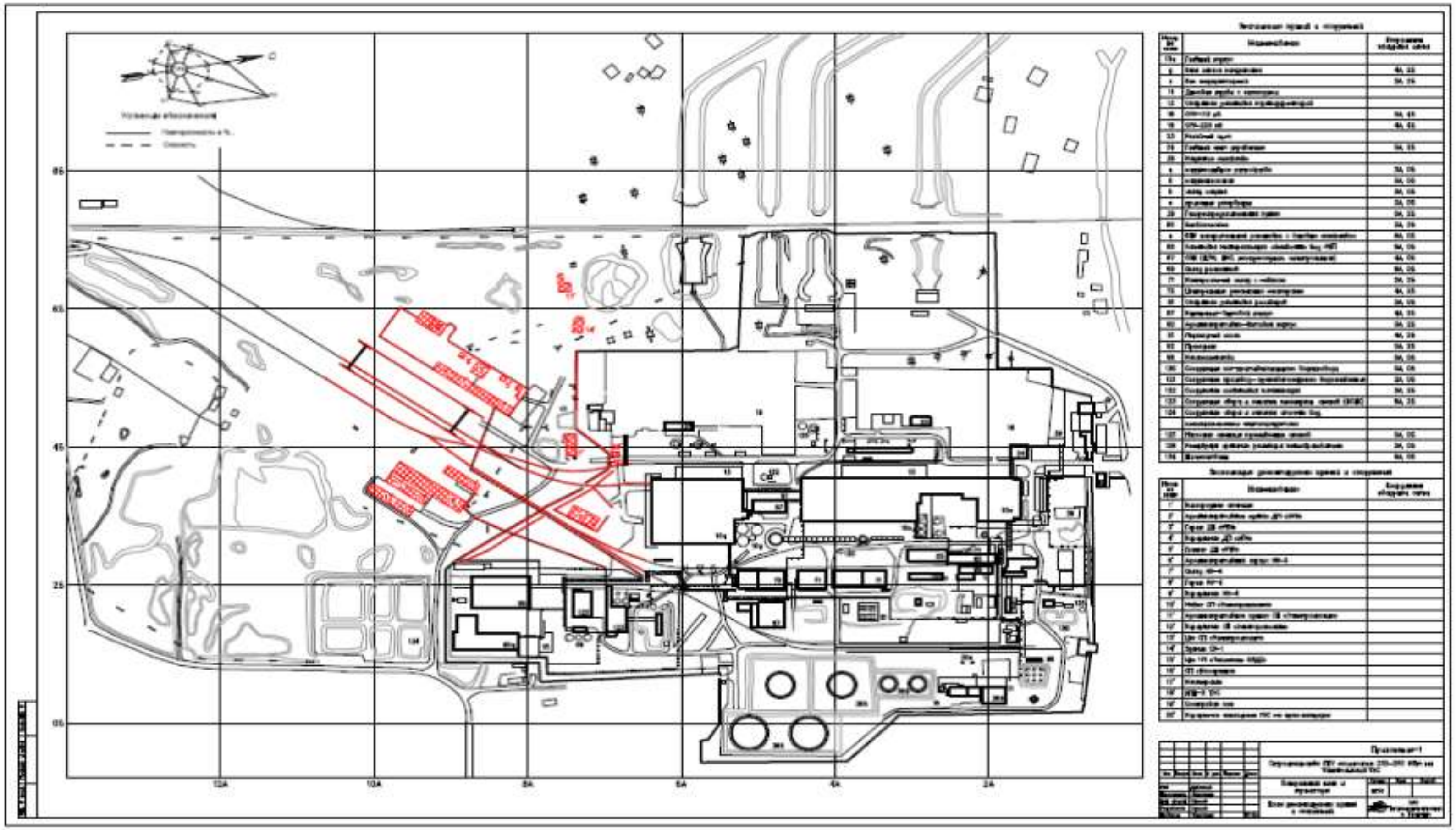
Number on the plan	Name	Coordinates
10a	Main building	
g	condensate storage tank	4A, 2Б
з	battery tank	2A, 2Б
11	Chimney	
13	Outdoor transformers plant	
16	OS-110kV	0A, 4Б
19	OS-220kV	4A, 4Б
23	Relay panel	
24	Main control panel	0A, 2Б
36	Fuel oil facilities	
a	Fuel oil discharging facility	2A, 0Б
б	Fuel oil pumping facility	0A, 0Б
в	Fuel oil storage facilities	2A, 0Б
г	Receiving tank	2A, 0Б
39	Gas-distribution station	0A, 2Б
65	Chemical water treatment	2A, 2Б
a	Demineralized water treatment plant for evaporator installation with tank facilities	8A, 0Б
66	Washing water neutralization facility for regenerative air heater	6A, 0Б
67	Integrated support complex (Central repair shops, central good shed, compressor plant, electrolysis plant)	4A, 0Б
69	Chemical warehouse	8A, 0Б
71	Goods shed	2A, 2Б
72	Central repair shops	4A, 2Б
81	Outdoor receiver plant	2A, 0Б
87	Engineering and utility building	4A, 2Б
90	Administrative building	0A, 2Б
91	Runway	4A, 2Б
92	Entrance	0A, 2Б
96	Mineral-oil facilities	0A, 0Б
120	Fire protection and utility water pipeline facilities	0A, 0Б
121	Fire protection and process water supply	2A, 0Б

	facilities	
122	Domestic sewage system facilities	2А, 2Б
123	Chemically contaminated flows collection and treatment facilities	8А, 2Б
124	Collection and treatment facilities for waste water chemically contaminated by oil products	
125	Pump station for washing water flows	0А, 0Б
126	Storage tanks for foaming agent solution	2А, 0Б
134	Sludge disposal sites	6А, 0Б

Dismantled building and constructions legend

Number on the plan	**Name**	**Coordinates**
1’	Oxygen plant	
2’	«ETM» affiliate’s administrative building	
3’	«ETM» affiliate’s garage	
4’	«ETM» affiliate’s sentry	
5	«ETM» affiliate’s toilet	
6’	MU-4 Administrative building	
7’	MU-4 warehouse	
8	MU-4 garage	
9’	MU-4 sentry	
10’	«Elektroezolit» JV shed	
11’	«Elektroezolit» JV administrative building	
12’	«Elektroezolit» JV sentry	
13’	«Elektroezolit» JV shop	
14’	SU-1 building	
15’	«Takhiatash ILDS» PE shop	
16’	«Kamarchina» JV	
17’	Shops	
18’	TPP checkpoint-2	
19’	Inspection pit	
20’	TPP sentry at industrial site	



Appendix 2: Takhiatash TPP. CCPU 230-250 MW. General plan and transport

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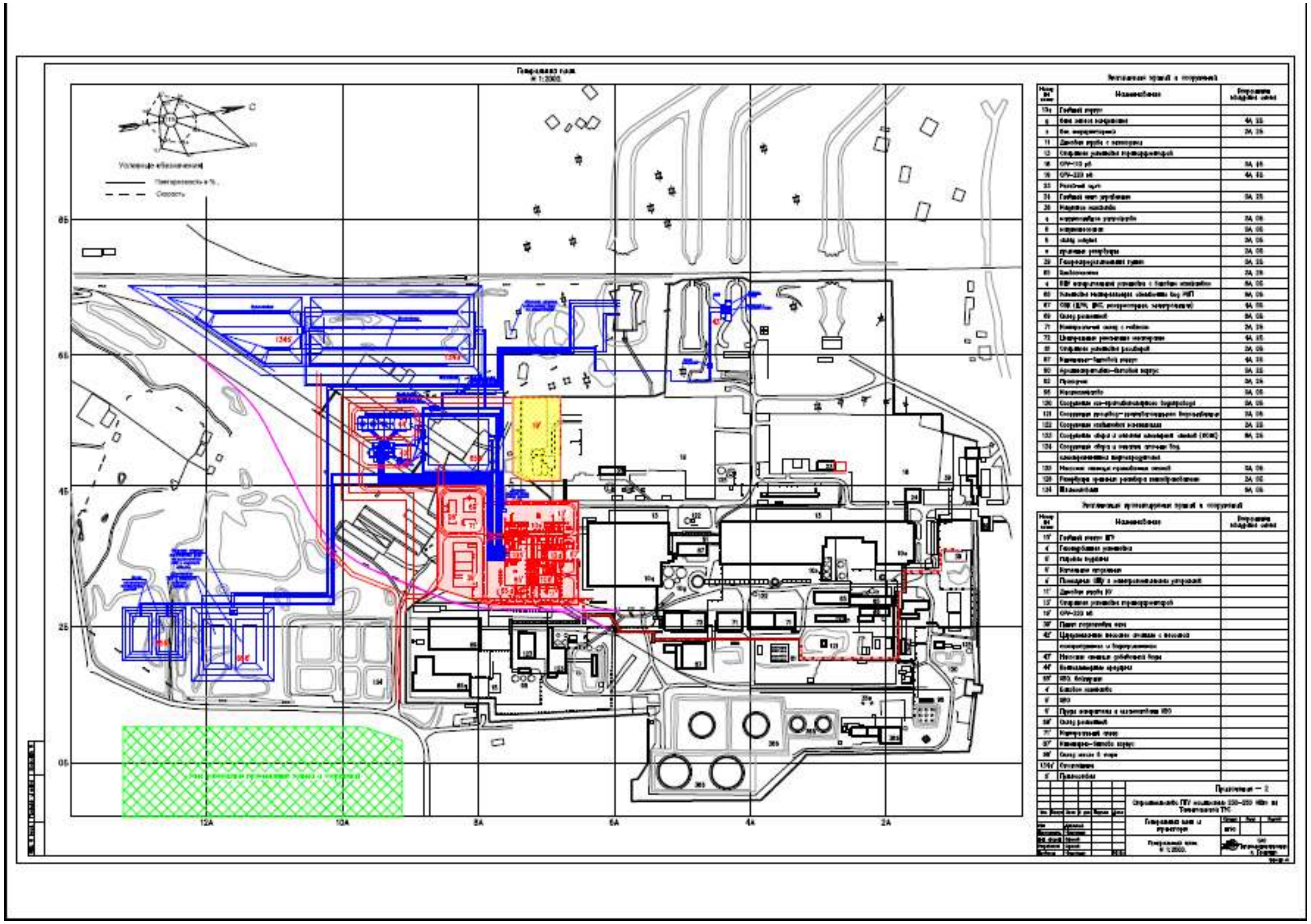
134	Sludge disposal sites	6А, 0Б

Designed building and constructions legend

Number on the plan	**Name**	**Coordinates**
10’	CCGT administrative building	
а’	CCGT	
б’	Steam turbine	
в’	Boiler room	
г’	MCP and electricals premises	
11’	Chimney	
13’	Outdoor transformer plant	
19’	OS-220kV	
39’	Gas treatment station	
42’	Circulating pumping station with firefighting pump and water-receiver	
43’	Make-up water pumping station	
44’	Mechanical-draft water cooling towers	
65’	Chemical water treatment, boiler room	
а’	Lateral facilities	
б’	Chemical water treatment	
в’	Evaporating pools and chemical water treatment sludge disposal sites	
69’	Chemical warehouse	
71’	Goods shed	
87’	Engineering and utility building	
96’	Mineral-oil in tanks	
134а’	Sedimentation basins	
б’	Mud disposal site	



ANNEX II: PHOTOGRAPHIC REPORT

Pictures taken on the site visit of 18 January 2013

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Photograph nº 2: General view from the east area

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Photograph nº 4: Closer houses to the TPP at the southeast area

Photograph nº 5: Turbine building of units III and IV (to be decommissioned)

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Photograph nº 26: Industrial waste water neutralization system.

SC-

Photograph nº 27: Oily waste water treatment. Currently out of order.

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Photograph nº 30: Detail of the cracked concrete material of the evaporation ponds.

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Photograph nº 31: Detail of the cracked concrete material of the evaporation ponds.

Photograph nº 32: Acid waste water evaporation pond cracked and corroded concrete

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Photograph nº 34: Bin for communal wastes

Photograph nº 35: Wood debris storage

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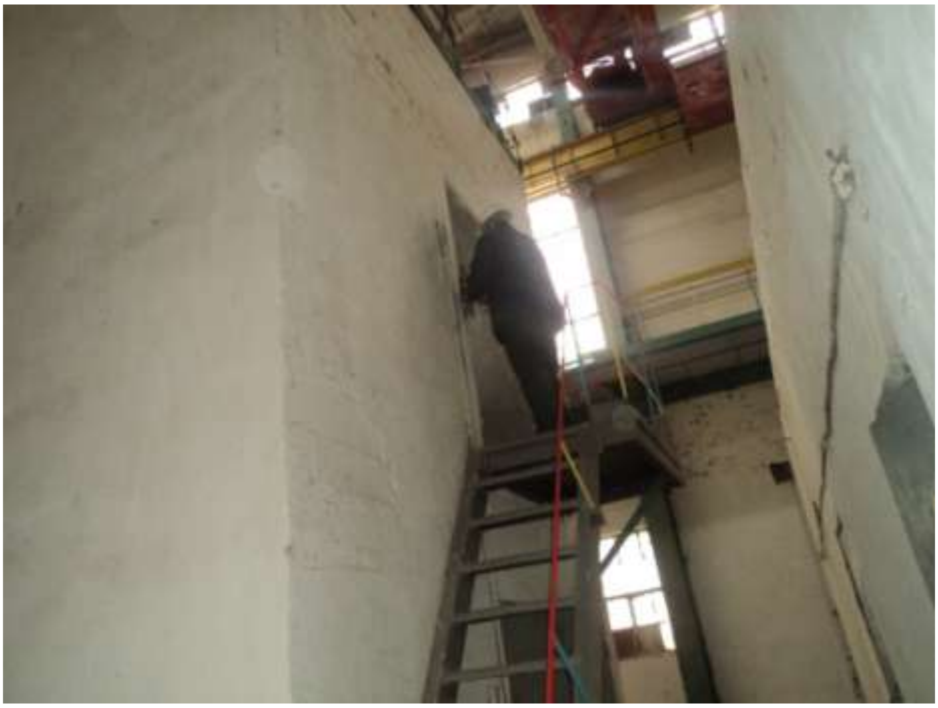
Photograph nº 36: Bin for oiled rags

Photograph nº 37: Used oil bin



Photograph nº 38: Room for lump storage – view outside

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Photograph nº 41: Used batteries storage – view inside

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Photograph nº 46: Bad condition of the pipe asbestos isolation that is exposed to the open.

Photograph nº 47: Bad condition of the pipe asbestos isolation that is exposed to the open.

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Photograph nº 48: Bad condition of the pipe asbestos isolation that is exposed to the open.

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1. Introduction

1.1. Scope

The scope of the present document is to determine pollutant immission concentration levels generated in two scenarios:

- Scenario 1 (current stage): by operation of the current units III, IV, V and VI at the Takhiatash TPP. There will be an evaluation to determine the degree of observance of legislation concerning air quality.

- Scenario 2 (future stage): by operation of the current units V and VI and the new CCPU in the Takhiatash plant. Once these concentration levels have been determined, and depending on the pre-existing background contamination before the operating phase, there will be an evaluation to determine the degree of observance of legislation concerning air quality, once the optimum stack height has been determined for the new CCPU.

1.2. Methodology

For the modelization of the two scenarios, continuous operation and maximal emission levels will need to be applied in order to analyse on the basis of the worst case scenario.

Background immission concentration level will need to be evaluated as part of the database survey concerning air quality. In this respect, data from two air quality stations within the area of the modellization has been gathered in order to calculate air quality standard levels.

The pollutants to be analysed are: NO_2, NO and CO. SO2 and particulate matter are practically not emitted by the combustion of natural gas.

The atmospheric dispersion programming model used

As the emission type generated by the Takhiatash TPP is defined as a fixed industrial source, the atmospheric dispersion program model used was AERMOD.

AERMOD was developed by AERMIC (meteorological company in the US (AMS), the Federal environmental agency (EPA), the American Meteorological Society (AMS)/United States Environmental Protection Agency (EPA) Regulatory Model Improvement Committee), and a workgroup of scientists from the AMS and the EPA. The AERMOD is the EPA's preferred regulation model.

In the World Bank Environmental, Health and Safety Directives (December 2008), it is stated that the atmospheric dispersion models that may be used are to be found in Appendix W of part 51 of the EPA Air Quality Modelling Directives (final decision of 9 November 2005). In this Appendix may also be found the AERMOD model defined as one of the most advanced.

Topography and discrete sensors

A numerical elevation model will be included in the modeling in order to examine the influence that elevation values may have on pollutant dispersion.

The model includes geographical location (coordinates) at which air quality is measured (two ari quality stations) as discrete sensors, as well as other specific points needing to be taken into account (sensitive receptors etc).

Meteorological data

As the meteorological data required for the modellization was incomplete at the closest meteorological station, the meteorological data used will be the data modeled with the Weather Research and Forecasting model (WRF) in 2012 at the site. WRF is a new generational non-hydrostatic and modular structure meteorological model developed by the National Center for Atmospheric Research (NCAR).

The input data used for WRF model execution is described below:

- Physiographic data of the simulated domain simulation: digital terrain elevation, land use, vegetation index, temperature climate of the sea, etc.

- Initial and boundary conditions. Can be obtained from a simulation or from global models, such as GFS (Global Forecast System). These data can be combined with available observations (radio soundings, surface measurements, data buoys, etc.) to obtain a more realistic analysis of meteorological fields. The initialization of the WRF-ARWv3.3 will be also preformed from GFS (Global Forecast System).

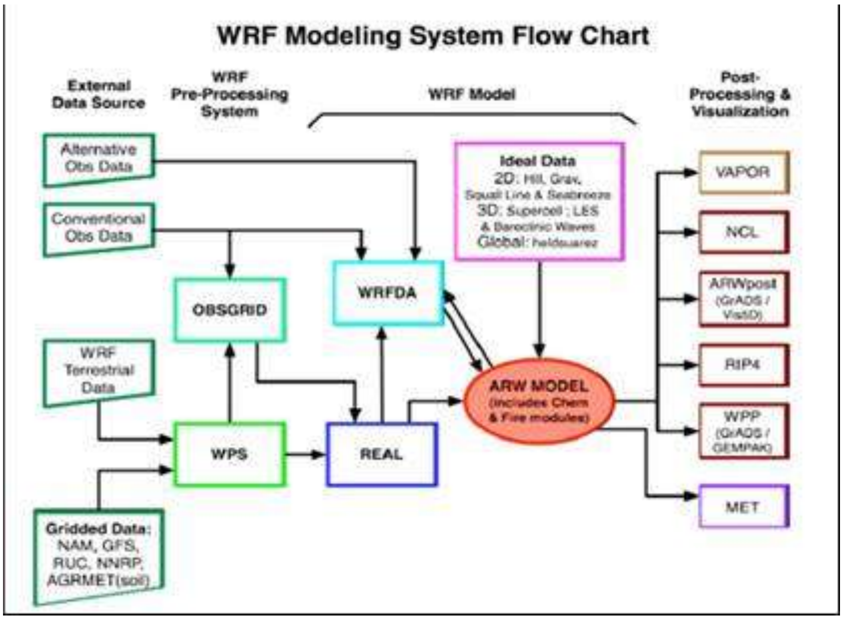


Figure 1. **WRF main structural and functional outline**

Source: http://www.mmm.ucar.edu/wrf/users/docs/user_guide_V3/contents.html

Initial and boundary conditions used for this study are based on simulations of larger scale models, specifically v.2 of the CFS model (Climate Forecast System), developed by the National Centers for Environmental Prediction (NCEP), which provides the simulation results with a 0.5° horizontal resolution.

WRF data provides both surface and vertical profiles of horizontal resolution on a 1km grid resolution covering the TPP area.

Some data provided by meteorological model should highlight variables such as the height of the cloud base or the fraction of sky covered. The values of the variables simulated with WRF at 1km grid resolution are incorporated in AERMOD.

Meteorological data are taken from the nearest point to the TPP from the WRF simulation at 1km grid resolution. This point is located at latitude 42° 19' north and longitude 59° 34' east.

Earth use categories

For each wind direction sector, an earth use category must be defined.

To perform the simulations it is considered that focus emission is located in an area where land is distributed among cultivated land and desert scrubland. This characterization is used to assign the value of several variables such as meteorological parameters: the albedo, Bowen ratio and the roughness length.

In Table 1 it is presented the assigned values to each of these parameters. These values are included in the model differentiated by sector.

Season	Land-Use	Albedo	Bowen ratio	Roughness
Spring	Cultivated Land	0.14	1.0	0.03
	Desert Scrubland	0.30	5.0	0.30
Summer	Cultivated Land	0.20	1.5	0.20
	Desert Scrubland	0.28	6.0	0.30
Autumn	Cultivated Land	0.18	2.0	0.05
	Desert Scrubland	0.28	10.0	0.30
Winter	Cultivated Land	0.60	2.0	0.01
	Desert Scrubland	0.45	10.0	0.15

Table 1. **Values of albedo, Bowen ratio and roughness length considered in the AERMOD.**

Results

The results will be analysed in order to determine pollution distribution in the survey area, as well as highest and lowest areas of concentration.

The numerical mode is applied in order to determine normal and high concentration levels in the area, as well as concentration levels at the discrete sensors.

Calculating stack height

Results concerning normal concentration shall be used in order to calculate height of the stack. This calculation will be made on the basis of modeling at various heights until optimum height, at which standards are observed, and keeping in mind the fact that beyond a certain height, further increase in the stack height will not result in corresponding reduction of pollution concentration levels.

Observing standards and contributions from the new units with regard to air quality reference level

Air quality measurements at the air quality stations (discrete sensors), as well as the existing air quality reference level, will be taken into account in order to determine whether standards are observed. At these points, contribution from the current units and the new CCPU concerning air quality reference levels may also be factored in. It should be pointed out that the air quality measurements of the two stations already take into account the contribution of the operation of the existing units III, IV, V and VI and, therefore, if we add the results of the simulations to the measurements we are overestimating the contribution of the TPP into the final air quality values. Therefore we are considering a very conservative hypothesis.

1.3. Scope of the survey

The area under consideration in the survey is rectangular, measuring 40km along one side, with the Takhiatash TPP at the centre (see Figure 2).

Figure 2. **Takhiatash CCPP location**

2. Plant description

Figure 3 below shows the location of the current plant and the planned TPP location under consideration.

Figure 3. **Current plant and CCPP planned site location.**

The site of existing Takhiatash TPP is located in the city of Takhiatash, 3 km to the south-west of the city centre and about 20 km to the south of Nukus city, the capital city of the Republic of Karakalpakstan (Khodjeyliy region).

The terrain on which the power station is built is flat.

In the TPP at present, the emission of pollutants into the air is caused by the exhaust gas combustion of natural gas in units III to VI.

Exhaust gases from boilers No. 1-4 (units III and IV) are discharged into the atmosphere through the 80 m high stack whereas gases from boilers No. 5-6 (units III and IV), 7 (unit V) and 8 (unit VI) are discharged through the 150 m high stack.

The below table is a summary of the main emission source parameters in the existing situation.

Parameter	Stack 1 (III and IV units)	Stack 2 (V-VI units)
Stack diameter (m)	5.1	7.2
Height (m)	80	150
Gas output speed (m/s)	20.0	21.2
Flow rate (m^3/s)	409.26	863.98
Temperature (ºC)	135	191

Table 2. **Emission sources' main parameters**

In the future operation of the Takhiatash TPP, after the decommissioning of old III and IV units, the emission of pollutants into the air will be caused by the exhaust gas generated in the combustion of natural gas both in the remaining units V and VI and in the future CCPU.

The exhaust gases of the remaining boilers 7 and 8 will be disposed of through the 150 m high existing stack and the new exhaust gases of the CCPU through a 60 m high individual stack. The height of the future stack, has been validated through the results of the present survey.

The below table is a *résumé* of the main emission source parameters in the future situation. The Thermoflow program was used in calculation the gas emission parameters for the new CCPU (see Appendix III).

Parameters	Stack 2 (V and VI units)	Stack 3 (new CCPP)
Stack diameter (m)	7.2	6.0
Gas output speed (m/s)	21.2	21.0
Flow rate (m^3/s)	650.41	582.00
Temperature (ºC)	191	112
Stack height (m)	150	60

Table 3. **Main parameters of emission sources**

For the existing units, Maximum Allowed Emissions (MAE), which are the emission standards to be fulfilled in the operation of the TPP, have been taking into account as the emission concentration for the simulation.

Pollutant	MAE Stack 1+Stack 2 = Total
	g/s
Nitrogen dioxide (NO_2)	35.054+110.76=145.814
Nitrogen oxide (NO)	5.696+17.998=23.694
Carbon oxide (CO)	2.29+5.63=7.92

Table 4. **MAE for the operation of the TPP**

For the future CCPU, emission concentration levels for the simulation will be defined in compliance with the Uzbek legislation on industrial emissions (integrated pollution prevention and control) and the World Bank IFC EHS guidelines for Thermal Power Plants IFC Guidelines (December 2008), whichever is more stringent. World Bank standard for combustion turbine (Table 5) is 51 mg/Nm^3 (dry gas, 15% O_2).

Parameters	Emission of the CCPU mg/Nm^3 (dry gas, 15% O2)
NO_2 emission rate*	51
NO emission rate**	43
CO emission rate***	20

Table 5. **Emission rates estimated for the future CCPU**

In order to take into consideration the emission worst case, NO_x emission standard has been took for the NO2 emission value for simulation. This is a very stringent hypothesis as NOx emitted is basically composed both of NO2 and NO. On top of that, an 84% of NOx has been considered to be emitted as NO but, as we are taking all the NO2 as NOx, NO is overestimated also. In this way, we can guarantee than the considered emission values to simulate are the highest possible. For CO, a very conservative bibliographic data has been considered.

In order to select the most stringent scenarios for the calculation of emissions dispersion, the two following scenarios have been considered:

- **Scenario 1**: This scenario corresponds to the current situation of the existing plant with a total capacity of 730 MW, operating at full load conditions.
- **Scenario 2**: This scenario corresponds to the future situation with units V and VI whose total capacity is 420 MW, operating at full load and the new CCPU with about 250 MW capacity, also operating at full load.

The simultaneous operation of blocks III, IV, V and VI and the new unit could be possible, however, taking into account the limited transmission capacity and the fact that at present the maximum demand being supplied by the TPP is about 550 MW, all these facilities would not be able to operate at full load simultaneously. Any possible combination of units at different levels of load with a maximum total output of 730 MW would produce in any case a lower level of emissions than those corresponding to the Scenario 1, because some of the current capacity of the units III and IV would be substituted by the same amount of power being generated by the combined cycle unit, with a much higher level of efficiency, thus releasing a lower amount of contaminants.

3. Legislation

The legal reference limits pertaining to air quality for each of the pollutants are those corresponding to the National Standards for Air Pollutants (in accordance with “SanR&N No 0293-11 Hygienic requirements) and the World Bank IFC general EHS guidelines (april 2007) based on the World Health Organization Air Quality Guidelines Global Update 2005.

Nitrogen dioxide

According to the National Standards for Air Pollutants the limits laid down for NO_2 are as follows:

National Standards for Air Pollutants			
Pollutant	Maximum allowed average day	Maximum allowed average monthly	Maximum allowed average year
NO_2 ($\mu g/m^3$)	60	50	40

Table 6. **NO2 National Standards**

According to the World Bank IFC guidelines 2007 air quality reference values, limits set for NO_2 are as follows:

World Bank IFC guidelines 2007		
Pollutant	Maximum allowed average 1 hour	Maximum allowed average year
NO_2 ($\mu g/m^3$)	200	40

Table 7. **NO2 World Bank Group IFC guidelines 2007 air quality standards**

Nitrogen oxide

According to the National Standards for Air Pollutants the limits laid down for NO are as follows:

National Standards for Air Pollutants			
Pollutant	Maximum allowed average day	Maximum allowed average monthly	Maximum allowed average year
NO ($\mu g/m^3$)	250	120	60

Table 8. **NO National Standards**

Carbon monoxide

According to the National Standards for Air Pollutants air quality reference values, limits set for CO are as follows:

National Standards for Air Pollutants		
Pollutant	Maximum allowed average day	Maximum allowed average monthly
CO ($\mu g/m^3$)	4000	3500

Table 9. **CO National Standards**

4. Characterization of the environment

4.1. Climate data

In order to model diffusion of pollutants released into the atmosphere, we need to know prevailing wind conditions in the area (direction and speed), the vertical thermal gradient and cloud cover.

Analysis of climate conditions of the Takhiatash TPP region was conducted on the base of meteorological station data (fig.4 and 5).

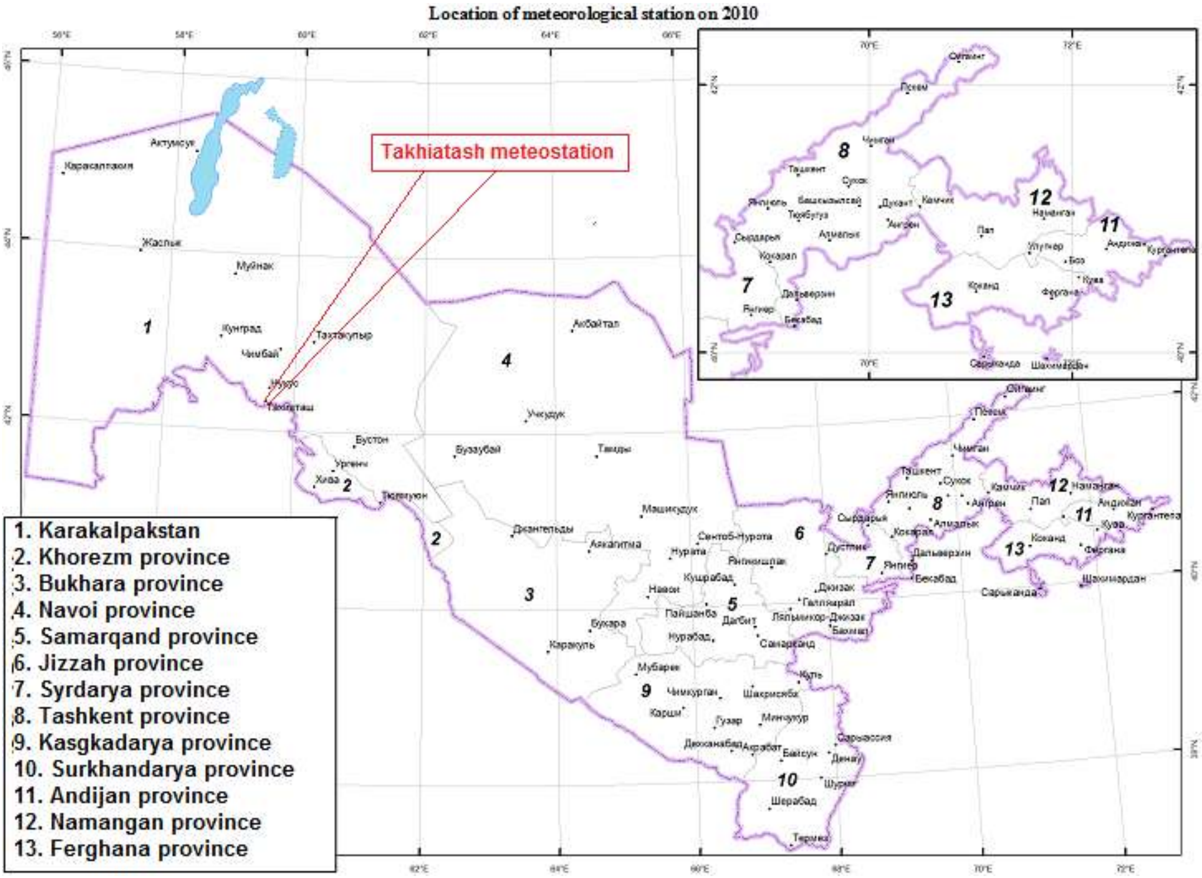


Figure 4. **Location of meteo-station**

In the following graph, the wind rose from this meteo station is shown.

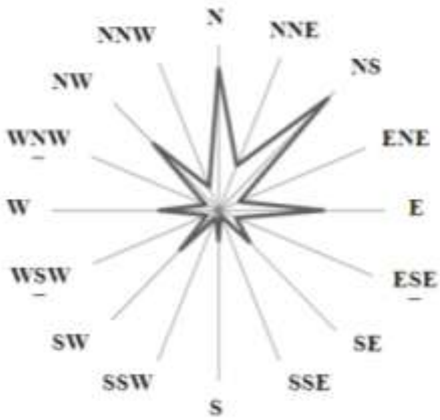


Figure 5. **Takhiatash city wind rose**

In the wind rose from meteorolical modeling carried out with WRF in 2012 for the atmospheric modellization can be observed that also the prevailing direction is northeast, as winds are of moderate strength and are among 3.6 and 5.7 as values statement.

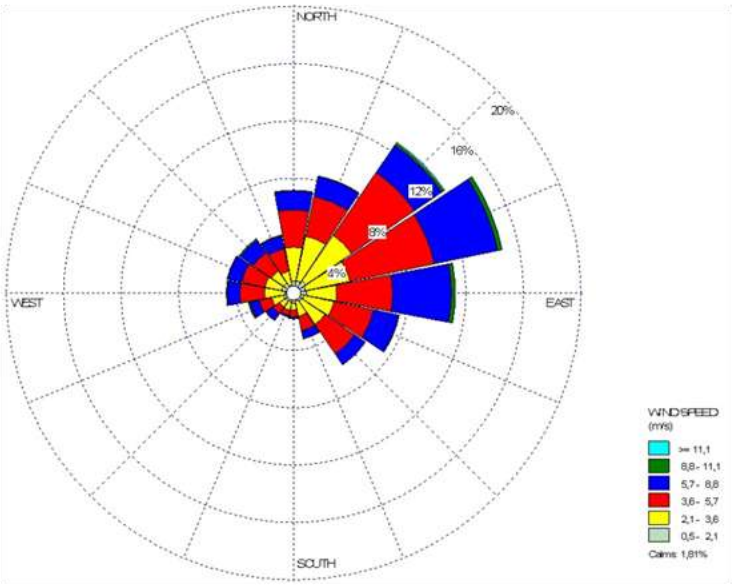


Figure 6. **Compass rose corresponding to the 2012 period in nearest CCPU point from the WRF simulation at 1km grid resolution.**

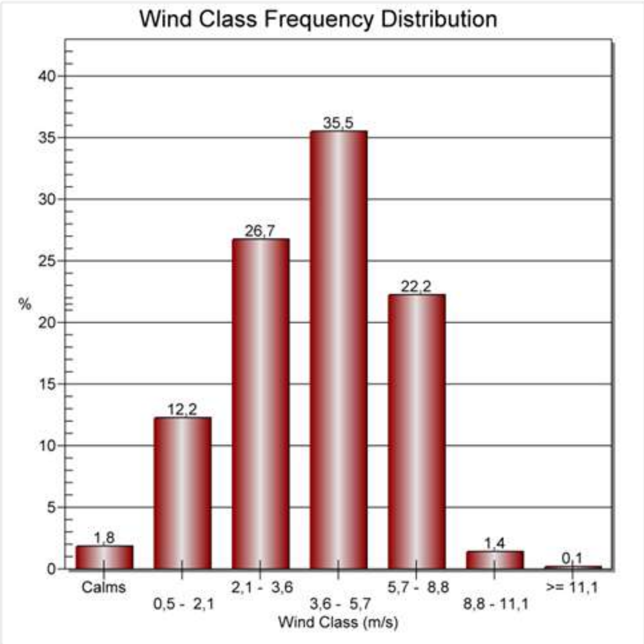


Figure 7. **Histogram of frequencies corresponding to the 2012 period in nearest CCPU point from the WRF simulation at 1km grid resolution.**

4.2. Background air quality levels.

Air quality in a region depends on a number of inter-dependent factors that may act directly or indirectly, such as pollutant emissions, weather conditions, or existing physiographic characteristics at a given spot. It is necessary to determine air quality in the area around the plant prior to the future stage: this will serve as a reference for immission forecasts of the new CCPU.

Main industrial enterprises of the Takhiatash city are Takhiatash TPP, construction industry enterprises, communal and motor industries enterprises: sintering plant, cereal products plant, repair and engineering plant, building structures and details plant, which characterized by dust emissions.

City boiler-houses, which mainly operate on the base of the fuel oil emit into the air the oxides of nitrogen, sulphur, carbon, benzpyrene, solid particles, hydrocarbons.As Takhiatash city is located very closely to such industrial centres as Nukus, Urgench and Khodjeyli, the city air is under the impact of their industrial plants.

Significant contribution into contamination of the environment is made by motor and railway transportations, which emit oxide of nitrogen and carbon, soot, benzpyrene, aldehydes.

The circumstance, worsening the negative impact of the industrial plants on the environment is distribution of sandy salt particulates from the drained bottom of the Aral sea. Radius of action of salty dust storms reaches 300 km. More than 80t/km2 of dry fallouts precipitate in Takhiatash city region.

Powerful sources of natural air contamination are Kyzyl-Kum and Kara-kum deserts; flat relief facilitates an unimpeded spreading of dust to the large distances.

In accordance with data provided by State Nature Committee of Republic Karakalpakstan (2012) Takhiatash the main air pollution sources in Karakalpakstan are presented by following big enterprises in decreasing contribution:

- Kungrad UMG (Branch of Uzbek Oil-gas company) – 14.7%
- Kungrad soda production plant (Chemical industry) – 14.0%
- “Shimologaztaminat” (Domestic gas supply sector) – 13.8%
- Takhiatash TPP – 13.6%
- Tuley UMG (Branch of Uzbek Oil-gas company) – 11.1%
- Karakalpak UMG (Branch of Uzbek Oil-gas company) – 10.0%
- Akchakal UMG (Branch of Uzbek Oil-gas company) – 1.0%

Air conditions in the Takhiatash TPP region are determined by the emissions of above mentioned facilities and depend on the conditions of their spread and spread of the dust from the bottom of Aral sea.

In order to determine air quality in the preoperational phase, data from the following existing air quality stations conducted by the Main Hydrometcenter of the Republic of Uzbekistan in Kizketken settlement area was analyzed:

- # 5 monitoring station located in Kizketken near Nukus.
- # 7 monitoring station located in Nukus.

Figure 8. **Location of the air quality monitoring stations**

Exact location and equipment at the 2 measuring points.		
Measuring points	**Coordinates**	**Parameters Measured**
# 5	42° 27' 36.522" N 59° 36' 15.208" E	Dust, SO2, NO2, NO, Phenol
# 7	42°23'24.74"N 59°38'29.88"E	Dust, SO2, NO2, CO Phenol

Table 10. **Exact location and equipment at the 2 measuring points**

Measurements analyzed were carried out over two periods of approximately 2 years as follows:

Measuring point and period.		
Measuring points	**Period start**	**Period ending**
# 5	03/01/2011	31/12/2011
	03/01/2012	30/12/2012
# 7	03/01/2011	31/12/2011
	03/01/2012	30/12/2012

Table 11. **Measuring point and period**

In order to analyze existing air quality in the area, we need to compare values recorded in the area using applicable standards indicated previously.

- NO2:

VALUES RECORDED FOR NO2 (µg/m3). **WORLD BANK GROUP IFC GUIDELINES 2007**			
Measuring points	Year	Annual mean value (Limit value: 40 $\mu g/m^3$)	Hourly value (Limit value: 200$\mu g/m^3$)
# 5	2011	24.25	40.00
	2012	20.53	50.00
# 7	2011	24.28	50.00
	2012	20.48	40.00

Table 12. **World Bank values recorded for NO2 (µg/m3).**

VALUES RECORDED FOR NO2 (μg/m3). NATIONAL STANDARDS FOR AIR POLLUTANTS				
Measuring points	Year	Annual mean value (Limit value: 40 μg/m^3)	Monthly value (Limit value: 50μg/m^3)	Daily value (Limit value: 60μg/m^3)
# 5	2011	24.25	29.36	36.67
	2012	20.53	24.49	30.00
# 7	2011	24.28	29.07	36.67
	2012	20.48	24.36	33.33

Table 13. **National Standards for Air Pollutants values recorded for NO2 (μg/m3)**

As can be observed in the above tables neither national nor international NO2 standards are exceed

- NO:

VALUES RECORDED FOR NO (μg/m3). NATIONAL STANDARDS FOR AIR POLLUTANTS				
Measuring points	Year	Annual mean value (Limit value: 60 μg/m^3)	Monthly value (Limit value: 120μg/m^3)	Daily value (Limit value: 250μg/m^3)
# 5	2011	12.84	16.54	16.67
	2012	10.92	14.72	80.00

Table 14. **National Standards for Air Pollutants values recorded for NO (μg/m3)**

No national or international standards are exceeded for NO.

- CO:

VALUES RECORDED FOR CO (μg/m3). **WORLD BANK GROUP IFC GUIDELINES 2007**			
Measuring points	Year	Monthly mean value (Limit value: 3500μg/m^3)	Daily value (Limit value: 4000μg/m^3)
# 7	2011	2500.00	3000.00
	2012	2506.67	3333.33

Table 15. **National Standards for Air Pollutants values recorded for CO (μg/m3).**

As for NO2 and NO, no national or international standards are exceeded for CO.

5. Atmospheric diffusion model

5.1. Description of the diffusion model

AERMOD was developed by AERMIC (meteorological company in the US (AMS), the Federal environmental agency (EPA), the Regulatory Model Improvement Committee), and a workgroup of scientists from the AMS and the EPA. AERMIC was created in 1991 for purposes of introducing state-of-the-art modeling concepts into the EPA's air quality modeling procedures. Thanks to the AERMIC software, the AERMOD modeling system (stationary plume modeling) was developed, incorporating air dispersion based on the Earth's outer layer structures and scale concepts, including surface source and high source processing, as well as simple and complex terrain.

On 21 April 2000, the EPA proposed that the AERMOD software be adopted as its preferred regulation modeling software for simple and complex terrain. On 9 November 2005, the EPA adopted AERMOD: it came into force on 9 December 2005 and was declared to be their preferred regulation modeling software. The entire development and adoption process took 14 years (from 1991 to 2005).

The AERMOD atmospheric dispersion modeling system is an integrated system comprising three modules:

- A state-of-the-art dispersion model designed for short distance polluting emission dispersion (up to 50 km) generated by stationary industrial sources;
- A meteorological data preprocessor (AERMET) capable of accepting surface meteorological data, data from high altitude atmospheric layers, and data from on-site sources. Using this data it calculates atmospheric parameters required for the dispersion model, such as atmospheric turbulence characteristics, altitudes of air limit layers, friction speed, Monin-Obukov length, and heat flow;
- A terrain preprocessor (AERMAP) the purpose of which is to generate physical relationship data connecting terrain characteristics and air pollution plume behavior. It generates data concerning the site, and the height for each sensor emplacement. It also obtains information that allows the dispersion model to simulate turbulence patterns over hills.

AERMOD also contains the PRIME algorithm (Plume Rise Model Enhancements) which models abatement effects generated by the polluting plume circulating over neighboring buildings.

Some of AERMOD's characteristics and capabilities:

- Source types: source multiple points, zone and volume
- source releases: Surface, near the surface, and high sources
- Source location: Urban or rural locations. Urban impact is evaluated by population
- Plume types: Continuous, floating plumes
- Plume deposit: Dry or humid particles and/or gas deposits
- Plume dispersal processing: Gaussian processing model in both dimensions (horizontal and vertical) for stable atmosphere pipes. Non Gaussian processing for vertical dimension modeling in unstable atmosphere types.
- Terrain types: Simple or complex terrain
- Effect of buildings: Processed by PRIME descending algorithms
- Levels of weather data concerning height; accepts meteorological data pertaining to different altitudes
- Meteorological data profiles: Vertical wind, turbulence and temperature profiles are created

5.2. Input data

The data required for application of the dispersion model may be split into the following categories: Emission, sensor characterisation and weather parameters.

Emission parameters

The emission data required for the model of geometrical or operational type. The geometrical type contains location and altitude coordinates above sea level of the emission-generating plant, and the height and inner diameter of the stack at its output. Operational data contains temperature and output flow rate for gases and emissions.

- Scenario 1:

Parameters of the Takhiatash CCPP emissions to the atmosphere are shown in table 16.

Emissions-generating milieu parameters		
	Values per unit (III and IV)	Values per unit (V and VI)
Stack diameter (m)	5.1	7.2
Gas output speed (m/s)	20.0	21.2
Flow rate (m^3/s)	409.26	863.98
Temperature (ºC)	135	191
Stack height (m)	80	150
NO_2 emission rate (g/s)	35.054	110.76
NO emission rate (g/s)	5.696	17.998
CO emission rate (g/s)	2.293	5.63

Table 16. **Parameters of the Takhiatash emissions to the atmosphere for scenario 1.**

- Scenario 2:

Parameters of the Takhiatash CCPP emissions to the atmosphere are shown in table 17.

Emissions-generating milieu parameters		
	Values per unit (V and VI)	Values per CCPU
Stack diameter (m)	7.2	6.0
Gas output speed (m/s)	21.2	21.0
Flow rate (m^3/s)	650.41	582.00
Temperature (ºC)	191	112
Stack height (m)	150	60
NO_2 emission rate (g/s)	83.381	20.450
NO emission rate (g/s)	13.549	17.382
CO emission rate (g/s)	4.238	8.019

Table 17. **Parameters of the Takhiatash emissions to the atmosphere for scenario 2**

Characterising the sensors

The simulation with the AERMOD dispersion model was performed on a domain of and 200m grid resolution. The domain is centered at a point of coordinates: 42° 19' 1.19'' N and 59° 33' 19.58'' E. Figure 9 shows the simulation domain and topography.

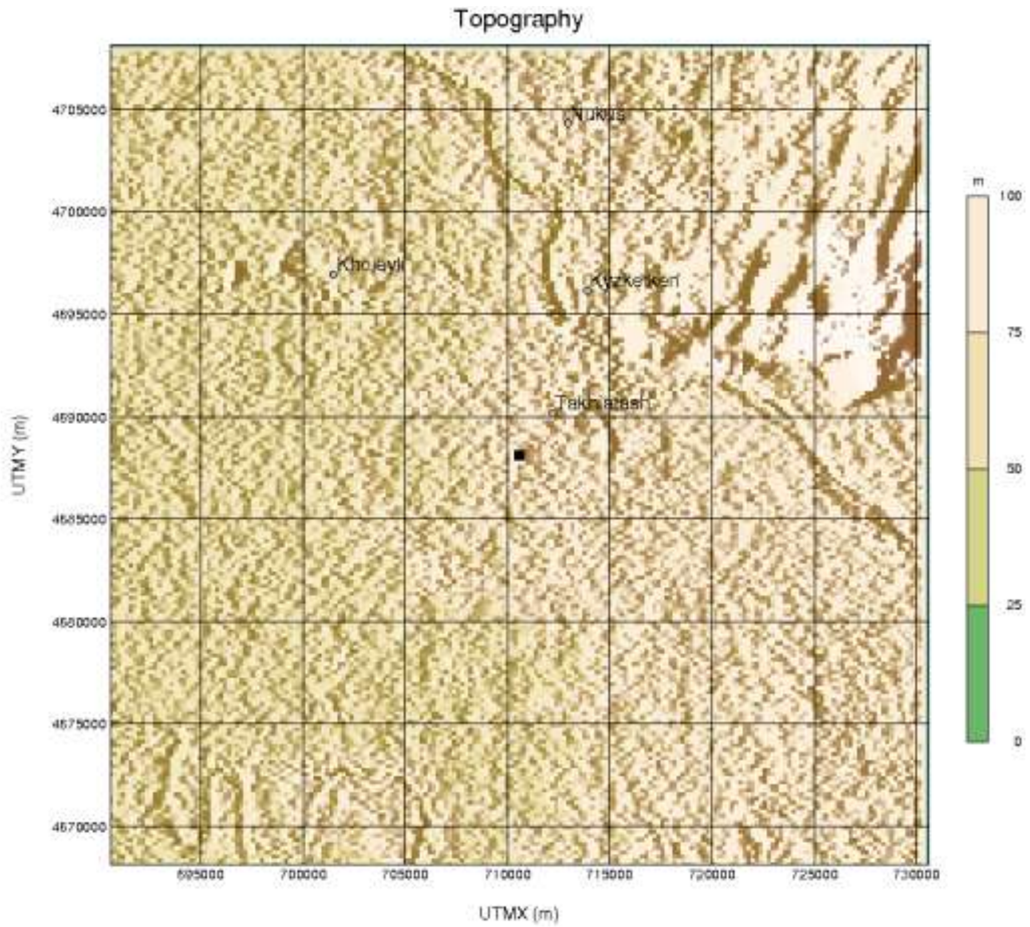


Figure 9. **Domain simulation and topography of the area. The coordinates are referred to as Area 40 and WGS-84 Black Point determines the location of the center speaker.**

The area under consideration in the survey is rectangular, measuring 40km along its side, with the Takhiatash CCPP at the centre.

The topography of the area under survey was incorporated into the AERMOD models using topography data sheets from the NASA SRMT (Shuttle Radar Topography Mission). These are 1984 geodesic projection data, given in metres. Each data sheet contains information for 1° of latitude and 1° of longitude, equivalent to 90 m resolution. The following data sheets for the area under survey were used:

- N42E059.hgt

Using this data sheets, a polar mesh of receptors was created with a 200 m distance between it, in such a way as to cover the entire zone under survey.

Similarly, in order to determine the incidence of modeled plants in the sensitive areas as well as at air quality monitoring stations, discrete sensors were placed at these stations and in the following sensitive areas:

Location of discrete sensors			
	X Coordinate (UTM zone 40)	Y Coordinate (UTM zone 40)	Elevation (m)
SENSITIVE AREAS			
Secondary School	710973	4689679	77
Kindergarten	711928	4689465	79
City Hospital	712264	4689437	80
College	712338	4689684	76
AIR QUALITY MONITORING STATIONS			
# 5	714122	4704154	79
# 7	717439	4696482	76

Table 18. **Location of discrete sensors**

Air quality monitoring stations have been located in a previous picture. In the following figure, the location of the sensitive city points can be observed.

Figure 10. **Location of the sensitive areas**

Weather parameters:

There is a weather station in Nukus which could provide part of the meterologic data needed for the modellization, but it is located far away from the project and the data provided doesn't gather the complet set of meterological input required.

In order to obtain the weather data required by the model, not recorded at the monitoring station, such as cloud cover and cloud base, a simulation of the last year (2012) was carried out using the WRF weather modeling system at a 1 km resolution for Uzbekistan, and extracting data for the closest point to the project localization.

Finally SAMSON format file was created with WRF data for be compatible with AERMOD.

In addition, the ground uses in the area under study were included for purposes of defining the following data in AERMOD: Albedo, Bowen ratio and surface roughness.

6. Calculating stack height for the new CCPU

This chapter gathers results from the calculation aimed at determining the height of the stack for the future units at the Takhiatash TPP. The calculation for determining that height is based on maximum immission values generated by stacks of varying heights in order to determine the height above which the "immission reduction / stack height increase" no longer increases efficiency.

Tables 19, 20 and 21 and graphs 11, 12 and 13 display the corresponding NO2, NO and CO values according to stack height. To this end episodic situations were modeled at stack heights between 30 m to 60 m at intervals of 10 m, and the results were compared with the above-mentioned limits. We took into consideration the modeling result that gave the severest air pollution generated by scenario 2 (new CCPU); since background air quality data was not available to us at the point at which these maximum levels are generated, we could not add the two values.

Stack height (m)	NO_2 (μgm^{-3})			
	Hourly	Daily	Monthly	Annual
60	46.74	9.55	3.61	1.58
50	46.58	9.88	3.70	1.64
40	46.44	10.07	3.78	1.70
30	46.32	10.73	4.01	1.76
Limit value (μgm^{-3})	200	60	50	40

Table 19. **Maximum NO2 values according to stack height**

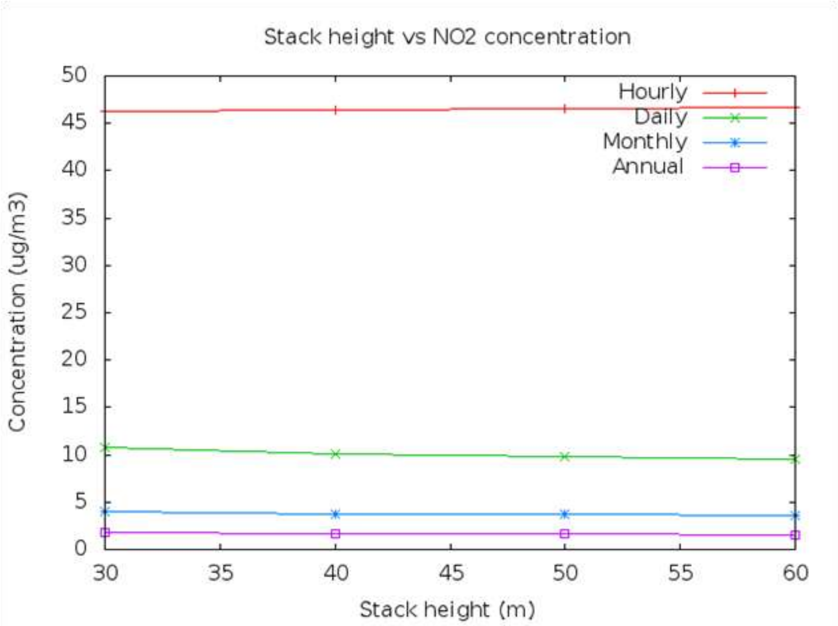


Figure 11. **Maximum NO2 values depending on stack height**

Stack height (m)	NO (μgm^{-3})		
	Daily	Monthly	Annual
60	10.02	0.77	0.33
50	5.27	1.90	0.84
40	6.47	2.05	0.92
30	7.87	2.28	0.99
Limit value (μgm^{-3})	250	120	60

Table 20. **Maximum NO values according to stack height**

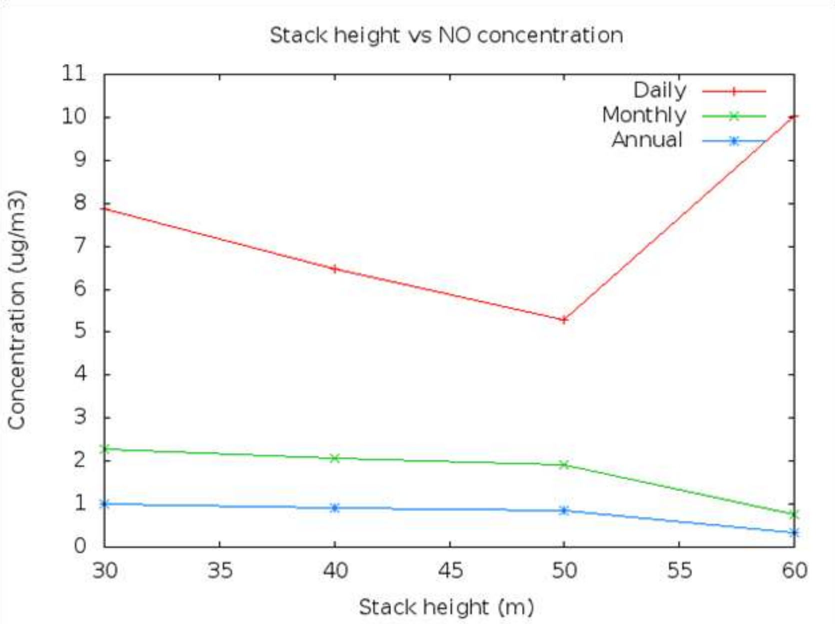


Figure 12. **Maximum NO values depending on stack height**

Stack height (m)	CO (μgm^{-3})	
	Daily	Monthly
60	0.72	0.27
50	2.40	0.83
40	2.94	0.92
30	3.59	1.03
Limit value (μgm^{-3})	4000	3500

Table 21. **Maximum CO values according to stack height**

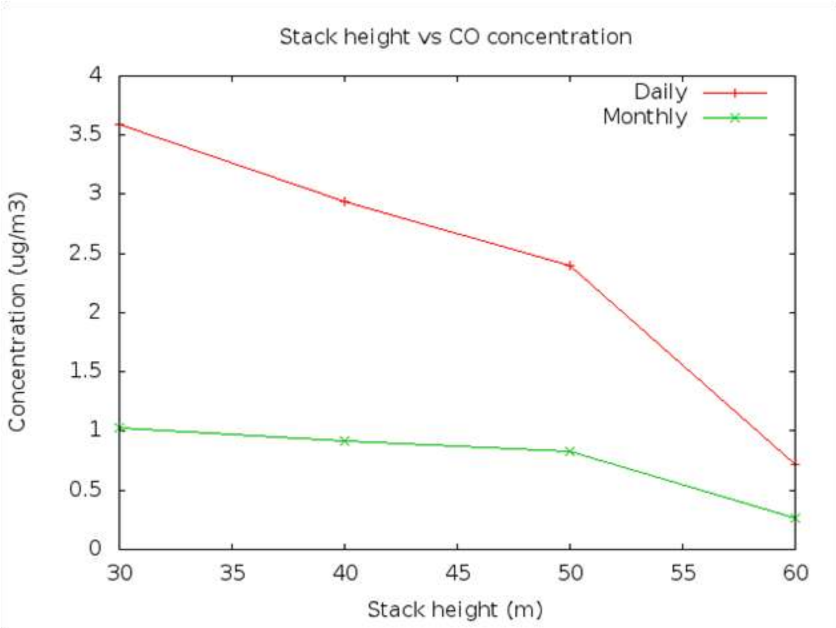


Figure 13. **Maximum CO values depending on stack height**

The "stack height/concentration" ratio shows a very linear progression in the graphics, therefore increase in stack height does not translate into significant reduction of immission concentration levels.

Therefore from an environmental protection viewpoint, we recommend a 60m stack height.

Nevertheless, if we take into consideration the stack calculation based on the international practice recommended by the industry (GIIP), according to the document “Réf. US EPA: 40 CFR, partie 51.100 (ii)”, minimum height of the stack is calculated using the following formula:

$$H_G = H + 1.5\ L$$

where:

HG = GEP stack height measured from the ground level elevation at the base of the stack

H = Height of nearby structure(s) above the base of the stack.

L = Lesser dimension, height (h) or width (w), of nearby structures “Nearby structures” = Structures within/touching a radius of 5L but less than 800 m.

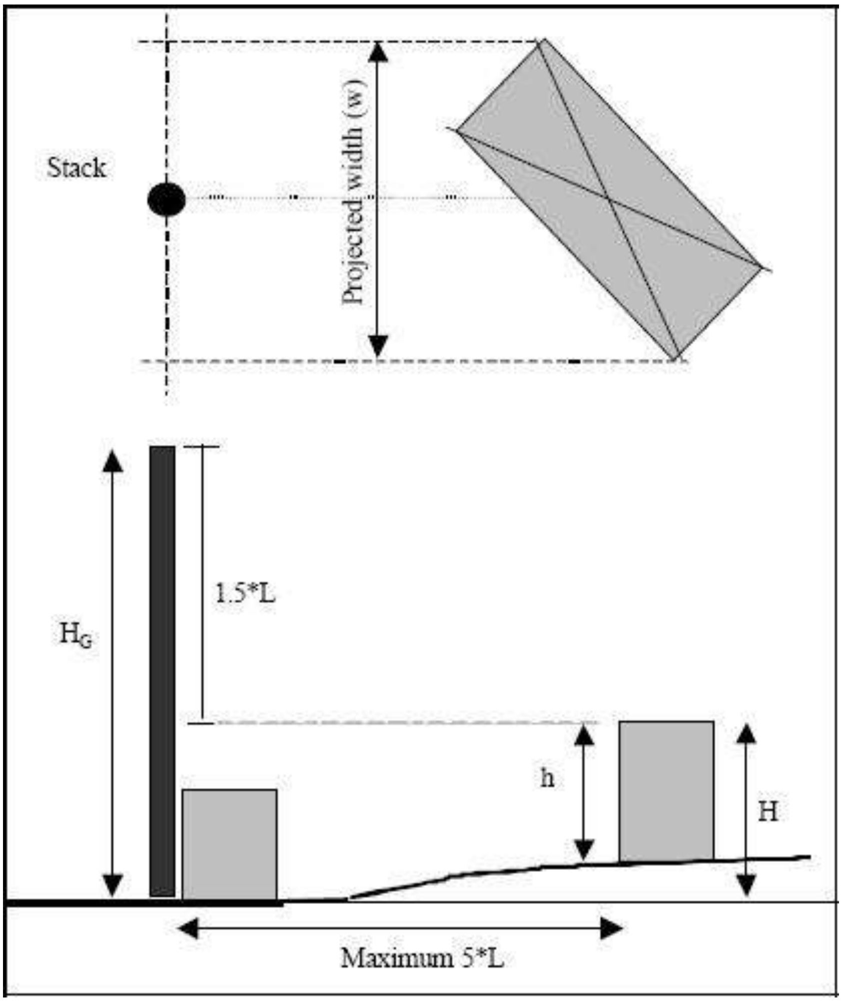


Figure 14. **Calculating stack height**

According to elevated and side views of the new Takiatash CCPU, those values are as follows:

H = 45 m y L = 45 m, therefore HG = 112,5 m.

This formula is mend to avoid excessive ground level concentrations due to downwash, wakes, and eddy effects, and to ensure reasonable diffusion to minimize impacts.

In any case, with a 60 m height stack, as it is shown below, air quality limits are fulfilled in air quality stations and contribution in sensitive points is small and lower than in the existing situation.

7. Results

Two scenarios have been considered with different features when running the AERMOD dispersion model. The different concentration camps considered are:

- Daily maximum concentration: corresponds to the maximum daily average diagnosed by the model during simulation for each point of the domain considered.

- Monthly maximum concentration: corresponds to the maximum monthly average diagnosed by the model during simulation for each point of the domain considered.

- Annual maximum concentration: maximum resulting value corresponds to the average of 1 year diagnosed by the model during simulation for each point of the domain considered.

7.1. Immission levels contributed by the current and future scenarios.

A) Scenario 1: Current situation (III, IV, V and VI units) contribution to daily, monthly and annual maximum immission levels

The following tables display modeling results separately take into account contribution as a result of operation by the current plant to daily, monthly and annual maximum immission levels, where applicable, recorded in the area under survey.

ANNUAL MAXIMUM IMMISSION MODELLING		
	NO_2 (μgm^{-3})	NO (μgm^{-3})
National Standards for Air Pollutants	40	60
World Bank Group IFC Guidelines 2007	40	
Maximum of the area of study	2,02	0.33
AIR QUALITY MONITORING STATIONS		
# 5	0.06	0.01
# 7	0.09	0.02
SENSITIVE AREAS		
Secondary School	0.34	0.06
Kindergarten	0.35	0.06
City Hospital	0.34	0.06
College	0.31	0.05

Table 22. **Maximum annual contribution to the background immission generated by the current Takhiatash CCPP in the scenario 1.**

MONTHLY MAXIMUM IMMISSION MODELLING			
	NO_2 (μgm^{-3})	NO (μgm^{-3})	CO (μgm^{-3})
National Standards for Air Pollutants	50	120	3500
Maximum of the area of study	4.71	0.77	0.27
AIR QUALITY MONITORING STATIONS			
# 5	0.15	0.02	0.01
# 7	0.18	0.03	0.01
SENSITIVE AREAS			

Secondary School	0.65	0.11	0.04
Kindergarten	0.73	0.12	0.04
City Hospital	0.69	0.11	0.04
College	0.65	0.11	0.04

Table 23. **Maximum monthly contribution to the background immission generated by the current Takhiatash CCPP in the scenario 1.**

DAILY MAXIMUM IMMISSION MODELLING			
	NO_2 (μgm^{-3})	NO (μgm^{-3})	CO (μgm^{-3})
National Standards for Air Pollutants	60	250	4000
Maximum of the area of study	12.54	2.04	0.72
AIR QUALITY MONITORING STATIONS			
# 5	1.07	0.17	0.06
# 7	1.49	0.24	0.08
SENSITIVE AREAS			
Secondary School	4.35	0.71	0.25
Kindergarten	5.57	0.91	0.33
City Hospital	5.33	0.87	0.31
College	4.99	0.81	0.29

Table 24. **Maximum daily contribution to the background immission generated by the current Takhiatash CCPP in the scenario 1.**

HOURLY MAXIMUM IMMISSION MODELLING	
	NO_2 (μgm^{-3})
World Bank Group IFC Guidelines 2007	200
Maximum of the area of study	61.64
AIR QUALITY MONITORING STATIONS	
# 5	21.35
# 7	13.72
SENSITIVE AREAS	
Secondary School	29.22
Kindergarten	26.11
City Hospital	31.33
College	30.41

Table 25. **Maximum hourly contribution to the background immission generated by the current Takhiatash CCPP in the scenario 1**

As we dispose of the real air quality measured in air quality station #5 and #7 and also we have simulated the contribution of the current operation of the TPP to these air quality stations, we can calculate the percentage of this contribution.

CONTRIBUTION OF THE EXISTING TPP TO THE AIR QUALITY STATIONS				
Air quality station	Measurement (2012) (μgm^{-3})		Model result in Scenario 1 (existing TPP) (μgm^{-3})	Contribution of the existing TPP to air quality stations (%)
# 5	NO2			
	-annual	20.53	0.06	0.29
	-monthly	24.49	0.15	0.61
	-daily	30	1.07	3.56
	-hourly	50	21.35	68.83
	NO			
	-annual	10.92	0.01	0.09
	-monthly	14.72	0.02	0.13
	-daily	80	0.17	0.21
# 7	NO2			
	-annual	20.48	0.09	0.44
	-monthly	24.36	0.18	0.74
	-daily	33.33	1.49	4.47
	-hourly	40	13.72	53.6
	CO			
	-monthly	2506.67	0.01	0.0004
	-daily	3333.33	0.08	0.0024

Table 26. **Contribution of the current operation of the TPP to the air quality stations**

The contribution of the operation of the existing units of the TPP for annual, monthly and daily averages is not very significant. Nevertheless, for short periods (hourly results) the contribution can rise up to 69%. For NO the contribution is almost no perceptible and for CO is insignificant.

B) Scenario 2: Future situation (V, VI and new CCPU units) contribution to daily, monthly and annual maximum immission levels

The following tables display modeling results separately take into account contribution as a result of operation by the future plant to daily, monthly and annual maximum immission levels, where applicable, recorded in the area under survey.

ANNUAL MAXIMUM IMMISSION MODELLING		
	NO_2 (µgm^{-3})	NO (µgm^{-3})
National Standards for Air Pollutants	40	60
World Bank Group IFC Guidelines 2007	40	
Maximum of the area of study	1.58	0.76
AIR QUALITY MONITORING STATIONS		
# 5	0.05	0.02
# 7	0.07	0.02
SENSITIVE AREAS		
Secondary School	0.25	0.09
Kindergarten	0.25	0.09
City Hospital	0.25	0.09
College	0.22	0.08

Table 27. **Maximum annual contribution to the background immission generated by the new Takhiatash CCPP in the scenario 2**

MONTH MAXIMUM IMMISSION MODELLING			
	NO_2 (µgm^{-3})	NO (µgm^{-3})	CO (µgm^{-3})
National Standards for Air Pollutants	50	120	3500
Maximum of the area of study	3.61	1.74	0.76
AIR QUALITY MONITORING STATIONS			
# 5	0.11	0.04	0.02
# 7	0.13	0.04	0.02
SENSITIVE AREAS			
Secondary School	0.47	0.16	0.06
Kindergarten	0.53	0.19	0.08
City Hospital	0.51	0.19	0.08
College	0.48	0.17	0.07

Table 28. **Maximum monthly contribution to the background immission generated by the new Takhiatash CCPP in the scenario 2.**

DAILY MAXIMUM IMMISSION MODELLING			
	NO_2 (μgm^{-3})	NO (μgm^{-3})	CO (μgm^{-3})
National Standards for Air Pollutants	60	250	4000
Maximum of the area of study	9.55	4.73	2.08
AIR QUALITY MONITORING STATIONS			
# 5	0.78	0.29	0.12
# 7	1.09	0.34	0.14
SENSITIVE AREAS			
Secondary School	3.02	1.21	0.51
Kindergarten	3.82	1.48	0.62
City Hospital	4.00	1.56	0.65
College	3.73	1.39	0.58

Table 29. **Maximum daily contribution to the background immission generated by the new Takhiatash CCPP in the scenario 2**

HOURLY MAXIMUM IMMISSION MODELLING	
	NO_2 (μgm^{-3})
World Bank Group IFC Guidelines 2007	200
Maximum of the area of study	46.74
AIR QUALITY MONITORING STATIONS	
# 5	15.51
# 7	10.24
SENSITIVE AREAS	
Secondary School	21.30
Kindergarten	20.00
City Hospital	21.50
College	20.89

Table 30. **Maximum hourly contribution to the background immission generated by the current Takhiatash CCPP in the scenario 2.**

As can be seen from the above tables, no air quality limit value will be exceeded in any air quality monitoring station or in any sensitive zone as a result of operating in the current and future scenarios.

7.2. Geographical distribution of immission levels

On the basis of the modelling, maps have been created showing daily, monthly and annual maximum immission levels for NO2, NO and CO. Appendix I bring together these data and in appendix II bring also together tables with the 50 maximum immission values for each scenario.

Examination of the maps leads to the conclusion that atmospheric pollution dispersion mainly occur as in the south-south-west direction. This diffusion direction is prevalent both in monthly and annual results. This means that the dispersion plume of the TPP operation affects the Turkmen side but, as the results conclude that the air quality is being improved and this is a positive environmental impact, not specific actions should be taken into account.

8. Comparing scenario 1 and scenario 2 immission values

Future immission levels will be the result of replacing old units III and IV with a new CCPU.

The following tables display, for each station/sensitive areas and for each pollutant, the air quality values in the scenario 1 and scenario 2 modeling results and finally, the immission increase that the changes will represent.

ANNUAL MAXIMUM IMMISSION FOR NO2 (μgm-3)			
Stations and Sensitive areas	Scenario 1	Scenario 2 (60 m)	Difference in %
# 5	0.06	0.05	-37
# 7	0.09	0.07	-38
Secondary School	0.34	0.25	-40
Kindergarten	0.35	0.25	-40
City Hospital	0.34	0.24	-39
College	0.31	0.22	-39
MONTLHY MAXIMUM IMMISSION FOR NO2 (μgm-3)			
Stations and Sensitive areas	Scenario 1	Scenario 2 (60 m)	Difference in %
# 5	0.15	0.11	-39
# 7	0.18	0.13	-36
Secondary School	0.65	0.47	-39
Kindergarten	0.73	0.53	-38
City Hospital	0.69	0.51	-34
College	0.65	0.48	-34
DAILY MAXIMUM IMMISSION FOR NO2 (μgm-3)			
Stations and Sensitive areas	Scenario 1	Scenario 2 (60 m)	Difference in %
# 5	1.07	0.78	-37
# 7	1.49	1.09	-36
Secondary School	4.35	3.02	-43
Kindergarten	5.57	3.82	-45
City Hospital	5.33	4.00	-33
College	4.99	3.73	-33
HOURLY MAXIMUM IMMISSION FOR NO2 (μgm-3)			

Stations and Sensitive areas	Scenario 1	Scenario 2 (60 m)	Differenc e in %
# 5	21.35	15.51	-37
# 7	13.72	10.24	-34
Secondary School	29.22	21.30	-37
Kindergarten	26.10	20.00	-30
City Hospital	31.33	21.50	-45
College	30.41	20.89	-45

Table 31. **Annual, monthly, daily and hourly maximum immission for NO2 μgm^{-3}**

NO2 inmissions will be decreased around 40%. Regarding NO and CO, we have to consider that the emission values included in the model for the new CCPU have been very overestimated and comparison with the existing situation (where emission values are fit to operation) would bring into not realistic conclusions.

9. Legislative analysis of the situation as forecast

In this section an analysis of the observance of the forecast levels with regard to legislation in force is undertake. Normally, to calculate the forecast level, background air quality data measured in the air quality stations is added to the simulation result at these air quality stations.

A) Scenario 1: Current situation (III, IV, V and VI units) air quality standards fulfillment

In this case, as air quality stations already take into account the contribution of the operation of the TPP and therefore, if we add the measurements of the air quality stations to the results of simulation on these stations, we are doubling the results. In paragraph 4.1. “Background air quality levels” it was concluded that the current air quality (in which the contribution due to the operation of the existing units of the TPP is included) is being fulfilled.

Nevertheless, even in the case that we would add model results with air quality measurements at the air quality stations, air quality standards would be still fulfilled as it shown in the following tables.

NO_2 (μgm^{-3})		
WORLD BANK GROUP IFC GUIDELINES 2007		
Hourly maximum value		
Station	Hourly mean limit value	PLANNED IMMISSION: Air quality (2011/2012 hourly mean maximum) + modeling (2012 hourly mean maximum)
# 5	200.00	50.00 + 21.35 = 71.35
# 7		50.00 + 13.72 = 63.72
National standards for air pollutants		
Daily maximum value		
Station	Daily mean limit value	PLANNED IMMISSION: Air quality (2011/2012 daily mean maximum) + modeling (2012

NO_2 (μgm^{-3})		
		daily mean maximum)
# 5	60.00	36.67 + 1.07 = 37.74
# 7		36.67 + 1.49 = 38.16
National standards for air pollutants		
Monthly maximum value		
Station	Monthly mean limit value	PLANNED IMMISSION: Air quality (2011/2012 monthly mean maximum) + modeling (2012 monthly mean maximum)
# 5	50.00	29.36 + 0.15 = 29.51
# 7		29.07 + 0.18 = 29.25
National standards for air pollutants and WORLD BANK GROUP IFC GUIDELINES 2007		
Annual maximum value		
Station	Annual mean limit value	PLANNED IMMISSION: Air quality (2011/2012 annual mean maximum) + modeling (2012 annual mean maximum)
# 5	40.00	24.25 + 0.06 = 24.31
# 7		24.28 + 0.09 = 24.37

Table 32. **Air quality reference limit values for NO2 (National standards for air pollutants) for scenario 1**

NO (μgm^{-3})		
National standards for air pollutants		
Daily maximum value		
Station	Daily mean limit value	PLANNED IMMISSION: Air quality (2011/2012 daily mean maximum) + modeling (2012 daily mean maximum)
# 5	250.00	80.00 + 0.17 = 80.17
National standards for air pollutants		
Monthly maximum value		
Station	Monthly mean limit value	PLANNED IMMISSION: Air quality (2011/2012 monthly mean maximum) + modeling (2012 monthly mean maximum)
# 5	120.00	16.54 + 0.02 = 16.56
National standards for air pollutants		
Annual maximum value		
Station	Annual mean limit value	PLANNED IMMISSION: Air quality (2011/2012 annual mean

NO (μgm^{-3})		
		maximum) + modeling (2012 annual mean maximum)
# 5	60.00	12.84 + 0.01 = 12.85

Table 33. **Air quality reference limit values for NO (National standards for air pollutants) for scenario 1.**

CO (μgm^{-3})		
National standards for air pollutants		
Daily maximum value		
Station	Daily mean limit value	PLANNED IMMISSION: Air quality (2011/2012 daily mean maximum) + modeling (2012 daily mean maximum)
# 7	4000.00	3333.33 + 0.08 = 3333.41
National standards for air pollutants		
Monthly maximum value		
Station	Monthly mean limit value	PLANNED IMMISSION: Air quality (2011/2012 monthly mean maximum) + modeling (2012 monthly mean maximum)
# 7	3500.00	2506.67 + 0.01 = 2506.68

Table 34. **Air quality reference limit values for CO (National standards for air pollutants) for scenario 1.**

B) Scenario 2: Future situation (V, VI and future CCPU units) air quality standards fulfillment

In this case, air quality stations measurements already take into account the contribution of the operation of the remaining units (units V and VI). Therefore, if we add the measurements of the air quality stations to the results of simulation on these stations we are doubling the results.

On the other hand, air quality station measurements include the contribution of the units that are going to be decommissioned (units III and IV). Therefore, the air quality measurements that we add to the results of the simulation will be higher than the future air quality. As a result of the two previous facts, forecast results are being overestimated. If these overestimated results are under the air quality standards, the real future situation would be even more far below. The following tables show the future situation air quality standards fulfillment in all pollutants.

NO$_2$ (μgm^{-3})		
WORLD BANK GROUP IFC GUIDELINES 2007		
Hourly maximum value		
Station	Hourly mean limit value	PLANNED IMMISSION: Air quality (2011/2012 hourly mean maximum) + modeling (2012 hourly mean maximum)
# 5	200.00	50.00 + 15.51 = 65.51
# 7		50.00 + 10.24 = 60.24
National standards for air pollutants		
Daily maximum value		
Station	Daily mean limit value	PLANNED IMMISSION: Air quality (2011/2012 daily mean maximum) + modeling (2012 daily mean maximum)
# 5	60.00	36.67 + 0.77 = 37.44
# 7		36.67 + 1.09 = 37.76
National standards for air pollutants		
Monthly maximum value		
Station	Monthly mean limit value	PLANNED IMMISSION: Air quality (2011/2012 monthly mean maximum) + modeling (2012 monthly mean maximum)
# 5	50.00	29.36 + 0.11 = 29.47
# 7		29.07 + 0.13 = 29.20
National standards for air pollutants and WORLD BANK GROUP IFC GUIDELINES 2007		
Annual maximum value		
Station	Annual mean limit value	PLANNED IMMISSION: Air quality (2011/2012 annual mean maximum) + modeling (2012 annual mean maximum)
# 5	40.00	24.25 + 0.05 = 24.30
# 7		24.28 + 0.07 = 24.35

Table 35. **Air quality reference limit values for NO2 (National standards for air pollutants) for scenario 2**

NO (μgm^{-3})		
National standards for air pollutants		
Daily maximum value		
Station	Daily mean limit value	PLANNED IMMISSION: Air quality (2011/2012 daily mean maximum) + modeling (2012 daily mean maximum)
# 5	250.00	80.00 + 0.12 = 80.12
National standards for air pollutants		
Monthly maximum value		
Station	Monthly mean limit value	PLANNED IMMISSION: Air quality (2011/2012 monthly mean maximum) + modeling (2012 monthly mean maximum)
# 5	120.00	16.54 + 0.02 = 16.56
National standards for air pollutants		
Annual maximum value		
Station	Annual mean limit value	PLANNED IMMISSION: Air quality (2011/2012 annual mean maximum) + modeling (2012 annual mean maximum)
# 5	60.00	12.84 + 0.02 = 12.86

Table 36. **Air quality reference limit values for NO2 (National standards for air pollutants) for scenario 2**

CO (μgm^{-3})		
National standards for air pollutants		
Daily maximum value		
Station	Daily mean limit value	PLANNED IMMISSION: Air quality (2011/2012 daily mean maximum) + modeling (2012 daily mean maximum)
# 7	4000.00	3333.33 + 0.14 = 3333.47
National standards for air pollutants		
Monthly maximum value		
Station	Monthly mean limit value	PLANNED IMMISSION: Air quality (2011/2012 monthly mean maximum) + modeling (2012 monthly mean maximum)
# 7	3500.00	2506.67 + 0.02 = 2506.69

Table 37. **Air quality reference limit values for NO2 (National standards for air pollutants) for scenario 2.**

10. Findings

Modeling of the dispersion of pollutants by AERMOD model has allowed study the contribution of different emissions on current and future scenario of the TPP located in the south of Takhiatash on levels of air quality in the region.

The aim of the study was to analyse the effect of two scenarios (scenario 1 (current existing units III, IV, V and VI) and scenario 2 (current units V and VI and the new CCPU)) on levels of CO, NO and NO2. SO2 and particulate matter are practically not emitted by the combustion of natural gas. For the scenario 2 the aim of the study was also to determine the optimum stack height for the new CCPU.

The simultaneous operation of blocks III, IV, V and VI and the new unit could be possible, however, taking into account the limited transmission capacity and the fact that at present the maximum demand being supplied by the TPP is about 550 MW, all these facilities would not be able to operate at full load simultaneously. Any possible combination of units at different levels of load with a maximum total output of 730 MW would produce in any case a lower level of emissions than those corresponding to the Scenario 1, because some of the current capacity of the units III and IV would be substituted by the same amount of power being generated by the combined cycle unit, with a much higher level of efficiency, thus releasing a lower amount of contaminants.

Within these two scenarios, worst case input data has been considered for the simulation:

- Continuous operation with a 100% load
- For the existing units, Maximum Allowed Emissions (MAE), which are the emission standards to be fulfilled in the operation of the TPP, have been taking into account as the emission concentration for the simulation. For the future CCPU, emission concentration levels for the simulation have been defined in compliance World Bank IFC EHS guidelines for Thermal Power

Plants IFC Guidelines (December 2008): NO_x emission standard has been took for the NO2 emission value for simulation. This is a very stringent hypothesis as NOx emitted is basically composed both of NO2 and NO. On top of that, an 84% of NOx has been considered to be emitted as NO but, as we are taking all the NO2 as NOx, NO is overestimated also. In this way, we can guarantee than the considered emission values to simulate are the highest possible. For CO, a very conservative bibliographic data has been considered.

Regarding air quality baseline, data of years 2011 and 2012 from two air quality stations within the area of study have been analyzed.

In order to analyze if the air quality limits are being fulfilled, the results of the simulation in the air quality stations is added to the air quality measurements in these stations. The results show that in neither case immissions from the scenarios exceed air quality limits established in National Standards for Air Pollutants and the World Bank Group IFC guidelines 2007 even taking into account that:

- For Scenario 1 (current stage), air quality stations already take into account the contribution of the operation of the TPP and therefore, if we add the measurements of the air quality stations to the results of simulation on these stations, we are doubling the results. In any case, the current air quality (in which the contribution due to the operation of the existing units of the TPP is included) is being fulfilled.

- **For Scenario 2 (future stage), air quality stations measurements already take into account the contribution of the operation of the remaining units (units V and VI). Therefore, if we add the measurements of the air quality stations to the results of simulation on these stations we are doubling the results. On the other hand, air quality station measurements include the contribution of the units that are going to be decommissioned (units III and IV). Therefore, the air quality measurements that we add to the results of the simulation will be higher than the future air quality. As a result of the two previous facts, forecast results are being overestimated.**

Regarding the modeling immission values:

- For scenario 1 has been observed annual maximum values of 2.02 μgm^{-3} NO2 and 0.33 μgm^{-3} NO (national and World Bank limit 40 and national limit 60 μgm^{-3} correspondingly) ; for monthly values has been observed that maximum contribution to the levels of the NO2 is about 4.71 μgm^{-3} (national limit 50 μgm^{-3}), 0.77 μgm^{-3} (national limit 120 μgm^{-3}) for NO and 0.27 μgm^{-3} (national limit 3550 μgm^{-3}) for CO. In the case of daily results, maximum values of 12.54 μgm^{-3} (national limit 60 μgm^{-3}) has been observed for NO2, 2.04 μgm^{-3} (national limit 250 μgm^{-3}) for NO and 0.72 μgm^{-3} (national limit 4000 μgm^{-3}) for CO. The maximum hourly value observed for NO2 has been 61.64 μgm^{-3} (World Bank limit 200 μgm^{-3}). In any case, results are away from the limit legislated.

- For scenario 2 it has obtained similar values, all far below the limits legislation. For example, 1.58 μgm^{-3} NO2 and 0.76 μgm^{-3} NO (national and World Bank limit 40 and national limit 60 μgm^{-3} correspondingly) has been obtained for annual maximum values. For monthly results 3.61 μgm^{-3} (national limit 50 μgm^{-3}) has been observed as a maximum value of NO2, 1.74 μgm^{-3} (national limit 120 μgm^{-3}) of NO and 0.76 μgm^{-3} (national limit 3550 μgm^{-3}) of CO. In the case of NO2 has been observed 9.55 μgm^{-3} (national limit 60 μgm^{-3}) for daily maximum values, 4.73 μgm^{-3} (national limit 250 μgm^{-3}) NO and 2.08 μgm^{-3} (national limit 4000 μgm^{-3}) CO. Finally, 46.74 μgm^{-3} of NO2 (World Bank limit 200 μgm^{-3})has been obtained for hourly values.

As we dispose of the real air quality measured in air quality stations and also we have simulated the contribution of the current operation of the TPP to these air quality station, we can calculate the percentage of this contribution. This contribution for annual, monthly and daily averages is not very significant. Nevertheless, for short periods (hourly results) the contribution can rise up to 69%. For NO the contribution is almost no perceptible and for CO is insignificant.

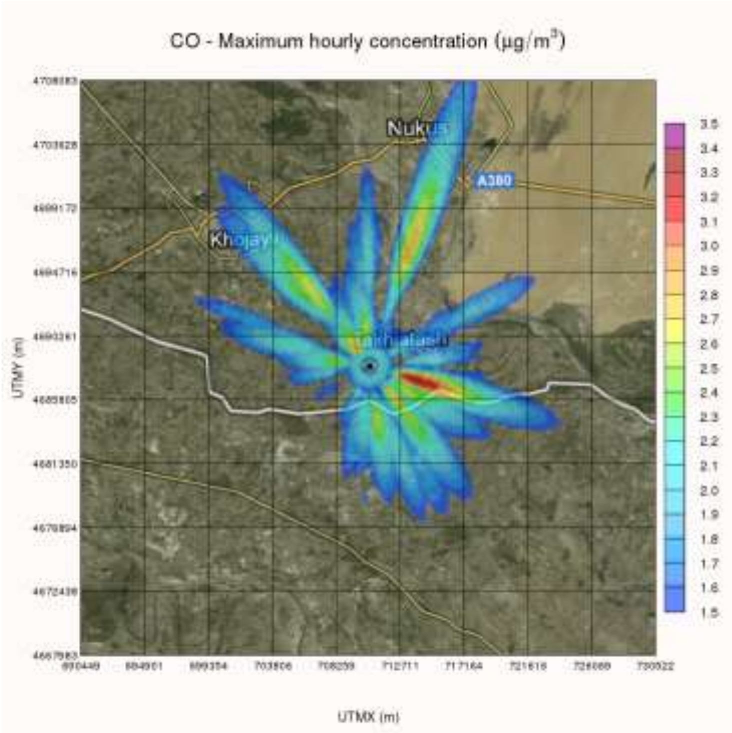
Comparing contribution to air quality baseline between the current and future stages, it can be concluded that NO2 inmissions will be decreased around 40%. Regarding NO and CO, we have to consider that the emission values included in the model for the new CCPU have been very overestimated and comparison with the existing situation (where emission values are fit to operation) would bring into not realistic conclusions.

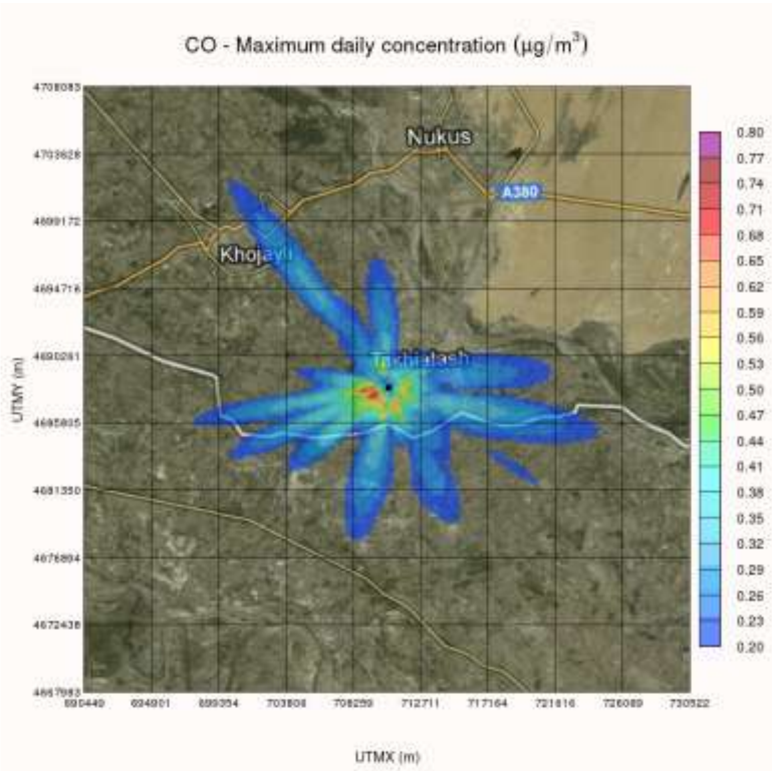
Examination of the simulation maps leads to the conclusion that atmospheric pollution dispersion mainly occur as in the south-south-west direction. This diffusion direction is prevalent both in monthly and annual results. This means that the dispersion plume of the TPP operation affects the Turkmen side but, as the results conclude that the air quality is being improved and this is a positive environmental impact, not specific actions should be taken into account.

It has been calculated the optimum stack height for the new CCPU and it has been considered as an optimum stack height the 60m. Nevertheless, if we take into consideration the stack calculation based on the international practice recommended by the industry (GIIP), according to the document “Réf. US EPA: 40 CFR, partie 51.100 (ii)”, minimum height of the stack should be 112, 5 meters. In any case, with a 60 m height stack, air quality limits are fulfilled.

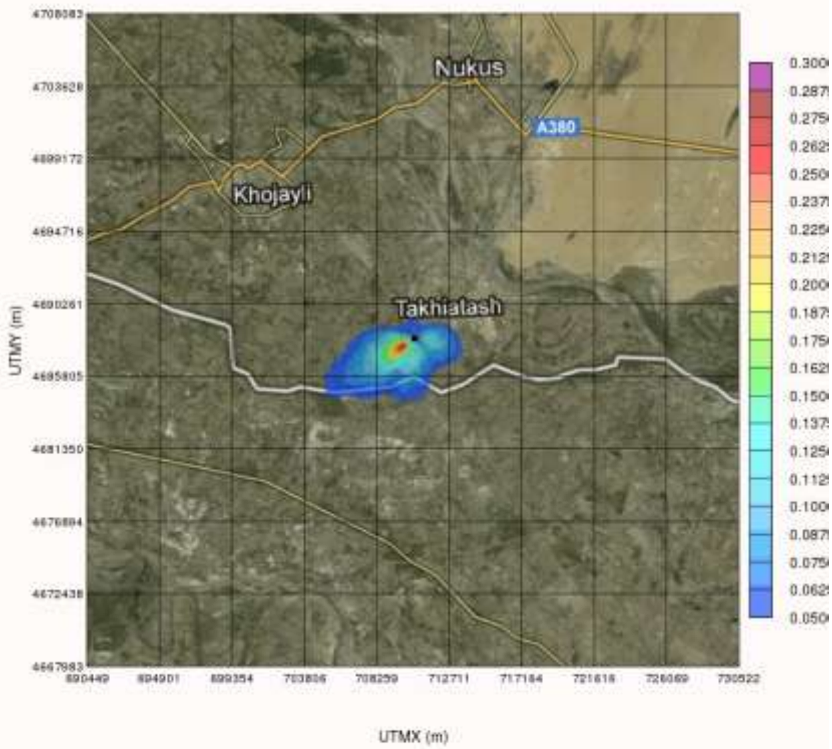
Appendix I: Modellization maps

Scenario 1

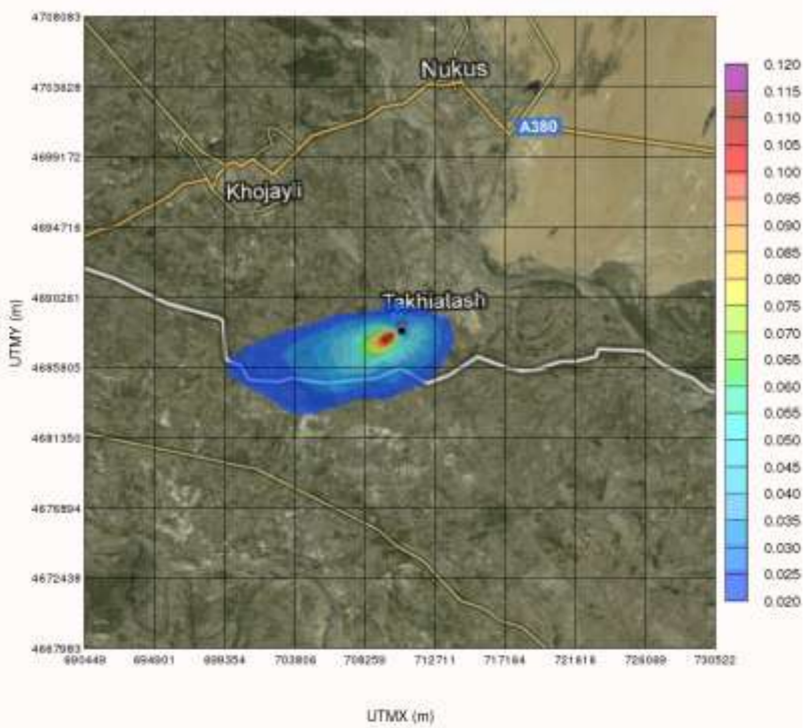

CO - Maximum hourly concentration (µg/m³)
Nukus
A380
Khojayli
Takhiatash
UTMY (m)
UTMX (m)
3.5
3.4
3.3
3.2
3.1
3.0
2.9
2.8
2.7
2.6
2.5
2.4
2.3
2.2
2.1
2.0
1.9
1.8
1.7
1.6
1.5

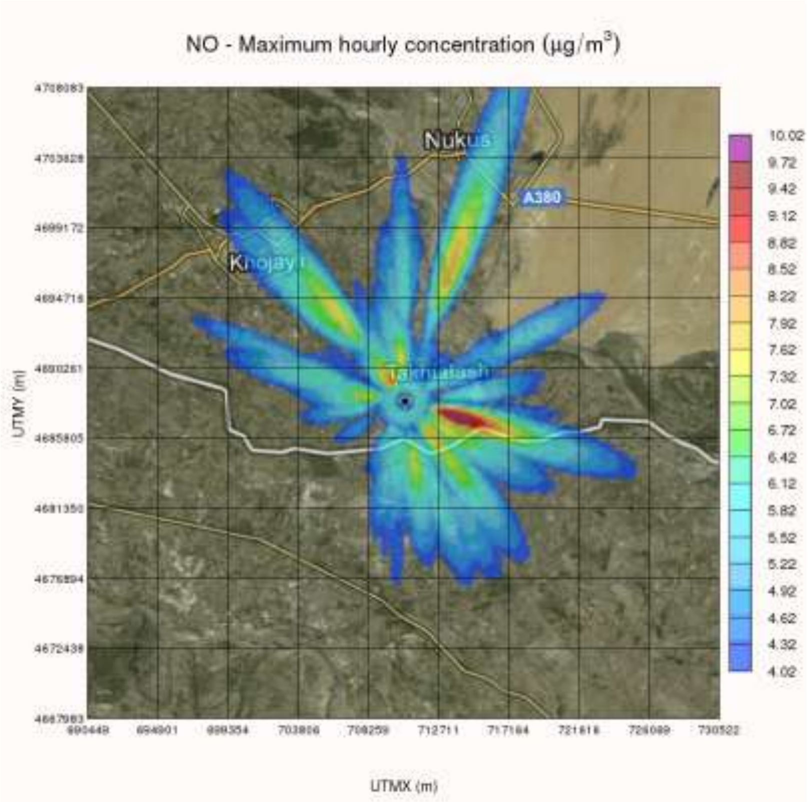

CO - Maximum daily concentration (µg/m³)
Nukus
A380
Khojayli
Takhiatash
UTMY (m)
UTMX (m)
0.80
0.77
0.74
0.71
0.68
0.65
0.62
0.59
0.56
0.53
0.50
0.47
0.44
0.41
0.38
0.35
0.32
0.29
0.26
0.23
0.20

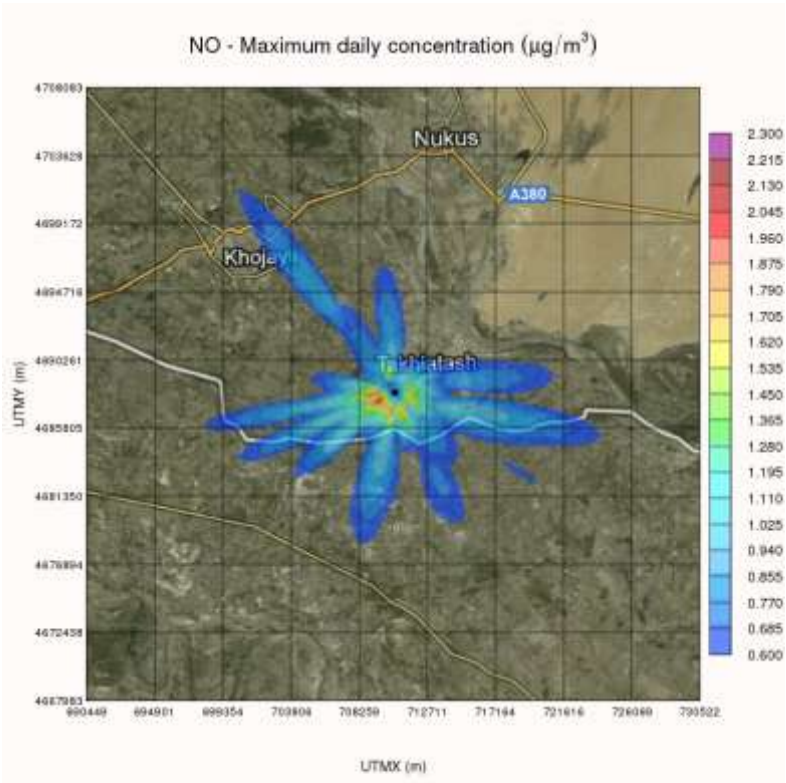
CO - Maximum monthly concentration ($\mu g/m^3$)

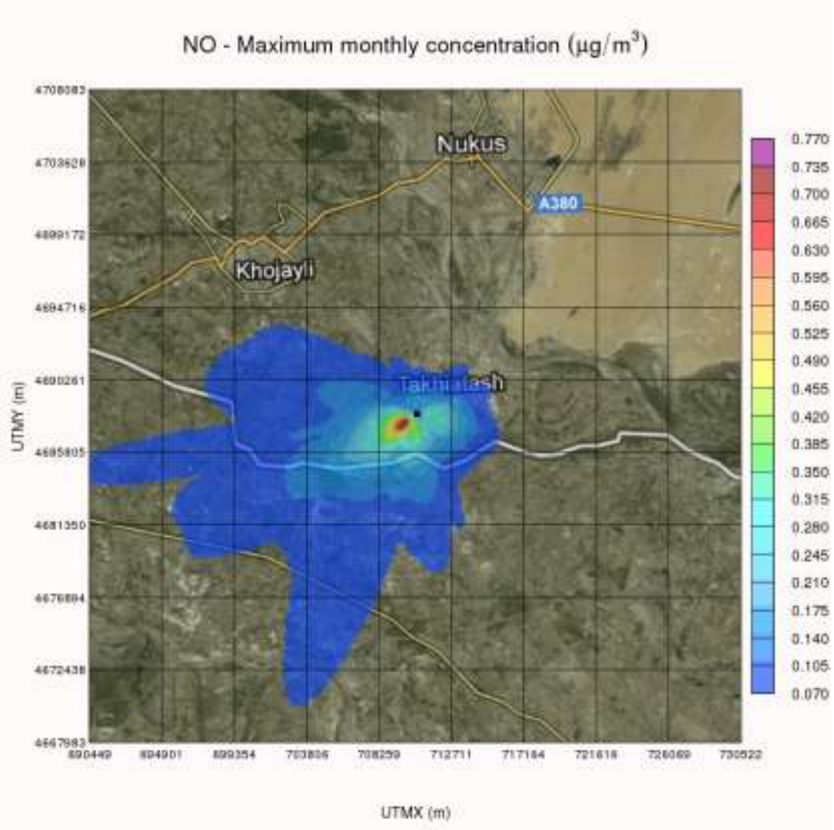


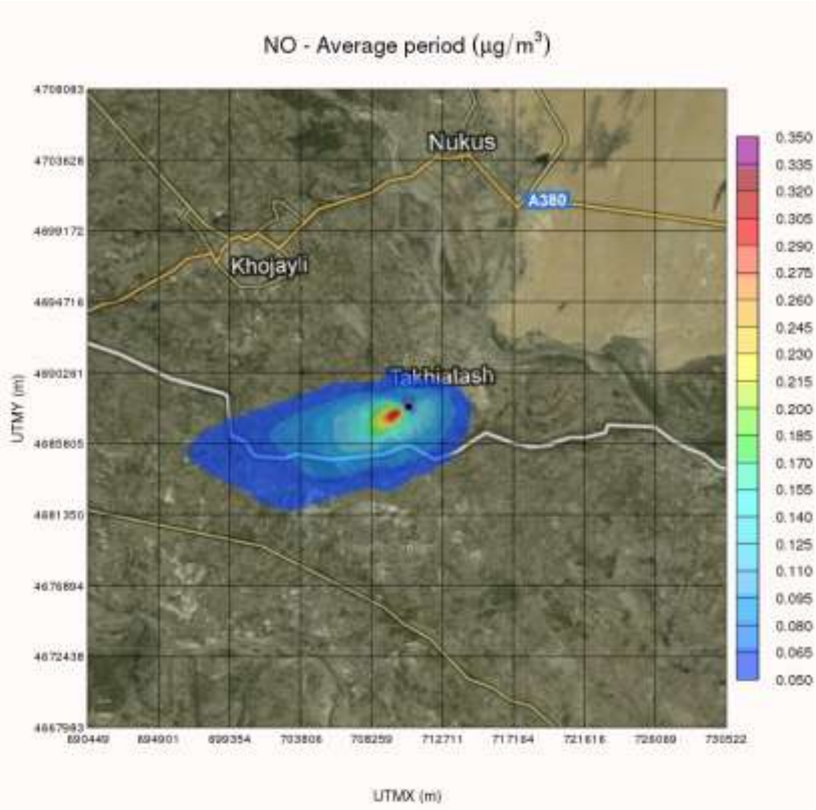
CO - Average period ($\mu g/m^3$)



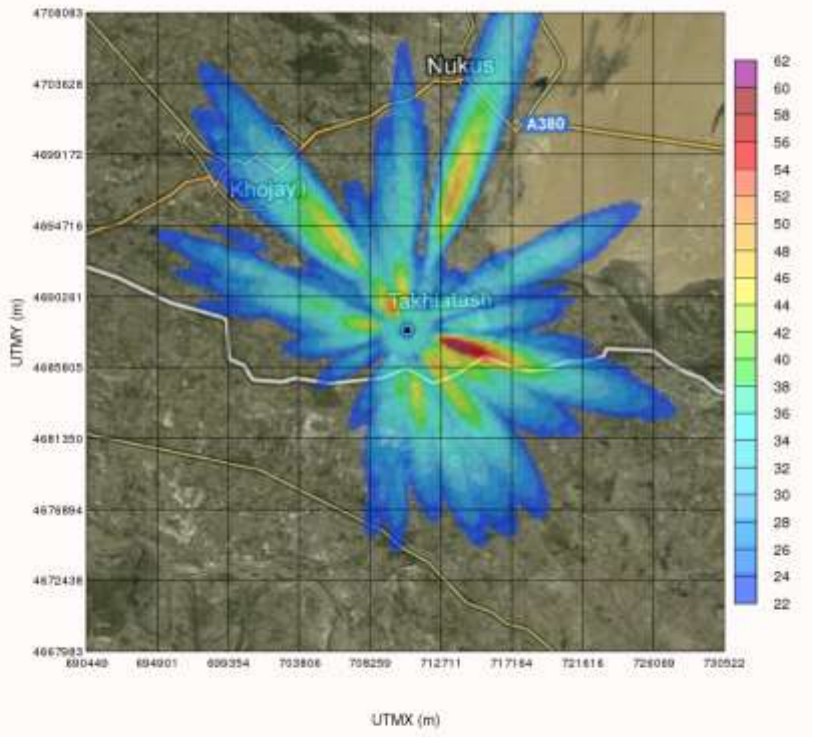

NO - Maximum hourly concentration (µg/m³)
Nukus
A380
Khojayli
Takhiatash
UTMY (m)
UTMX (m)
10.02
9.72
9.42
9.12
8.82
8.52
8.22
7.92
7.62
7.32
7.02
6.72
6.42
6.12
5.82
5.52
5.22
4.92
4.62
4.32
4.02


NO - Maximum daily concentration (µg/m³)
Nukus
A380
Khojayli
Takhiatash
UTMY (m)
UTMX (m)
2.300
2.215
2.130
2.045
1.960
1.875
1.790
1.705
1.620
1.535
1.450
1.365
1.280
1.195
1.110
1.025
0.940
0.855
0.770
0.685
0.600

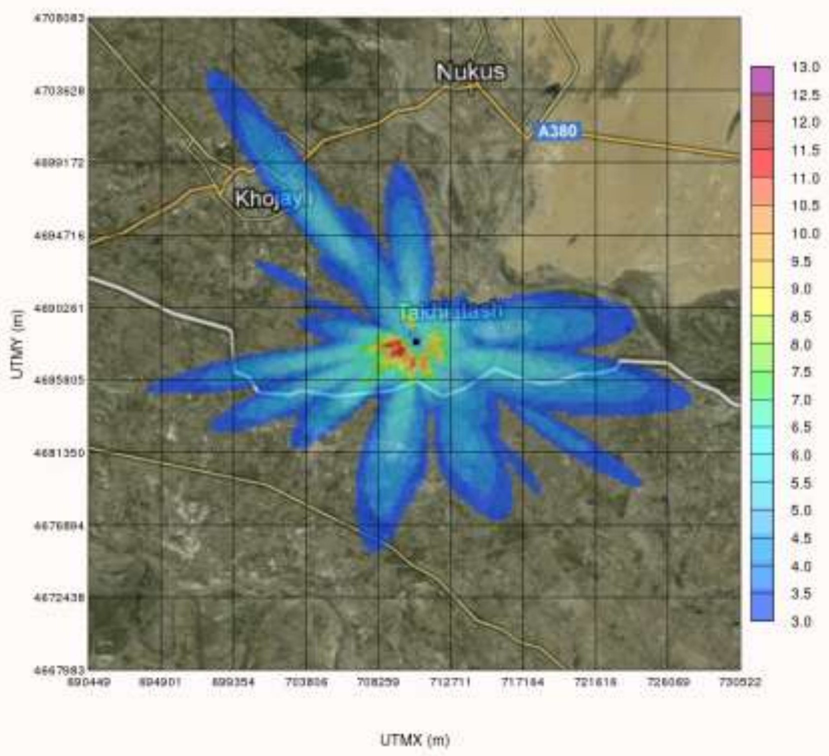

NO - Maximum monthly concentration ($\mu g/m^3$)
Nukus
A380
Khojayli
Takhiatash
UTMY (m)
UTMX (m)
0.770
0.735
0.700
0.665
0.630
0.595
0.560
0.525
0.490
0.455
0.420
0.385
0.350
0.315
0.280
0.245
0.210
0.175
0.140
0.105
0.070

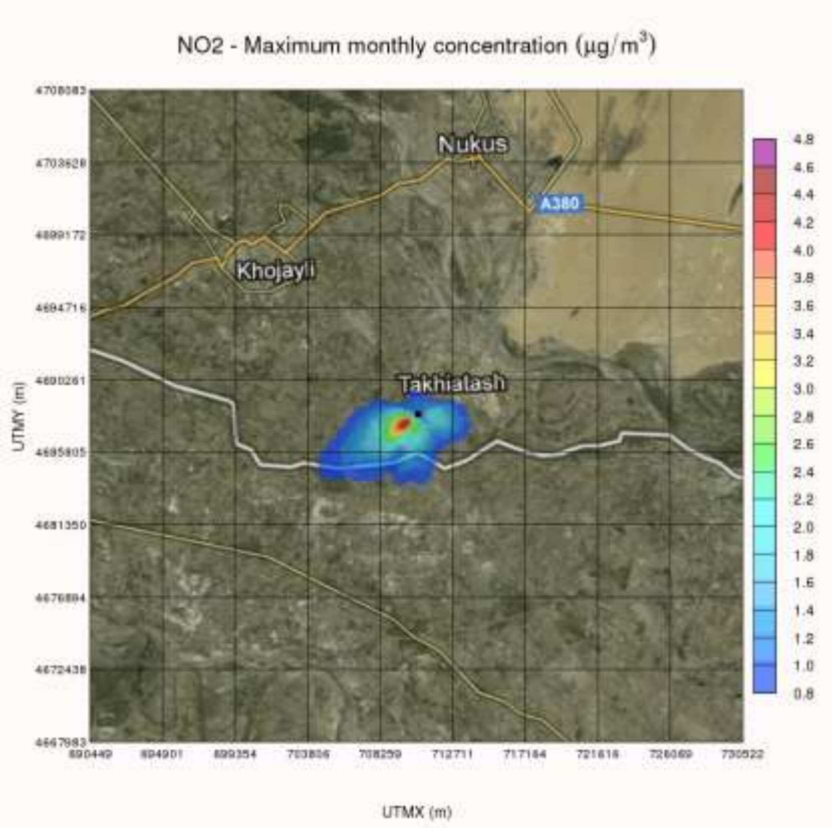

NO - Average period ($\mu g/m^3$)
Nukus
A380
Khojayli
Takhiatash
UTMY (m)
UTMX (m)
0.350
0.335
0.320
0.305
0.290
0.275
0.260
0.245
0.230
0.215
0.200
0.185
0.170
0.155
0.140
0.125
0.110
0.095
0.080
0.065
0.050

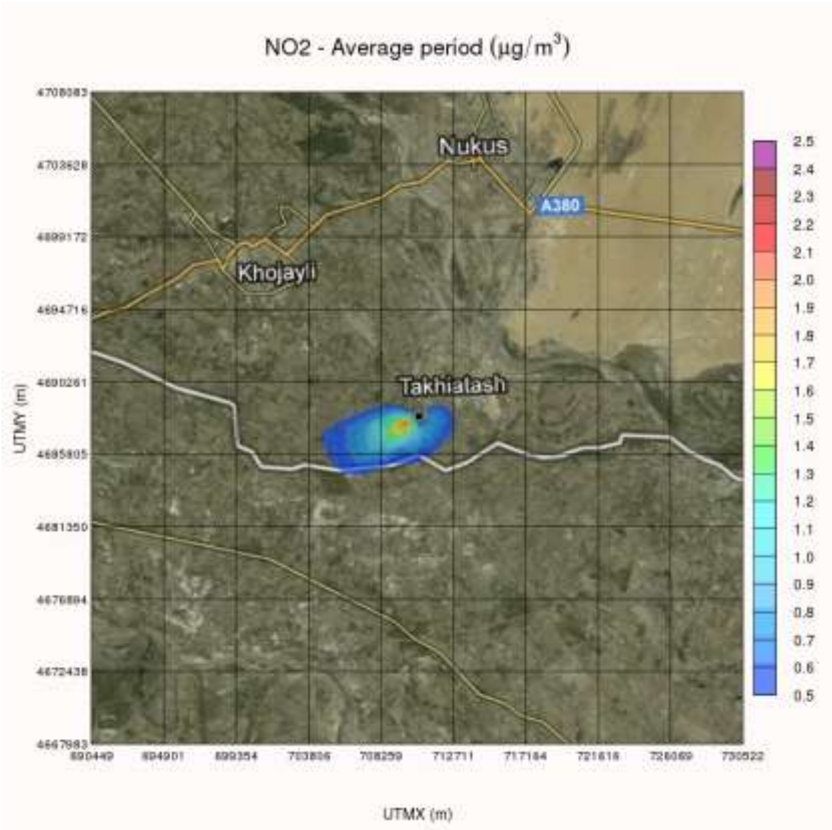
NO2 - Maximum hourly concentration ($\mu g/m^3$)



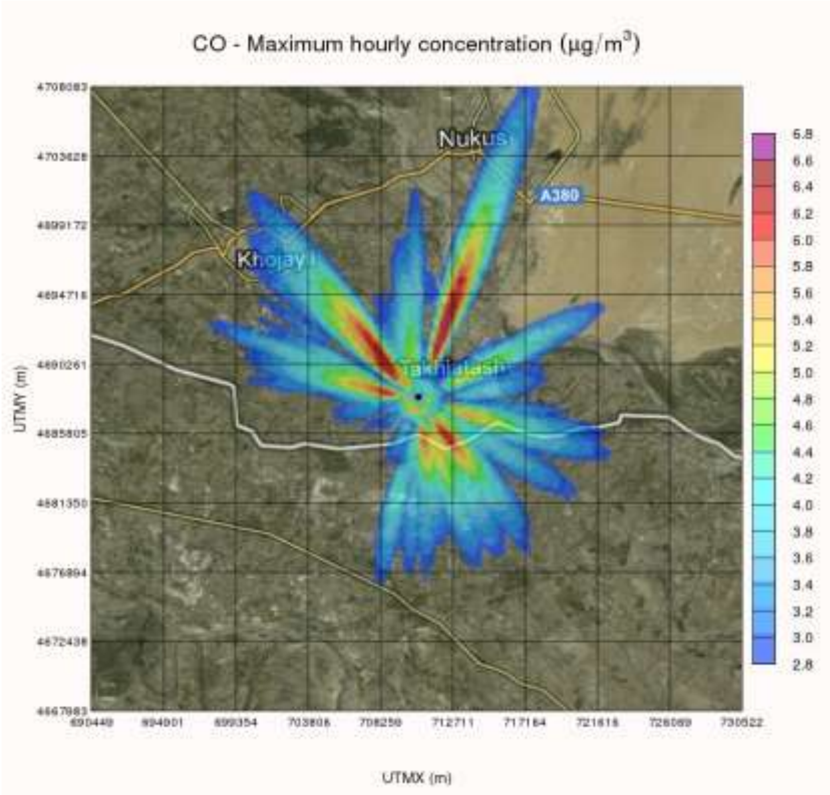
NO2 - Maximum daily concentration ($\mu g/m^3$)



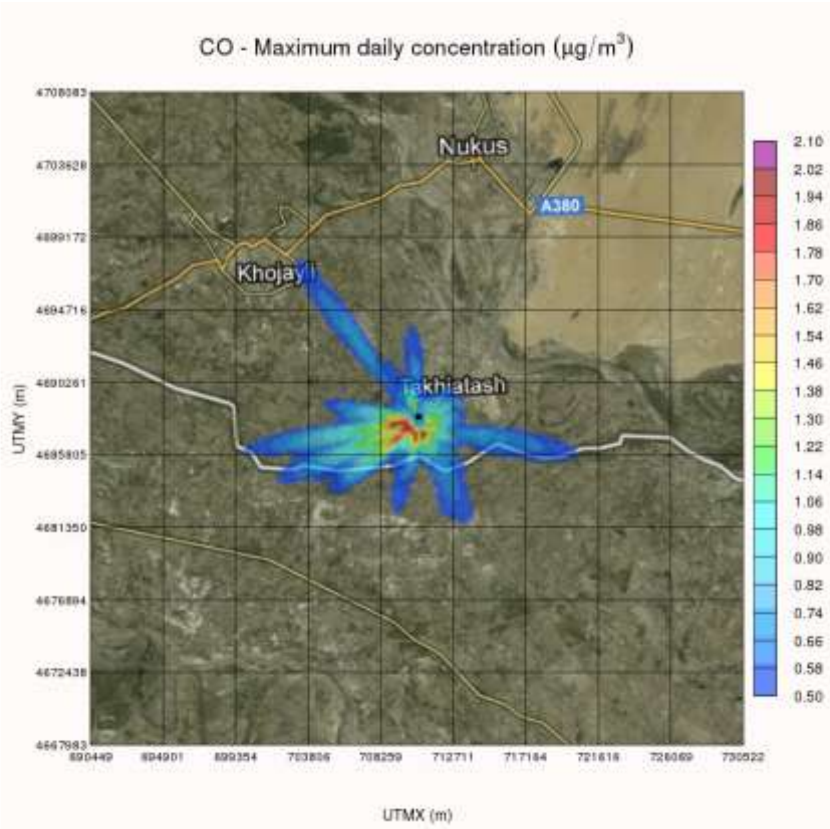

NO2 - Maximum monthly concentration ($\mu g/m^3$)
Nukus
A380
Khojayli
Takhiatash
UTMY (m)
UTMX (m)
4.8
4.6
4.4
4.2
4.0
3.8
3.6
3.4
3.2
3.0
2.8
2.6
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
0.8


NO2 - Average period ($\mu g/m^3$)
Nukus
A380
Khojayli
Takhiatash
UTMY (m)
UTMX (m)
2.5
2.4
2.3
2.2
2.1
2.0
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5

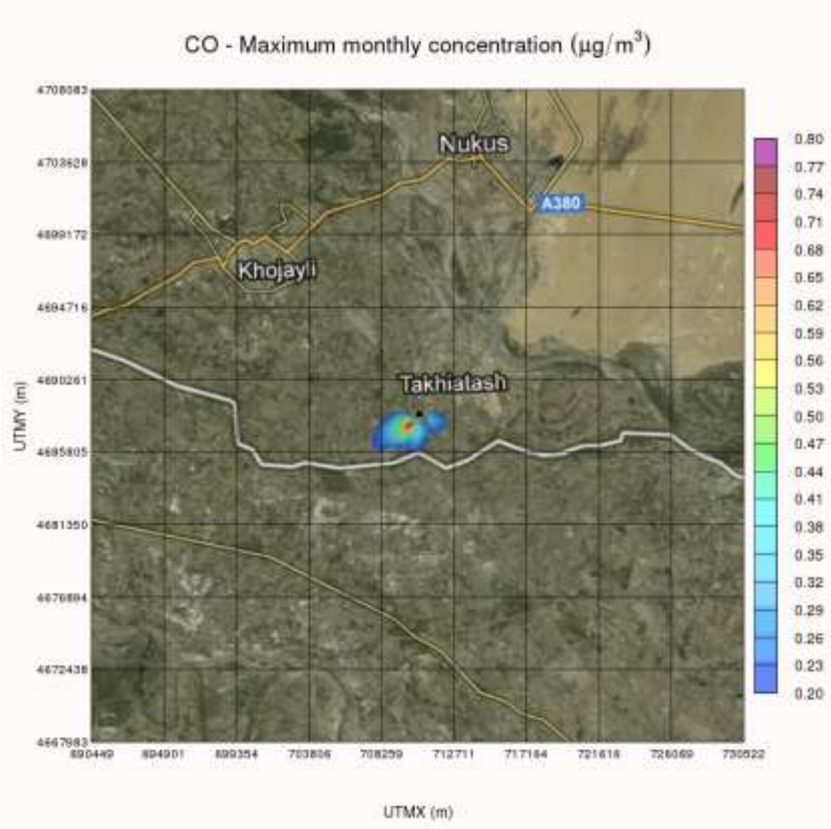
Scenario 2



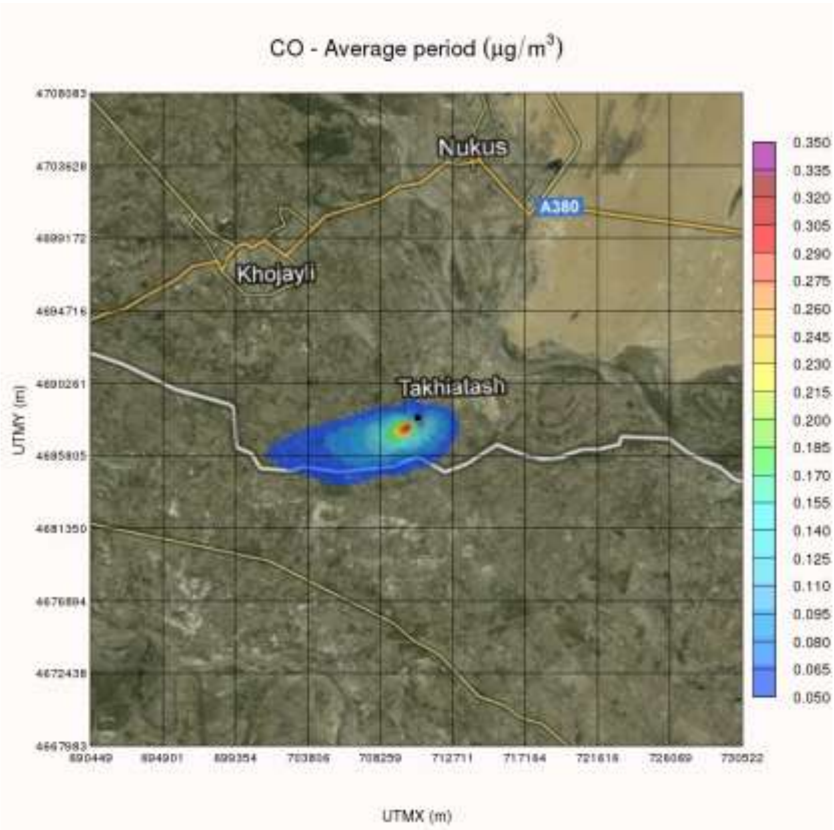
CO - Maximum hourly concentration (μg/m³)
Nukus
A380
Khojayli
Takhiatash
UTMY (m)
UTMX (m)



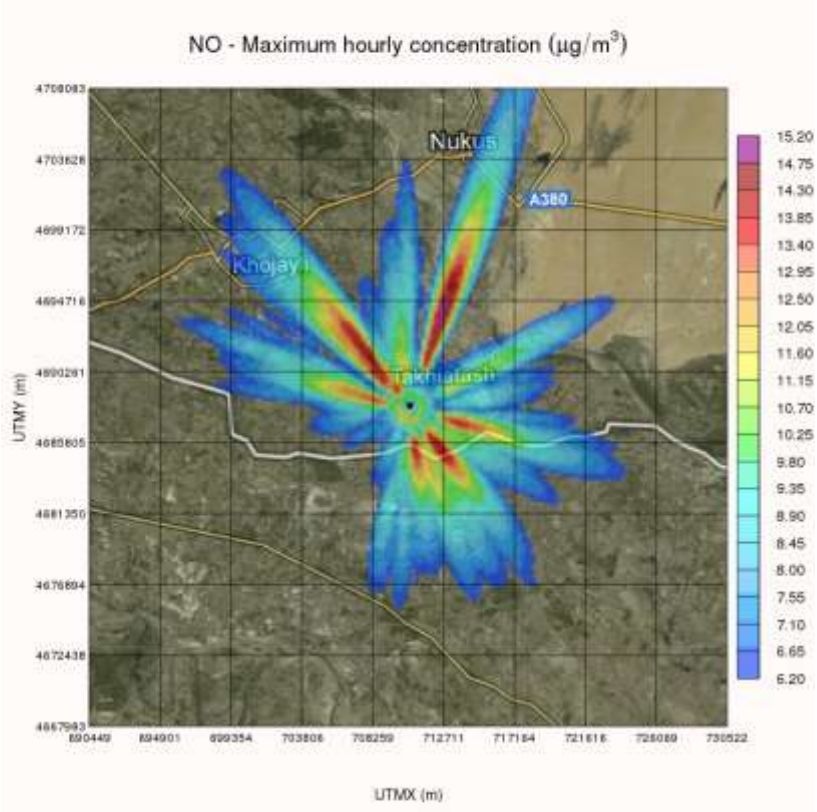
CO - Maximum daily concentration (μg/m³)
Nukus
A380
Khojayli
Takhiatash
UTMY (m)
UTMX (m)

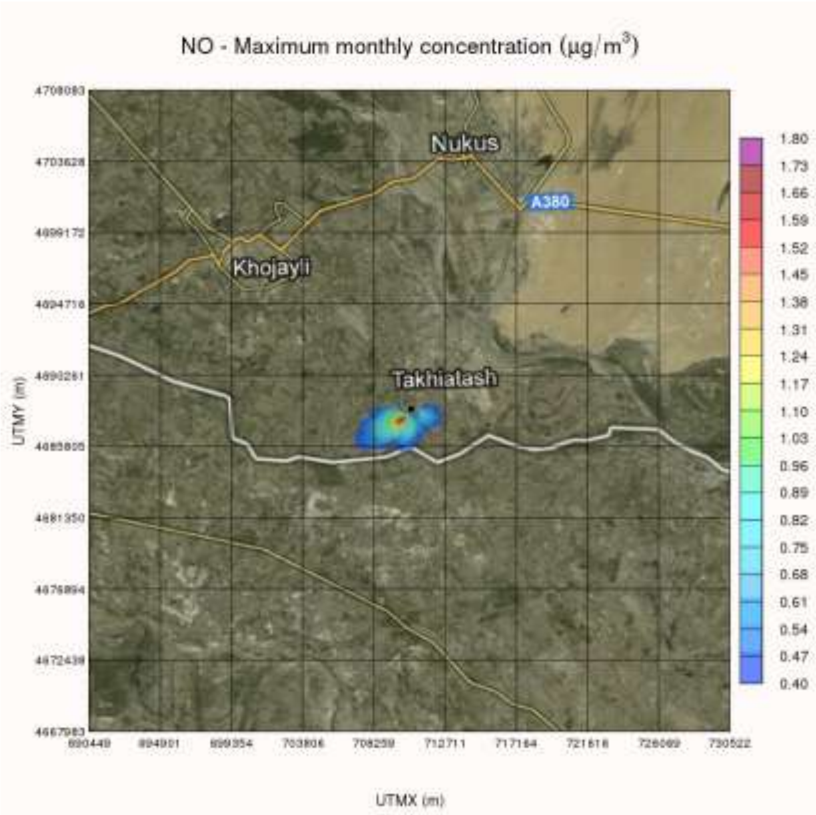


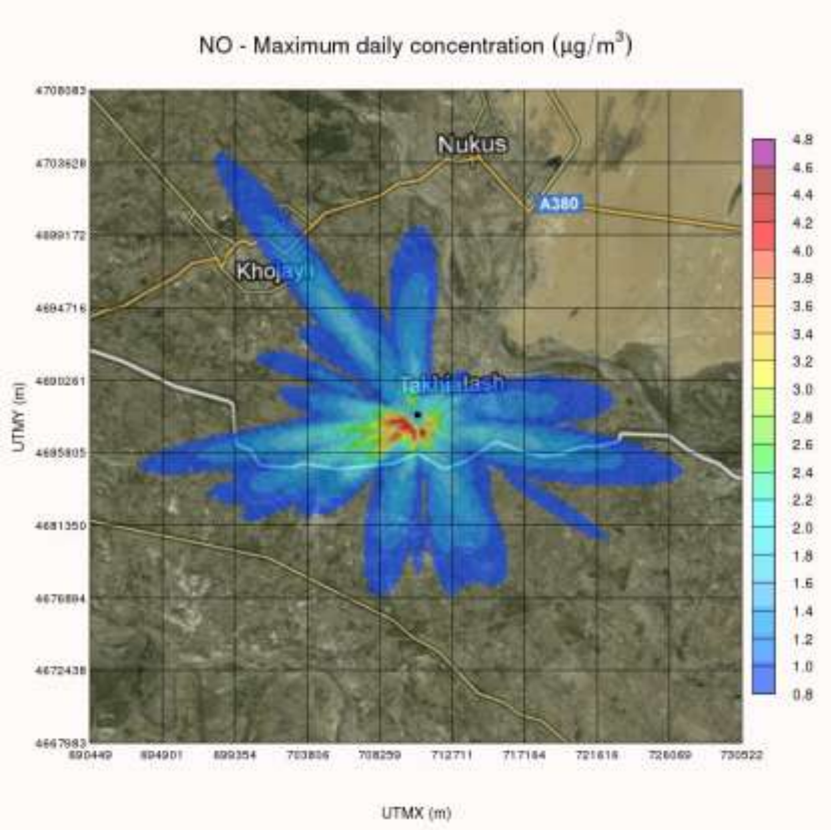
CO - Maximum monthly concentration (µg/m³)
Nukus
A380
Khojayli
Takhiatash
UTMY (m)
UTMX (m)
0.80
0.77
0.74
0.71
0.68
0.65
0.62
0.59
0.56
0.53
0.50
0.47
0.44
0.41
0.38
0.35
0.32
0.29
0.26
0.23
0.20

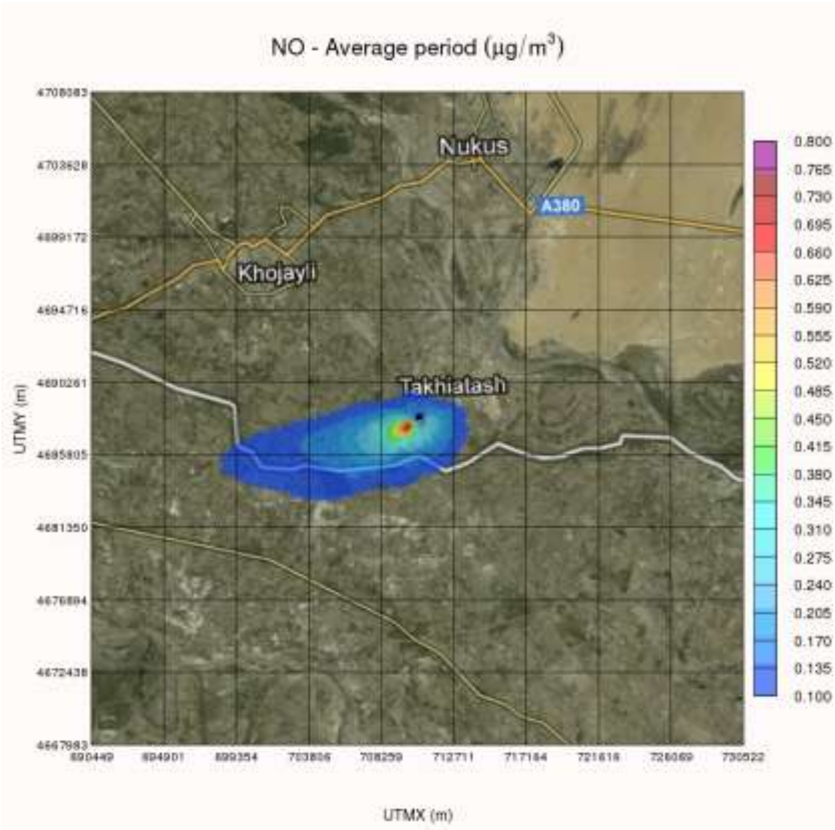


CO - Average period (µg/m³)
Nukus
A380
Khojayli
Takhiatash
UTMY (m)
UTMX (m)
0.350
0.335
0.320
0.305
0.290
0.275
0.260
0.245
0.230
0.215
0.200
0.185
0.170
0.155
0.140
0.125
0.110
0.095
0.080
0.065
0.050

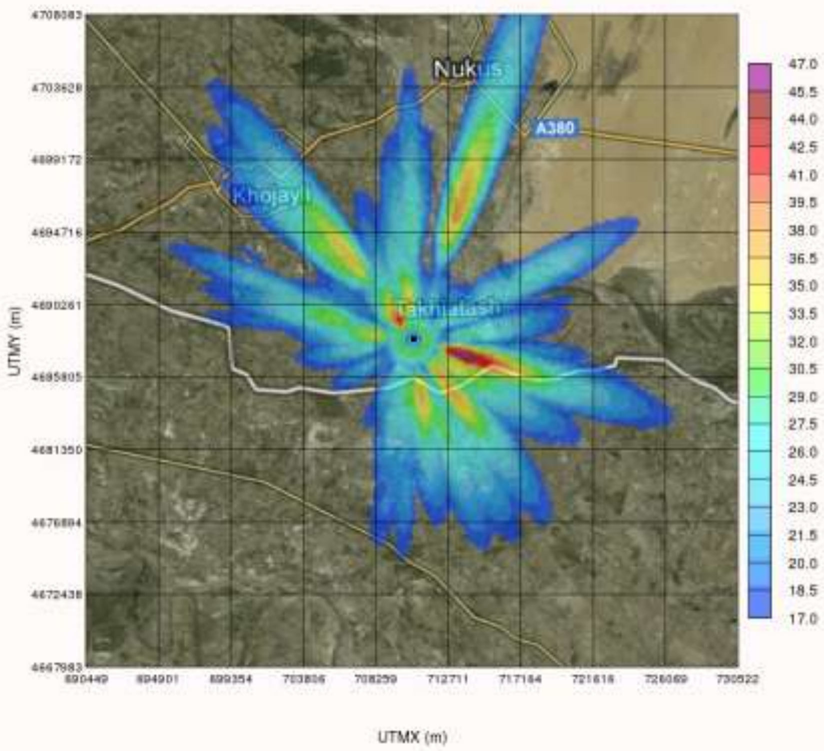

NO - Maximum hourly concentration (µg/m³)
Nukus
A380
Khojayli
Takhiatash
UTMY (m)
UTMX (m)
15.20
14.75
14.30
13.85
13.40
12.95
12.50
12.05
11.60
11.15
10.70
10.25
9.80
9.35
8.90
8.45
8.00
7.55
7.10
6.65
6.20


NO - Maximum monthly concentration (µg/m³)
Nukus
A380
Khojayli
Takhiatash
UTMY (m)
UTMX (m)
1.80
1.73
1.66
1.59
1.52
1.45
1.38
1.31
1.24
1.17
1.10
1.03
0.96
0.89
0.82
0.75
0.68
0.61
0.54
0.47
0.40

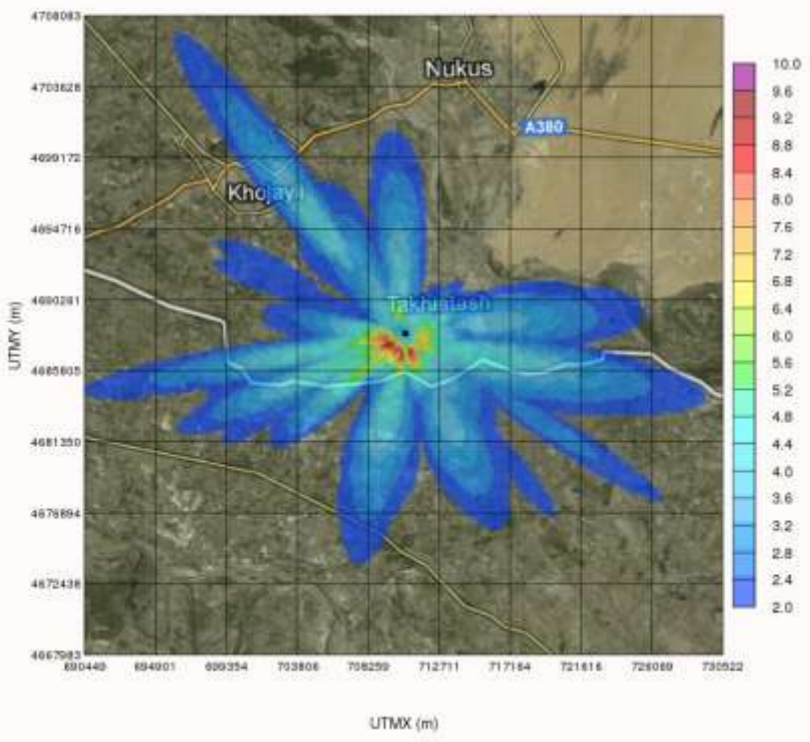

NO - Maximum daily concentration (µg/m³)
Nukus
A380
Khojayli
Takhiatash
UTMY (m)
UTMX (m)

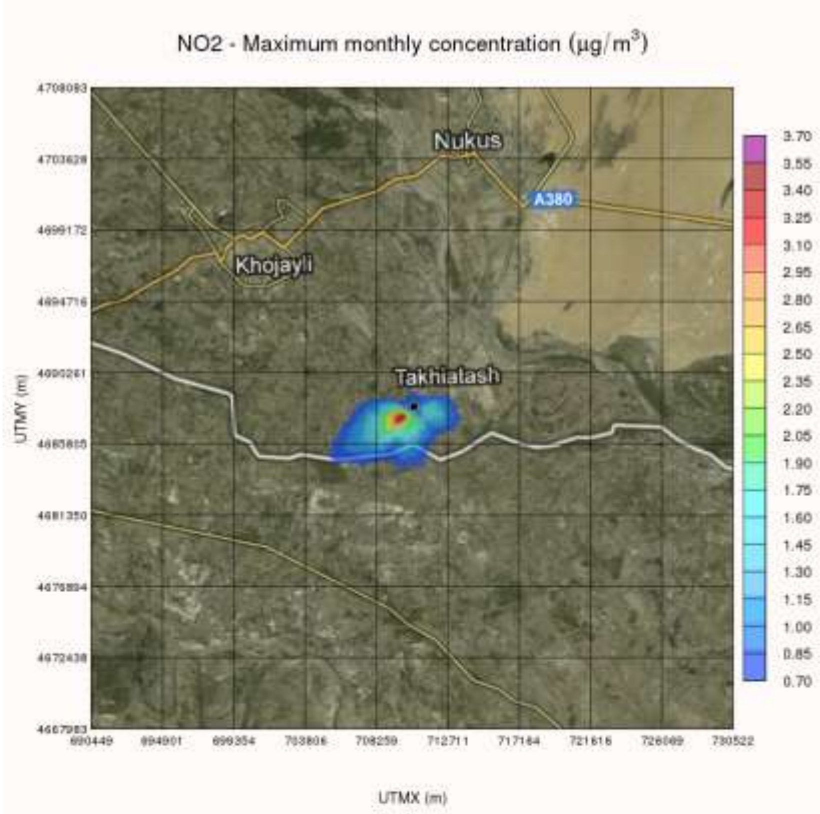

NO - Average period (µg/m³)
Nukus
A380
Khojayli
Takhiatash
UTMY (m)
UTMX (m)

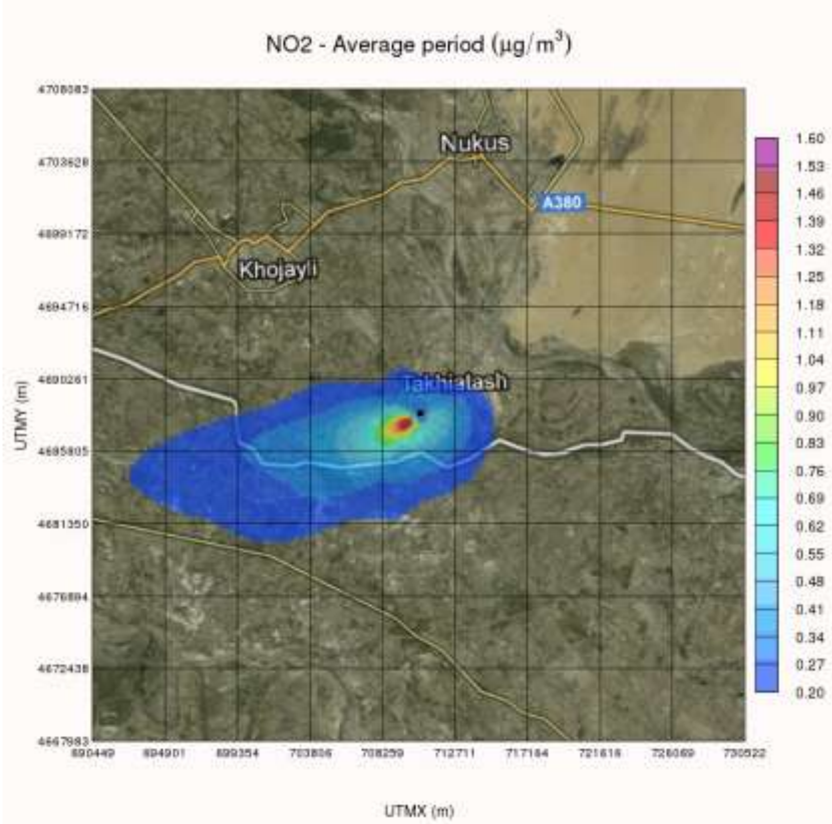
NO2 - Maximum hourly concentration ($\mu g/m^3$)



NO2 - Maximum daily concentration ($\mu g/m^3$)




NO2 - Maximum monthly concentration (µg/m³)
Nukus
A380
Khojayli
Takhiatash
UTMY (m)
UTMX (m)
3.70
3.55
3.40
3.25
3.10
2.95
2.80
2.65
2.50
2.35
2.20
2.05
1.90
1.75
1.60
1.45
1.30
1.15
1.00
0.85
0.70


NO2 - Average period (µg/m³)
Nukus
A380
Khojayli
Takhiatash
UTMY (m)
UTMX (m)
1.60
1.53
1.46
1.39
1.32
1.25
1.18
1.11
1.04
0.97
0.90
0.83
0.76
0.69
0.62
0.55
0.48
0.41
0.34
0.27
0.20

Appendix II: Concentration values

Scenario 1

*** THE MAXIMUM 50 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***

INCLUDING SOURCE(S): STACK1 , STACK2 ,

** CONC OF CO IN MICROGRAMS/M**3 **

RANK	CONC (YYMMDDHH) AT	RECEPTOR (XR,YR) OF TYPE	RANK	CONC (YYMMDDHH) AT	RECEPTOR (XR,YR) OF TYPE
1.	0.71857 (12070424) AT	(-1200.00, -600.00) GC	26.	0.63487 (12052124) AT	(-1000.00, -200.00) GC
2.	0.70749 (12070424) AT	(-800.00, -400.00) GC	27.	0.63342c(12081224) AT	(-1000.00, -800.00) GC
3.	0.69880 (12070424) AT	(-1000.00, -600.00) GC	28.	0.62983 (12070524) AT	(-1200.00, -600.00) GC
4.	0.69773 (12070424) AT	(-1000.00, -400.00) GC	29.	0.62600 (12071024) AT	(-1400.00, 0.00) GC
5.	0.68917 (12041724) AT	(-1600.00, -200.00) GC	30.	0.62431 (12050724) AT	(-1000.00, -600.00) GC
6.	0.66999 (12070524) AT	(-800.00, -400.00) GC	31.	0.62416c(12051124) AT	(-600.00, -1000.00) GC
7.	0.66924 (12041724) AT	(-1400.00, -200.00) GC	32.	0.61980c(12060424) AT	(400.00, -800.00) GC
8.	0.66402 (12052024) AT	(-1000.00, -600.00) GC	33.	0.61943 (12081624) AT	(-800.00, -600.00) GC
9.	0.66304c(12072324) AT	(-200.00, -1200.00) GC	34.	0.61897 (12052124) AT	(-1200.00, -200.00) GC
10.	0.65988 (12071024) AT	(-1000.00, 0.00) GC	35.	0.61895 (12050724) AT	(-1400.00, -800.00) GC
11.	0.65982 (12071024) AT	(-1400.00, -200.00) GC	36.	0.61893 (12041724) AT	(-2000.00, -200.00) GC
12.	0.65935c(12081224) AT	(-800.00, -600.00) GC	37.	0.61801c(12060424) AT	(600.00, -1200.00) GC
13.	0.65929 (12041724) AT	(-1800.00, -200.00) GC	38.	0.61221c(12060424) AT	(400.00, -1000.00) GC
14.	0.65644 (12071024) AT	(-1200.00, 0.00) GC	39.	0.61048 (12051924) AT	(-800.00, -600.00) GC
15.	0.64878 (12071024) AT	(-1600.00, -200.00) GC	40.	0.60685c(12081224) AT	(-800.00, -800.00) GC
16.	0.64871 (12070524) AT	(-1000.00, -600.00) GC	41.	0.60624 (12071024) AT	(-1800.00, -200.00) GC
17.	0.64526 (12070524) AT	(-1000.00, -400.00) GC	42.	0.60470 (12070324) AT	(-1200.00, -600.00) GC
18.	0.64409c(12072324) AT	(-200.00, -1000.00) GC	43.	0.60436 (12071024) AT	(-800.00, 0.00) GC
19.	0.64327 (12052024) AT	(-800.00, -400.00) GC	44.	0.60382 (12083024) AT	(-800.00, -400.00) GC
20.	0.64089 (12070424) AT	(-1400.00, -800.00) GC	45.	0.60262 (12070324) AT	(-1000.00, -600.00) GC
21.	0.63960c(12072324) AT	(-200.00, -1400.00) GC	46.	0.60243 (12060824) AT	(-800.00, -400.00) GC
22.	0.63922 (12070424) AT	(-1400.00, -600.00) GC	47.	0.60175 (12052024) AT	(-1200.00, -800.00) GC
23.	0.63837 (12050724) AT	(-1200.00, -600.00) GC	48.	0.60162c(12060424) AT	(600.00, -1000.00) GC
24.	0.63671 (12071024) AT	(-1200.00, -200.00) GC	49.	0.60144 (12041724) AT	(-1200.00, -200.00) GC
25.	0.63497 (12070624) AT	(-800.00, -600.00) GC	50.	0.60137 (12052024) AT	(-800.00, -600.00) GC

*** THE MAXIMUM 50 MONTH AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): STACK1 , STACK2 ,

** CONC OF CO IN MICROGRAMS/M**3 **

RANK	CONC (YYMMDDHH) AT	RECEPTOR (XR,YR) OF TYPE	RANK	CONC (YYMMDDHH) AT	RECEPTOR (XR,YR) OF TYPE
1.	0.27308c(12083124) AT (	-800.00, -600.00) GC	26.	0.20478c(12073124) AT (	-1200.00, -400.00) GC
2.	0.26369c(12083124) AT (	-600.00, -400.00) GC	27.	0.20258c(12083124) AT (	-1400.00, -800.00) GC
3.	0.25821c(12083124) AT (	-1000.00, -600.00) GC	28.	0.20118c(12083124) AT (	-1400.00, -1000.00) GC
4.	0.25743c(12083124) AT (	-800.00, -400.00) GC	29.	0.19970c(12073124) AT (	-800.00, -600.00) GC
5.	0.24952c(12083124) AT (	-1000.00, -800.00) GC	30.	0.19902c(12073124) AT (	-600.00, -400.00) GC
6.	0.24361c(12083124) AT (	-600.00, -600.00) GC	31.	0.19657c(12053124) AT (	-600.00, -600.00) GC
7.	0.23818c(12083124) AT (	-800.00, -800.00) GC	32.	0.19651c(12073124) AT (	-1000.00, -200.00) GC
8.	0.23226c(12083124) AT (	-1200.00, -800.00) GC	33.	0.19601c(12053124) AT (	-800.00, -800.00) GC
9.	0.22734c(12073124) AT (	-800.00, -400.00) GC	34.	0.19597c(12063024) AT (	-800.00, -400.00) GC
10.	0.22663c(12053124) AT (	-800.00, -400.00) GC	35.	0.19486c(12073124) AT (	-600.00, -200.00) GC
11.	0.22626c(12053124) AT (	-1000.00, -600.00) GC	36.	0.19378c(12083124) AT (	-600.00, -200.00) GC
12.	0.22461c(12053124) AT (	-800.00, -600.00) GC	37.	0.19296c(12093024) AT (	-800.00, -400.00) GC
13.	0.22391c(12073124) AT (	-1000.00, -400.00) GC	38.	0.19287c(12073124) AT (	-1400.00, -600.00) GC
14.	0.21924c(12083124) AT (	-1200.00, -600.00) GC	39.	0.19275c(12063024) AT (	-600.00, -400.00) GC
15.	0.21570c(12083124) AT (	-1000.00, -400.00) GC	40.	0.19246c(12083124) AT (	-400.00, -400.00) GC
16.	0.21506c(12053124) AT (	-600.00, -400.00) GC	41.	0.19221c(12053124) AT (	-1400.00, -800.00) GC
17.	0.21396c(12073124) AT (	-1000.00, -600.00) GC	42.	0.19110c(12083124) AT (	-600.00, -800.00) GC
18.	0.21388c(12083124) AT (	-1200.00, -1000.00) GC	43.	0.18826c(12093024) AT (	-600.00, -400.00) GC
19.	0.21069c(12053124) AT (	-1000.00, -800.00) GC	44.	0.18769c(12083124) AT (	-800.00, -1000.00) GC
20.	0.21049c(12083124) AT (	-1000.00, -1000.00) GC	45.	0.18737c(12093024) AT (	-600.00, -200.00) GC
21.	0.21007c(12053124) AT (	-1000.00, -400.00) GC	46.	0.18604c(12063024) AT (	-800.00, -600.00) GC
22.	0.20838c(12073124) AT (	-800.00, -200.00) GC	47.	0.18559c(12053124) AT (	-600.00, -200.00) GC
23.	0.20793c(12073124) AT (	-1200.00, -600.00) GC	48.	0.18546c(12053124) AT (	-800.00, -200.00) GC
24.	0.20736c(12053124) AT (	-1200.00, -600.00) GC	49.	0.18534c(12053124) AT (	-1200.00, -1000.00) GC
25.	0.20657c(12053124) AT (	-1200.00, -800.00) GC	50.	0.18489c(12073124) AT (	-1200.00, -800.00) GC

*** THE SUMMARY OF MAXIMUM PERIOD (8784 HRS) RESULTS ***

** CONC OF CO IN MICROGRAMS/M**3 **

GROUP ID		AVERAGE CONC	RECEPTOR (XR, YR, ZELEV, ZHILL, ZFLAG) OF TYPE	NETWORK GRID-ID
ALL	1ST HIGHEST VALUE IS	0.11875 AT (	-800.00, -400.00, 75.60, 75.60, 0.00) GC	CAR1
	2ND HIGHEST VALUE IS	0.11455 AT (	-1000.00, -600.00, 75.20, 75.20, 0.00) GC	CAR1
	3RD HIGHEST VALUE IS	0.11293 AT (	-800.00, -600.00, 73.90, 73.90, 0.00) GC	CAR1
	4TH HIGHEST VALUE IS	0.11209 AT (	-1000.00, -400.00, 75.40, 75.40, 0.00) GC	CAR1
	5TH HIGHEST VALUE IS	0.11152 AT (	-600.00, -400.00, 75.20, 75.20, 0.00) GC	CAR1
	6TH HIGHEST VALUE IS	0.10687 AT (	-1200.00, -600.00, 74.60, 74.60, 0.00) GC	CAR1
	7TH HIGHEST VALUE IS	0.10407 AT (	-800.00, -200.00, 78.00, 78.00, 0.00) GC	CAR1
	8TH HIGHEST VALUE IS	0.10402 AT (	-1000.00, -800.00, 76.20, 76.20, 0.00) GC	CAR1
	9TH HIGHEST VALUE IS	0.10278 AT (	-1200.00, -800.00, 74.80, 74.80, 0.00) GC	CAR1
	10TH HIGHEST VALUE IS	0.10218 AT (	-600.00, -200.00, 76.90, 76.90, 0.00) GC	CAR1

*** THE MAXIMUM 50 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): STACK1 , STACK2 ,

** CONC OF NO IN MICROGRAMS/M**3 **

RANK	CONC	(YYMMDDHH) AT	RECEPTOR (XR,YR) OF TYPE		RANK	CONC	(YYMMDDHH) AT	RECEPTOR (XR,YR) OF TYPE	
1.	2.03707	(12070424) AT	(-1200.00, -600.00)	GC	26.	1.76188c	(12051124) AT	(-600.00, -1000.00)	GC
2.	1.97586	(12070424) AT	(-1000.00, -600.00)	GC	27.	1.75857c	(12072324) AT	(-200.00, -1000.00)	GC
3.	1.92558	(12070424) AT	(-800.00, -400.00)	GC	28.	1.75765	(12050724) AT	(-1400.00, -800.00)	GC
4.	1.91643	(12070424) AT	(-1000.00, -400.00)	GC	29.	1.75090	(12071024) AT	(-1400.00, 0.00)	GC
5.	1.89740	(12041724) AT	(-1600.00, -200.00)	GC	30.	1.74729	(12052124) AT	(-1000.00, -200.00)	GC
6.	1.85773	(12052024) AT	(-1000.00, -600.00)	GC	31.	1.74645	(12050724) AT	(-1000.00, -600.00)	GC
7.	1.85032	(12070524) AT	(-800.00, -400.00)	GC	32.	1.73829	(12052024) AT	(-800.00, -400.00)	GC
8.	1.84799	(12070424) AT	(-1400.00, -800.00)	GC	33.	1.73615c	(12060424) AT	(600.00, -1200.00)	GC
9.	1.84444c	(12072324) AT	(-200.00, -1200.00)	GC	34.	1.73284	(12070424) AT	(-1600.00, -800.00)	GC
10.	1.84424	(12071024) AT	(-1400.00, -200.00)	GC	35.	1.72820	(12081624) AT	(-800.00, -600.00)	GC
11.	1.84231	(12041724) AT	(-1400.00, -200.00)	GC	36.	1.72586	(12052124) AT	(-1200.00, -200.00)	GC
12.	1.83926	(12070524) AT	(-1000.00, -600.00)	GC	37.	1.72585	(12070424) AT	(-1200.00, -800.00)	GC
13.	1.82255	(12071024) AT	(-1200.00, 0.00)	GC	38.	1.71728	(12052024) AT	(-1200.00, -800.00)	GC
14.	1.81975c	(12081224) AT	(-800.00, -600.00)	GC	39.	1.71391c	(12081224) AT	(-800.00, -800.00)	GC
15.	1.81810	(12041724) AT	(-1800.00, -200.00)	GC	40.	1.71017	(12041724) AT	(-2000.00, -200.00)	GC
16.	1.81610	(12071024) AT	(-1600.00, -200.00)	GC	41.	1.70434	(12070324) AT	(-1200.00, -600.00)	GC
17.	1.81549	(12070424) AT	(-1400.00, -600.00)	GC	42.	1.69928	(12071024) AT	(-1800.00, -200.00)	GC
18.	1.80688	(12071024) AT	(-1000.00, 0.00)	GC	43.	1.69856	(12070624) AT	(-1000.00, -800.00)	GC
19.	1.80234c	(12072324) AT	(-200.00, -1400.00)	GC	44.	1.69485c	(12060424) AT	(400.00, -1000.00)	GC
20.	1.80157	(12070524) AT	(-1000.00, -400.00)	GC	45.	1.69452	(12070324) AT	(-1000.00, -600.00)	GC
21.	1.79666	(12070524) AT	(-1200.00, -600.00)	GC	46.	1.68923	(12051924) AT	(-800.00, -600.00)	GC
22.	1.79147c	(12081224) AT	(-1000.00, -800.00)	GC	47.	1.68105c	(12072324) AT	(-200.00, -1600.00)	GC
23.	1.78897	(12050724) AT	(-1200.00, -600.00)	GC	48.	1.67918	(12062924) AT	(-800.00, -400.00)	GC
24.	1.77560	(12070624) AT	(-800.00, -600.00)	GC	49.	1.67876c	(12060424) AT	(400.00, -800.00)	GC
25.	1.77183	(12071024) AT	(-1200.00, -200.00)	GC	50.	1.67777	(12060824) AT	(-800.00, -400.00)	GC

*** THE MAXIMUM 50 MONTH AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): STACK1 , STACK2 ,

** CONC OF **N**O IN MICROGRAMS/M**3 **

RANK	CONC	(YYMMDDHH) AT	RECEPTOR (XR,YR) OF TYPE		RANK	CONC	(YYMMDDHH) AT	RECEPTOR (XR,YR) OF TYPE	
1.	0.76558c	(12083124) AT	(-800.00, -600.00)	GC	26.	0.58093c	(12083124) AT	(-1400.00, -1000.00)	GC
2.	0.72968c	(12083124) AT	(-1000.00, -600.00)	GC	27.	0.57824c	(12073124) AT	(-1200.00, -400.00)	GC
3.	0.71642c	(12083124) AT	(-600.00, -400.00)	GC	28.	0.56884c	(12073124) AT	(-800.00, -200.00)	GC
4.	0.71177c	(12083124) AT	(-1000.00, -800.00)	GC	29.	0.56415c	(12073124) AT	(-800.00, -600.00)	GC
5.	0.70945c	(12083124) AT	(-800.00, -400.00)	GC	30.	0.55433c	(12053124) AT	(-800.00, -800.00)	GC
6.	0.67526c	(12083124) AT	(-800.00, -800.00)	GC	31.	0.55183c	(12073124) AT	(-1400.00, -600.00)	GC
7.	0.67516c	(12083124) AT	(-600.00, -600.00)	GC	32.	0.54876c	(12053124) AT	(-1400.00, -800.00)	GC
8.	0.66526c	(12083124) AT	(-1200.00, -800.00)	GC	33.	0.54793c	(12063024) AT	(-800.00, -400.00)	GC
9.	0.63703c	(12053124) AT	(-1000.00, -600.00)	GC	34.	0.54739c	(12073124) AT	(-600.00, -400.00)	GC
10.	0.63221c	(12073124) AT	(-800.00, -400.00)	GC	35.	0.54439c	(12073124) AT	(-1000.00, -200.00)	GC
11.	0.62816c	(12073124) AT	(-1000.00, -400.00)	GC	36.	0.54420c	(12053124) AT	(-600.00, -600.00)	GC
12.	0.62782c	(12053124) AT	(-800.00, -600.00)	GC	37.	0.54034c	(12093024) AT	(-800.00, -400.00)	GC
13.	0.62367c	(12053124) AT	(-800.00, -400.00)	GC	38.	0.53603c	(12083124) AT	(-600.00, -800.00)	GC
14.	0.62300c	(12083124) AT	(-1200.00, -600.00)	GC	39.	0.53514c	(12083124) AT	(-800.00, -1000.00)	GC
15.	0.61590c	(12083124) AT	(-1200.00, -1000.00)	GC	40.	0.53285c	(12063024) AT	(-600.00, -400.00)	GC
16.	0.60847c	(12073124) AT	(-1000.00, -600.00)	GC	41.	0.53218c	(12073124) AT	(-1200.00, -800.00)	GC
17.	0.60375c	(12083124) AT	(-1000.00, -1000.00)	GC	42.	0.53133c	(12053124) AT	(-1200.00, -1000.00)	GC
18.	0.60117c	(12083124) AT	(-1000.00, -400.00)	GC	43.	0.52731c	(12083124) AT	(-1400.00, -1200.00)	GC
19.	0.59882c	(12053124) AT	(-1000.00, -800.00)	GC	44.	0.52677c	(12063024) AT	(-800.00, -600.00)	GC
20.	0.59356c	(12073124) AT	(-1200.00, -600.00)	GC	45.	0.52605c	(12083124) AT	(-1200.00, -1200.00)	GC

21.	0.58880c(12053124) AT (-1200.00, -800.00) GC	46.	0.52476c(12053124) AT (-1400.00, -1000.00) GC
22.	0.58678c(12053124) AT (-1200.00, -600.00) GC	47.	0.52335c(12073124) AT (-600.00, -200.00) GC
23.	0.58474c(12053124) AT (-1000.00, -400.00) GC	48.	0.52326c(12093024) AT (-600.00, -400.00) GC
24.	0.58464c(12053124) AT (-600.00, -400.00) GC	49.	0.52216c(12073124) AT (-1400.00, -800.00) GC
25.	0.58217c(12083124) AT (-1400.00, -800.00) GC	50.	0.52017c(12053124) AT (-1400.00, -600.00) GC

*** THE SUMMARY OF MAXIMUM PERIOD (8784 HRS) RESULTS ***

** CONC OF NO IN MICROGRAMS/M**3 **

GROUP ID		AVERAGE CONC	RECEPTOR (XR, YR, ZELEV, ZHILL, ZFLAG) OF TYPE	NETWORK GRID-ID
ALL	1ST HIGHEST VALUE IS	0.32794 AT (	-800.00, -400.00, 75.60, 75.60, 0.00) GC	CAR1
	2ND HIGHEST VALUE IS	0.32266 AT (	-1000.00, -600.00, 75.20, 75.20, 0.00) GC	CAR1
	3RD HIGHEST VALUE IS	0.31611 AT (	-800.00, -600.00, 73.90, 73.90, 0.00) GC	CAR1
	4TH HIGHEST VALUE IS	0.31238 AT (	-1000.00, -400.00, 75.40, 75.40, 0.00) GC	CAR1
	5TH HIGHEST VALUE IS	0.30473 AT (	-600.00, -400.00, 75.20, 75.20, 0.00) GC	CAR1
	6TH HIGHEST VALUE IS	0.30238 AT (	-1200.00, -600.00, 74.60, 74.60, 0.00) GC	CAR1
	7TH HIGHEST VALUE IS	0.29526 AT (	-1000.00, -800.00, 76.20, 76.20, 0.00) GC	CAR1
	8TH HIGHEST VALUE IS	0.29265 AT (	-1200.00, -800.00, 74.80, 74.80, 0.00) GC	CAR1
	9TH HIGHEST VALUE IS	0.28298 AT (	-800.00, -200.00, 78.00, 78.00, 0.00) GC	CAR1
	10TH HIGHEST VALUE IS	0.28283 AT (	-1200.00, -400.00, 74.40, 74.40, 0.00) GC	CAR1

*** THE MAXIMUM 50 1-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): STACK1 , STACK2 ,

** CONC OF NO2 IN MICROGRAMS/M**3 **

RANK	CONC (YYMMDDHH) AT	RECEPTOR (XR,YR) OF TYPE	RANK	CONC (YYMMDDHH) AT	RECEPTOR (XR,YR) OF TYPE
1.	61.63678 (12021212) AT (	3400.00, -1000.00) GC	26.	57.23863 (12021212) AT (	2600.00, -600.00) GC
2.	61.51841 (12021212) AT (	3200.00, -1000.00) GC	27.	57.14634 (12021212) AT (	4600.00, -1400.00) GC
3.	61.02152 (12021212) AT (	3000.00, -800.00) GC	28.	57.12181 (12021212) AT (	4200.00, -1000.00) GC
4.	60.97657 (12021212) AT (	3600.00, -1000.00) GC	29.	56.90259 (12021212) AT (	2800.00, -600.00) GC
5.	60.72593 (12021212) AT (	3000.00, -1000.00) GC	30.	56.61421 (12021212) AT (	2400.00, -600.00) GC
6.	60.68333 (12021212) AT (	2800.00, -800.00) GC	31.	56.49436 (12021212) AT (	4600.00, -1200.00) GC
7.	60.40190 (12021212) AT (	3600.00, -1200.00) GC	32.	56.33431 (12021212) AT (	3600.00, -1400.00) GC
8.	60.37708 (12021212) AT (	3200.00, -800.00) GC	33.	56.20687 (12021212) AT (	3800.00, -800.00) GC
9.	60.34014 (12021212) AT (	3800.00, -1200.00) GC	34.	56.03849 (12021212) AT (	2600.00, -1000.00) GC
10.	59.95504 (12021212) AT (	3800.00, -1000.00) GC	35.	56.02609 (12021212) AT (	4800.00, -1400.00) GC
11.	59.87947 (12021212) AT (	4000.00, -1200.00) GC	36.	56.01421 (12021212) AT (	3000.00, -600.00) GC
12.	59.73523 (12021212) AT (	2600.00, -800.00) GC	37.	55.82257 (12021212) AT (	3000.00, -1200.00) GC
13.	59.66651 (12021212) AT (	3400.00, -1200.00) GC	38.	55.49187 (12021212) AT (	4600.00, -1600.00) GC
14.	59.31998 (12021212) AT (	3400.00, -800.00) GC	39.	55.42742 (12021212) AT (	4400.00, -1000.00) GC
15.	59.09972 (12021212) AT (	4200.00, -1200.00) GC	40.	55.39407 (12021212) AT (	4400.00, -1600.00) GC
16.	58.93267 (12021212) AT (	2800.00, -1000.00) GC	41.	55.15122 (12021212) AT (	4800.00, -1600.00) GC
17.	58.64315 (12021212) AT (	4000.00, -1000.00) GC	42.	54.93459 (12021212) AT (	4800.00, -1200.00) GC
18.	58.34330 (12021212) AT (	3200.00, -1200.00) GC	43.	54.87512 (12021212) AT (	4200.00, -1600.00) GC
19.	58.24271 (12021212) AT (	4200.00, -1400.00) GC	44.	54.75835 (12021212) AT (	5000.00, -1400.00) GC
20.	58.10479 (12021212) AT (	4000.00, -1400.00) GC	45.	54.72420 (12021212) AT (	2200.00, -600.00) GC
21.	57.92948 (12021212) AT (	4400.00, -1200.00) GC	46.	54.69858 (12021212) AT (	3200.00, -600.00) GC
22.	57.88298 (12021212) AT (	4400.00, -1400.00) GC	47.	54.45276 (12021212) AT (	5000.00, -1600.00) GC
23.	57.79150 (12021212) AT (	3600.00, -800.00) GC	48.	54.37661 (12021212) AT (	4000.00, -800.00) GC
24.	57.58973 (12021212) AT (	3800.00, -1400.00) GC	49.	54.36578 (12021212) AT (	3400.00, -1400.00) GC
25.	57.41775 (12021212) AT (	2400.00, -800.00) GC	50.	53.82492 (12021212) AT (	4000.00, -1600.00) GC

*** THE MAXIMUM 50 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): STACK1 , STACK2 ,

** CONC OF NO2 IN MICROGRAMS/M**3 **

RANK	CONC (YYMMDDHH) AT	RECEPTOR (XR,YR)	OF TYPE	RANK	CONC (YYMMDDHH) AT	RECEPTOR (XR,YR)	OF TYPE
1.	12.53628 (12070424) AT	(-1200.00, -600.00)	GC	26.	10.84273c(12051124) AT	(-600.00, -1000.00)	GC
2.	12.15959 (12070424) AT	(-1000.00, -600.00)	GC	27.	10.82240c(12072324) AT	(-200.00, -1000.00)	GC
3.	11.85020 (12070424) AT	(-800.00, -400.00)	GC	28.	10.81672 (12050724) AT	(-1400.00, -800.00)	GC
4.	11.79389 (12070424) AT	(-1000.00, -400.00)	GC	29.	10.77517 (12071024) AT	(-1400.00, 0.00)	GC
5.	11.67675 (12041724) AT	(-1600.00, -200.00)	GC	30.	10.75297 (12052124) AT	(-1000.00, -200.00)	GC
6.	11.43263 (12052024) AT	(-1000.00, -600.00)	GC	31.	10.74779 (12050724) AT	(-1000.00, -600.00)	GC
7.	11.38703 (12070524) AT	(-800.00, -400.00)	GC	32.	10.69758 (12052024) AT	(-800.00, -400.00)	GC
8.	11.37266 (12070424) AT	(-1400.00, -800.00)	GC	33.	10.68438c(12060424) AT	(600.00, -1200.00)	GC
9.	11.35082c(12072324) AT	(-200.00, -1200.00)	GC	34.	10.66398 (12070424) AT	(-1600.00, -800.00)	GC
10.	11.34960 (12071024) AT	(-1400.00, -200.00)	GC	35.	10.63546 (12081624) AT	(-800.00, -600.00)	GC
11.	11.33776 (12041724) AT	(-1400.00, -200.00)	GC	36.	10.62109 (12052124) AT	(-1200.00, -200.00)	GC
12.	11.31897 (12070524) AT	(-1000.00, -600.00)	GC	37.	10.62099 (12070424) AT	(-1200.00, -800.00)	GC
13.	11.21616 (12071024) AT	(-1200.00, 0.00)	GC	38.	10.56824 (12052024) AT	(-1200.00, -800.00)	GC
14.	11.19892c(12081224) AT	(-800.00, -600.00)	GC	39.	10.54755c(12081224) AT	(-800.00, -800.00)	GC
15.	11.18872 (12041724) AT	(-1800.00, -200.00)	GC	40.	10.52453 (12041724) AT	(-2000.00, -200.00)	GC
16.	11.17643 (12071024) AT	(-1600.00, -200.00)	GC	41.	10.48863 (12070324) AT	(-1200.00, -600.00)	GC
17.	11.17268 (12070424) AT	(-1400.00, -600.00)	GC	42.	10.45748 (12071024) AT	(-1800.00, -200.00)	GC
18.	11.11970 (12071024) AT	(-1000.00, 0.00)	GC	43.	10.45303 (12070624) AT	(-1000.00, -800.00)	GC
19.	11.09175c(12072324) AT	(-200.00, -1400.00)	GC	44.	10.43022c(12060424) AT	(400.00, -1000.00)	GC
20.	11.08703 (12070524) AT	(-1000.00, -400.00)	GC	45.	10.42823 (12070324) AT	(-1000.00, -600.00)	GC
21.	11.05675 (12070524) AT	(-1200.00, -600.00)	GC	46.	10.39569 (12051924) AT	(-800.00, -600.00)	GC
22.	11.02482c(12081224) AT	(-1000.00, -800.00)	GC	47.	10.34528c(12072324) AT	(-200.00, -1600.00)	GC
23.	11.00947 (12050724) AT	(-1200.00, -600.00)	GC	48.	10.33381 (12062924) AT	(-800.00, -400.00)	GC
24.	10.92721 (12070624) AT	(-800.00, -600.00)	GC	49.	10.33127c(12060424) AT	(400.00, -800.00)	GC
25.	10.90401 (12071024) AT	(-1200.00, -200.00)	GC	50.	10.32511 (12060824) AT	(-800.00, -400.00)	GC

*** THE MAXIMUM 50 MONTH AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): STACK1 , STACK2 ,

** CONC OF NO2 IN MICROGRAMS/M**3 **

RANK	CONC (YYMMDDHH) AT	RECEPTOR (XR,YR)	OF TYPE	RANK	CONC (YYMMDDHH) AT	RECEPTOR (XR,YR)	OF TYPE
1.	4.71145c(12083124) AT	(-800.00, -600.00)	GC	26.	3.57506c(12083124) AT	(-1400.00, -1000.00)	GC
2.	4.49053c(12083124) AT	(-1000.00, -600.00)	GC	27.	3.55856c(12073124) AT	(-1200.00, -400.00)	GC
3.	4.40891c(12083124) AT	(-600.00, -400.00)	GC	28.	3.50071c(12073124) AT	(-800.00, -200.00)	GC
4.	4.38028c(12083124) AT	(-1000.00, -800.00)	GC	29.	3.47184c(12073124) AT	(-800.00, -600.00)	GC
5.	4.36601c(12083124) AT	(-800.00, -400.00)	GC	30.	3.41136c(12053124) AT	(-800.00, -800.00)	GC
6.	4.15558c(12083124) AT	(-800.00, -800.00)	GC	31.	3.39600c(12073124) AT	(-1400.00, -600.00)	GC
7.	4.15502c(12083124) AT	(-600.00, -600.00)	GC	32.	3.37708c(12053124) AT	(-1400.00, -800.00)	GC
8.	4.09403c(12083124) AT	(-1200.00, -800.00)	GC	33.	3.37198c(12063024) AT	(-800.00, -400.00)	GC
9.	3.92033c(12053124) AT	(-1000.00, -600.00)	GC	34.	3.36866c(12073124) AT	(-600.00, -400.00)	GC
10.	3.89068c(12073124) AT	(-800.00, -400.00)	GC	35.	3.35019c(12073124) AT	(-1000.00, -200.00)	GC
11.	3.86577c(12073124) AT	(-1000.00, -400.00)	GC	36.	3.34903c(12053124) AT	(-600.00, -600.00)	GC
12.	3.86367c(12053124) AT	(-800.00, -600.00)	GC	37.	3.32532c(12093024) AT	(-800.00, -400.00)	GC
13.	3.83811c(12053124) AT	(-800.00, -400.00)	GC	38.	3.29878c(12083124) AT	(-600.00, -800.00)	GC
14.	3.83399c(12083124) AT	(-1200.00, -600.00)	GC	39.	3.29328c(12083124) AT	(-800.00, -1000.00)	GC
15.	3.79031c(12083124) AT	(-1200.00, -1000.00)	GC	40.	3.27921c(12063024) AT	(-600.00, -400.00)	GC
16.	3.74457c(12073124) AT	(-1000.00, -600.00)	GC	41.	3.27508c(12073124) AT	(-1200.00, -800.00)	GC
17.	3.71552c(12083124) AT	(-1000.00, -1000.00)	GC	42.	3.26986c(12053124) AT	(-1200.00, -1000.00)	GC

18.	3.69967c(12083124) AT (-1000.00, -400.00) GC	43.	3.24508c(12083124) AT (-1400.00, -1200.00) GC
19.	3.68517c(12053124) AT (-1000.00, -800.00) GC	44.	3.24180c(12063024) AT (-800.00, -600.00) GC
20.	3.65280c(12073124) AT (-1200.00, -600.00) GC	45.	3.23735c(12083124) AT (-1200.00, -1200.00) GC
21.	3.62350c(12053124) AT (-1200.00, -800.00) GC	46.	3.22939c(12053124) AT (-1400.00, -1000.00) GC
22.	3.61108c(12053124) AT (-1200.00, -600.00) GC	47.	3.22073c(12073124) AT (-600.00, -200.00) GC
23.	3.59856c(12053124) AT (-1000.00, -400.00) GC	48.	3.22019c(12093024) AT (-600.00, -400.00) GC
24.	3.59791c(12053124) AT (-600.00, -400.00) GC	49.	3.21341c(12073124) AT (-1400.00, -800.00) GC
25.	3.58269c(12083124) AT (-1400.00, -800.00) GC	50.	3.20115c(12053124) AT (-1400.00, -600.00) GC

*** THE SUMMARY OF MAXIMUM PERIOD (8784 HRS) RESULTS ***

** CONC OF NO2 IN MICROGRAMS/M**3 **

GROUP ID		AVERAGE CONC	NETWORK RECEPTOR (XR, YR, ZELEV, ZHILL, ZFLAG) OF TYPE GRID-ID
ALL	1ST HIGHEST VALUE IS	2.01817 AT (	-800.00, -400.00, 75.60, 75.60, 0.00) GC CAR1
	………..2ND HIGHEST VALUE IS	1.98564 AT (	-1000.00, -600.00, 75.20, 75.20, 0.00) GC CAR1
	………..3RD HIGHEST VALUE IS	1.94539 AT (	-800.00, -600.00, 73.90, 73.90, 0.00) GC CAR1
	………..4TH HIGHEST VALUE IS	1.92240 AT (	-1000.00, -400.00, 75.40, 75.40, 0.00) GC CAR1
	………..5TH HIGHEST VALUE IS	1.87532 AT (	-600.00, -400.00, 75.20, 75.20, 0.00) GC CAR1
	………..6TH HIGHEST VALUE IS	1.86084 AT (	-1200.00, -600.00, 74.60, 74.60, 0.00) GC CAR1
	………..7TH HIGHEST VALUE IS	1.81705 AT (	-1000.00, -800.00, 76.20, 76.20, 0.00) GC CAR1
	………..8TH HIGHEST VALUE IS	1.80099 AT (	-1200.00, -800.00, 74.80, 74.80, 0.00) GC CAR1
	………..9TH HIGHEST VALUE IS	1.74151 AT (	-800.00, -200.00, 78.00, 78.00, 0.00) GC CAR1
	……….10TH HIGHEST VALUE IS	1.74055 AT (	-1200.00, -400.00, 74.40, 74.40, 0.00) GC CAR1

Scenario 2

*** THE MAXIMUM 50 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): STACK1 , STACK2 ,

** CONC OF CO IN MICROGRAMS/M**3 **

RANK	CONC (YYMMDDHH) AT	RECEPTOR (XR,YR) OF TYPE	RANK	CONC (YYMMDDHH) AT	RECEPTOR (XR,YR) OF TYPE
1.	2.08024 (12070424) AT	(-800.00, -600.00) GC	26.	1.78279 (12041724) AT	(-1600.00, -600.00) GC
2.	2.07156 (12070424) AT	(-600.00, -600.00) GC	27.	1.77963 (12071024) AT	(-1400.00, -400.00) GC
3.	1.98697 (12052024) AT	(-600.00, -600.00) GC	28.	1.77685c(12081224) AT	(-400.00, -600.00) GC
4.	1.97417c(12072624) AT	(200.00, -1000.00) GC	29.	1.77289c(12060424) AT	(400.00, -1200.00) GC
5.	1.97327c(12072324) AT	(-200.00, -1200.00) GC	30.	1.77120c(12051124) AT	(-400.00, -1000.00) GC
6.	1.94546 (12041724) AT	(-1200.00, -400.00) GC	31.	1.76718 (12050724) AT	(-600.00, -600.00) GC
7.	1.92774 (12041724) AT	(-1400.00, -400.00) GC	32.	1.76172 (12070524) AT	(-800.00, -600.00) GC
8.	1.92247 (12020224) AT	(-1200.00, -1200.00) GC	33.	1.75569 (12050724) AT	(-800.00, -600.00) GC
9.	1.91163c(12081224) AT	(-600.00, -800.00) GC	34.	1.75139 (12020224) AT	(-1600.00, -1400.00) GC
10.	1.89440 (12071024) AT	(-1000.00, -400.00) GC	35.	1.75139 (12050724) AT	(-1000.00, -800.00) GC
11.	1.88889c(12072324) AT	(-200.00, -1000.00) GC	36.	1.74906 (12070324) AT	(-600.00, -600.00) GC
12.	1.88835 (12020224) AT	(-1400.00, -1400.00) GC	37.	1.74877 (12020224) AT	(-1600.00, -1600.00) GC
13.	1.88456c(12072624) AT	(200.00, -1200.00) GC	38.	1.74181 (12041724) AT	(-1400.00, -600.00) GC
14.	1.87299 (12052124) AT	(-800.00, -400.00) GC	39.	1.74153c(12081224) AT	(-600.00, -600.00) GC
15.	1.87050 (12070424) AT	(-1000.00, -800.00) GC	40.	1.73809 (12071024) AT	(-800.00, -200.00) GC
16.	1.86957c(12060424) AT	(400.00, -1000.00) GC	41.	1.73732 (12020224) AT	(-1400.00, -1200.00) GC
17.	1.85924 (12071024) AT	(-1200.00, -400.00) GC	42.	1.73350 (12041724) AT	(-1800.00, -600.00) GC
18.	1.85514 (12041724) AT	(-1000.00, -400.00) GC	43.	1.72666 (12081724) AT	(-600.00, -600.00) GC
19.	1.84437c(12051124) AT	(-400.00, -800.00) GC	44.	1.72551 (12051924) AT	(-600.00, -800.00) GC
20.	1.83100c(12072324) AT	(-200.00, -1400.00) GC	45.	1.71809 (12070424) AT	(-800.00, -800.00) GC
21.	1.80812 (12052024) AT	(-800.00, -800.00) GC	46.	1.71617 (12070324) AT	(-800.00, -600.00) GC
22.	1.80101 (12071024) AT	(-800.00, -400.00) GC	47.	1.71410 (12083024) AT	(-600.00, -600.00) GC
23.	1.79446 (12041724) AT	(-1600.00, -400.00) GC	48.	1.71288 (12052124) AT	(-1000.00, -400.00) GC
24.	1.79444 (12070524) AT	(-600.00, -600.00) GC	49.	1.70051 (12020224) AT	(-1000.00, -1000.00) GC
25.	1.78778c(12081224) AT	(-800.00, -800.00) GC	50.	1.69857 (12071224) AT	(-800.00, -200.00) GC

*** THE MAXIMUM 50 MONTH AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): STACK1 , STACK2 ,

** CONC OF CO IN MICROGRAMS/M**3 **

RANK	CONC (YYMMDDHH) AT	RECEPTOR (XR,YR) OF TYPE	RANK	CONC (YYMMDDHH) AT	RECEPTOR (XR,YR) OF TYPE
1.	0.75898c(12083124) AT	(-600.00, -600.00) GC	26.	0.50620c(12053124) AT	(-1000.00, -1000.00) GC
2.	0.70936c(12083124) AT	(-600.00, -800.00) GC	27.	0.50514c(12053124) AT	(-1000.00, -600.00) GC
3.	0.70370c(12083124) AT	(-800.00, -800.00) GC	28.	0.50296c(12053124) AT	(-800.00, -1000.00) GC
4.	0.68801c(12083124) AT	(-400.00, -600.00) GC	29.	0.49545c(12083124) AT	(-1200.00, -1000.00) GC
5.	0.65062c(12053124) AT	(-600.00, -600.00) GC	30.	0.48763c(12053124) AT	(-600.00, -400.00) GC
6.	0.62278c(12083124) AT	(-800.00, -600.00) GC	31.	0.48325c(12073124) AT	(-1000.00, -400.00) GC
7.	0.61746c(12073124) AT	(-600.00, -600.00) GC	32.	0.48232c(12073124) AT	(-1200.00, -600.00) GC
8.	0.61178c(12073124) AT	(-800.00, -600.00) GC	33.	0.48215c(12073124) AT	(-1200.00, -800.00) GC
9.	0.60872c(12053124) AT	(-800.00, -800.00) GC	34.	0.48146c(12083124) AT	(-1000.00, -600.00) GC
10.	0.59489c(12083124) AT	(-800.00, -1000.00) GC	35.	0.47879c(12073124) AT	(-600.00, -800.00) GC
11.	0.59211c(12053124) AT	(-800.00, -600.00) GC	36.	0.47818c(12063024) AT	(-400.00, -600.00) GC
12.	0.59112c(12083124) AT	(-1000.00, -800.00) GC	37.	0.47606c(12063024) AT	(-800.00, -600.00) GC
13.	0.57800c(12053124) AT	(-600.00, -800.00) GC	38.	0.47592c(12083124) AT	(-1000.00, -1200.00) GC

14.	0.56734c(12083124) AT (-1000.00, -1000.00) GC	39.	0.47493c(12053124) AT (-1200.00, -1000.00) GC
15.	0.55590c(12073124) AT (-1000.00, -600.00) GC	40.	0.47493c(12093024) AT (-800.00, -600.00) GC
16.	0.55373c(12053124) AT (-1000.00, -800.00) GC	41.	0.47469c(12093024) AT (-600.00, -400.00) GC
17.	0.55295c(12073124) AT (-600.00, -400.00) GC	42.	0.47364c(12053124) AT (-1200.00, -800.00) GC
18.	0.54996c(12083124) AT (-400.00, -800.00) GC	43.	0.47073c(12093024) AT (-400.00, -600.00) GC
19.	0.54353c(12053124) AT (-400.00, -600.00) GC	44.	0.47013c(12073124) AT (-400.00, -600.00) GC
20.	0.54257c(12073124) AT (-800.00, -400.00) GC	45.	0.46675c(12083124) AT (-1200.00, -800.00) GC
21.	0.53761c(12063024) AT (-600.00, -600.00) GC	46.	0.46510c(12093024) AT (-400.00, -400.00) GC
22.	0.53657c(12083124) AT (-600.00, -1000.00) GC	47.	0.46061c(12063024) AT (-800.00, -800.00) GC
23.	0.53556c(12073124) AT (-800.00, -800.00) GC	48.	0.46006c(12063024) AT (-600.00, -800.00) GC
24.	0.52468c(12073124) AT (-1000.00, -800.00) GC	49.	0.45763c(12053124) AT (-800.00, -400.00) GC
25.	0.51871c(12093024) AT (-600.00, -600.00) GC	50.	0.45655c(12083124) AT (-1200.00, -1200.00) GC

*** THE SUMMARY OF MAXIMUM PERIOD (8784 HRS) RESULTS ***

** CONC OF CO IN MICROGRAMS/M**3 **

NETWORK

GROUP ID		AVERAGE CONC	RECEPTOR (XR, YR, ZELEV, ZHILL, ZFLAG) OF TYPE GRID-ID
ALL	1ST HIGHEST VALUE IS	0.33197 AT (	-600.00, -600.00, 76.20, 76.20, 0.00) GC CAR1
…………	2ND HIGHEST VALUE IS	0.31067 AT (	-800.00, -600.00, 73.90, 73.90, 0.00) GC CAR1
…………	3RD HIGHEST VALUE IS	0.30097 AT (	-800.00, -800.00, 76.90, 76.90, 0.00) GC CAR1
………..	4TH HIGHEST VALUE IS	0.28294 AT (	-600.00, -800.00, 74.10, 74.10, 0.00) GC CAR1
………..	5TH HIGHEST VALUE IS	0.28004 AT (	-600.00, -400.00, 75.20, 75.20, 0.00) GC CAR1
………..	6TH HIGHEST VALUE IS	0.27880 AT (	-1000.00, -800.00, 76.20, 76.20, 0.00) GC CAR1
……….	7TH HIGHEST VALUE IS	0.27655 AT (	-400.00, -600.00, 75.30, 75.30, 0.00) GC CAR1
………..	8TH HIGHEST VALUE IS	0.27577 AT (	-1000.00, -600.00, 75.20, 75.20, 0.00) GC CAR1
………	9TH HIGHEST VALUE IS	0.26882 AT (	-800.00, -400.00, 75.60, 75.60, 0.00) GC CAR1
………….	10TH HIGHEST VALUE IS	0.24711 AT (	-1000.00, -1000.00, 74.40, 74.40, 0.00) GC CAR1

*** THE MAXIMUM 50 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***

INCLUDING SOURCE(S): STACK1 , STACK2 ,

** CONC OF NO IN MICROGRAMS/M**3 **

RANK	CONC (YYMMDDHH) AT RECEPTOR (XR,YR) OF TYPE	RANK	CONC (YYMMDDHH) AT RECEPTOR (XR,YR) OF TYPE
1.	4.72991 (12070424) AT (-800.00, -600.00) GC	26.	4.07593 (12071024) AT (-1400.00, -400.00) GC
2.	4.57137 (12070424) AT (-600.00, -600.00) GC	27.	4.04975 (12070524) AT (-800.00, -600.00) GC
3.	4.54029c(12072324) AT (-200.00, -1200.00) GC	28.	4.00647 (12050724) AT (-1000.00, -800.00) GC
4.	4.47798c(12072624) AT (200.00, -1000.00) GC	29.	4.00493 (12070524) AT (-600.00, -600.00) GC
5.	4.45052 (12052024) AT (-600.00, -600.00) GC	30.	3.98916 (12050724) AT (-800.00, -600.00) GC
6.	4.35900 (12041724) AT (-1200.00, -400.00) GC	31.	3.98278c(12081224) AT (-600.00, -600.00) GC
7.	4.35501 (12041724) AT (-1400.00, -400.00) GC	32.	3.98012 (12041724) AT (-1600.00, -600.00) GC
8.	4.32132c(12081224) AT (-600.00, -800.00) GC	33.	3.97213 (12070424) AT (-1000.00, -600.00) GC
9.	4.32004c(12072624) AT (200.00, -1200.00) GC	34.	3.95529 (12071024) AT (-800.00, -400.00) GC
10.	4.30947c(12072324) AT (-200.00, -1000.00) GC	35.	3.93831c(12081224) AT (-400.00, -600.00) GC
11.	4.28713 (12070424) AT (-1000.00, -800.00) GC	36.	3.93525c(12051124) AT (-600.00, -1000.00) GC
12.	4.28660c(12060424) AT (400.00, -1000.00) GC	37.	3.92546 (12052124) AT (-1000.00, -400.00) GC
13.	4.25112 (12020224) AT (-1200.00, -1200.00) GC	38.	3.92364 (12070424) AT (-1200.00, -800.00) GC
14.	4.25026c(12072324) AT (-200.00, -1400.00) GC	39.	3.92067 (12070324) AT (-800.00, -600.00) GC
15.	4.22884 (12071024) AT (-1000.00, -400.00) GC	40.	3.91735 (12020224) AT (-1600.00, -1400.00) GC
16.	4.21726c(12051124) AT (-400.00, -800.00) GC	41.	3.90252 (12081724) AT (-600.00, -600.00) GC
17.	4.21389 (12071024) AT (-1200.00, -400.00) GC	42.	3.90238 (12071024) AT (-800.00, -200.00) GC
18.	4.19264 (12052124) AT (-800.00, -400.00) GC	43.	3.90099 (12020224) AT (-1600.00, -1600.00) GC

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  19.    4.19202 (12020224) AT (  -1400.00,   -1400.00)  GC      44.     3.90050 (12051924) AT (   -600.00,    -800.00)  GC
  20.    4.14509c(12081224) AT (   -800.00,    -800.00)  GC      45.     3.89768 (12050724) AT (   -600.00,    -600.00)  GC
  21.    4.11543 (12041724) AT (  -1000.00,    -400.00)  GC      46.     3.89477 (12041724) AT (  -1800.00,    -600.00)  GC
  22.    4.10412 (12052024) AT (   -800.00,    -800.00)  GC      47.     3.89058 (12070324) AT (   -600.00,    -600.00)  GC
  23.    4.08511 (12041724) AT (  -1600.00,    -400.00)  GC      48.     3.87121 (12020224) AT (  -1400.00,   -1200.00)  GC
  24.    4.08251c(12060424) AT (    400.00,   -1200.00)  GC      49.     3.86513 (12041724) AT (  -1400.00,    -600.00)  GC
  25.    4.07623c(12051124) AT (   -400.00,   -1000.00)  GC      50.     3.84945 (12070624) AT (   -600.00,    -600.00)  GC


          *** THE MAXIMUM   50  MONTH AVERAGE CONCENTRATION   VALUES FOR SOURCE GROUP:  ALL      ***
                                  INCLUDING SOURCE(S):     STACK1      , STACK2      ,

                              ** CONC OF NO       IN MICROGRAMS/M**3                        **

RANK       CONC    (YYMMDDHH) AT      RECEPTOR (XR,YR) OF TYPE    RANK       CONC    (YYMMDDHH) AT      RECEPTOR (XR,YR) OF TYPE
 - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
   1.    1.73906c(12083124) AT (   -600.00,    -600.00)  GC      26.     1.19244c(12053124) AT (  -1000.00,    -600.00)  GC
   2.    1.63457c(12083124) AT (   -800.00,    -800.00)  GC      27.     1.18281c(12053124) AT (  -1000.00,   -1000.00)  GC
   3.    1.61933c(12083124) AT (   -600.00,    -800.00)  GC      28.     1.18068c(12083124) AT (  -1200.00,   -1000.00)  GC
   4.    1.54416c(12083124) AT (   -400.00,    -600.00)  GC      29.     1.16499c(12053124) AT (   -800.00,   -1000.00)  GC
   5.    1.48471c(12053124) AT (   -600.00,    -600.00)  GC      30.     1.15739c(12083124) AT (  -1000.00,    -600.00)  GC
   6.    1.46451c(12083124) AT (   -800.00,    -600.00)  GC      31.     1.14346c(12073124) AT (  -1200.00,    -600.00)  GC
   7.    1.41474c(12073124) AT (   -800.00,    -600.00)  GC      32.     1.14101c(12073124) AT (  -1000.00,    -400.00)  GC
   8.    1.40742c(12053124) AT (   -800.00,    -800.00)  GC      33.     1.13699c(12073124) AT (  -1200.00,    -800.00)  GC
   9.    1.40663c(12073124) AT (   -600.00,    -600.00)  GC      34.     1.12409c(12053124) AT (   -600.00,    -400.00)  GC
  10.    1.39941c(12083124) AT (  -1000.00,    -800.00)  GC      35.     1.12354c(12083124) AT (  -1200.00,    -800.00)  GC
  11.    1.37907c(12083124) AT (   -800.00,   -1000.00)  GC      36.     1.12330c(12053124) AT (  -1200.00,    -800.00)  GC
  12.    1.37551c(12053124) AT (   -800.00,    -600.00)  GC      37.     1.11954c(12053124) AT (  -1200.00,   -1000.00)  GC
  13.    1.33326c(12083124) AT (  -1000.00,   -1000.00)  GC      38.     1.11659c(12083124) AT (  -1000.00,   -1200.00)  GC
  14.    1.32086c(12053124) AT (   -600.00,    -800.00)  GC      39.     1.11648c(12063024) AT (   -800.00,    -600.00)  GC
  15.    1.30394c(12073124) AT (  -1000.00,    -600.00)  GC      40.     1.11143c(12093024) AT (   -800.00,    -600.00)  GC
  16.    1.29762c(12053124) AT (  -1000.00,    -800.00)  GC      41.     1.10463c(12093024) AT (   -600.00,    -400.00)  GC
  17.    1.26863c(12073124) AT (   -600.00,    -400.00)  GC      42.     1.09752c(12073124) AT (   -600.00,    -800.00)  GC
  18.    1.26484c(12073124) AT (   -800.00,    -400.00)  GC      43.     1.08635c(12063024) AT (   -400.00,    -600.00)  GC
  19.    1.24324c(12083124) AT (   -400.00,    -800.00)  GC      44.     1.08325c(12093024) AT (   -400.00,    -600.00)  GC
  20.    1.23854c(12063024) AT (   -600.00,    -600.00)  GC      45.     1.08239c(12083124) AT (  -1200.00,   -1200.00)  GC
  21.    1.23656c(12073124) AT (   -800.00,    -800.00)  GC      46.     1.07541c(12063024) AT (   -800.00,    -800.00)  GC
  22.    1.23091c(12083124) AT (   -600.00,   -1000.00)  GC      47.     1.07258c(12053124) AT (   -800.00,    -400.00)  GC
  23.    1.22615c(12053124) AT (   -400.00,    -600.00)  GC      48.     1.06730c(12093024) AT (   -400.00,    -400.00)  GC
  24.    1.22491c(12073124) AT (  -1000.00,    -800.00)  GC      49.     1.06501c(12073124) AT (   -400.00,    -600.00)  GC
  25.    1.19903c(12093024) AT (   -600.00,    -600.00)  GC      50.     1.06142c(12063024) AT (   -600.00,    -800.00)  GC


                              *** THE SUMMARY OF MAXIMUM PERIOD (  8784 HRS) RESULTS ***

                                 ** CONC OF NO       IN MICROGRAMS/M**3                        **
                                                                             NETWORK
         GROUP ID                  AVERAGE CONC               RECEPTOR  (XR, YR, ZELEV, ZHILL, ZFLAG)  OF TYPE  GRID-ID
 - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -


ALL       1ST HIGHEST VALUE IS       0.75841 AT (    -600.00,     -600.00,     76.20,     76.20,     0.00)  GC  CAR1
          2ND HIGHEST VALUE IS       0.72068 AT (    -800.00,     -600.00,     73.90,     73.90,     0.00)  GC  CAR1
          3RD HIGHEST VALUE IS       0.69585 AT (    -800.00,     -800.00,     76.90,     76.90,     0.00)  GC  CAR1
          4TH HIGHEST VALUE IS       0.65239 AT (   -1000.00,     -800.00,     76.20,     76.20,     0.00)  GC  CAR1
          5TH HIGHEST VALUE IS       0.64775 AT (   -1000.00,     -600.00,     75.20,     75.20,     0.00)  GC  CAR1
          6TH HIGHEST VALUE IS       0.64772 AT (    -600.00,     -800.00,     74.10,     74.10,     0.00)  GC  CAR1
          7TH HIGHEST VALUE IS       0.64440 AT (    -600.00,     -400.00,     75.20,     75.20,     0.00)  GC  CAR1
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8TH HIGHEST VALUE IS 0.62689 AT (-800.00, -400.00, 75.60, 75.60, 0.00) GC CAR1
9TH HIGHEST VALUE IS 0.62551 AT (-400.00, -600.00, 75.30, 75.30, 0.00) GC CAR1
10TH HIGHEST VALUE IS 0.58173 AT (-1200.00, -800.00, 74.80, 74.80, 0.00) GC CAR1

*** THE MAXIMUM 50 1-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): STACK1 , STACK2 ,

** CONC OF NO2 IN MICROGRAMS/M**3 **

RANK	CONC	(YYMMDDHH) AT	RECEPTOR (XR,YR) OF TYPE	RANK	CONC	(YYMMDDHH) AT	RECEPTOR (XR,YR) OF TYPE
1.	46.73724	(12021212) AT	(3000.00, -1000.00) GC	26.	42.87257	(12021212) AT	(4400.00, -1400.00) GC
2.	46.70871	(12021212) AT	(3200.00, -1000.00) GC	27.	42.73832	(12021212) AT	(4000.00, -1000.00) GC
3.	46.26811	(12021212) AT	(3400.00, -1000.00) GC	28.	42.63066	(12021212) AT	(3400.00, -1400.00) GC
4.	46.11015	(12021212) AT	(2800.00, -1000.00) GC	29.	42.54095	(12021212) AT	(2400.00, -600.00) GC
5.	46.00281	(12021212) AT	(2600.00, -800.00) GC	30.	42.35662	(12021212) AT	(2600.00, -600.00) GC
6.	45.97244	(12021212) AT	(2800.00, -800.00) GC	31.	42.33936	(12021212) AT	(2400.00, -1000.00) GC
7.	45.83206	(12021212) AT	(3600.00, -1200.00) GC	32.	42.30668	(12021212) AT	(2800.00, -1200.00) GC
8.	45.81617	(12021212) AT	(3400.00, -1200.00) GC	33.	42.27057	(12021212) AT	(4400.00, -1200.00) GC
9.	45.61081	(12021212) AT	(3000.00, -800.00) GC	34.	42.06395	(12021212) AT	(4600.00, -1400.00) GC
10.	45.39349	(12021212) AT	(3200.00, -1200.00) GC	35.	42.02795	(12021212) AT	(3600.00, -800.00) GC
11.	45.32906	(12021212) AT	(3600.00, -1000.00) GC	36.	41.95597	(12021212) AT	(2200.00, -600.00) GC
12.	45.24519	(12021212) AT	(3800.00, -1200.00) GC	37.	41.62959	(12021212) AT	(4400.00, -1600.00) GC
13.	45.14852	(12021212) AT	(2400.00, -800.00) GC	38.	41.60522	(12021212) AT	(2800.00, -600.00) GC
14.	44.73998	(12021212) AT	(2600.00, -1000.00) GC	39.	41.60516	(12021212) AT	(4200.00, -1600.00) GC
15.	44.64124	(12021212) AT	(3200.00, -800.00) GC	40.	41.42308	(12021212) AT	(4600.00, -1600.00) GC
16.	44.39781	(12021212) AT	(4000.00, -1200.00) GC	41.	41.33749	(12030206) AT	(-800.00, 1200.00) GC
17.	44.13488	(12021212) AT	(3800.00, -1000.00) GC	42.	41.31243	(12021212) AT	(4200.00, -1000.00) GC
18.	44.12730	(12021212) AT	(3000.00, -1200.00) GC	43.	41.27354	(12030206) AT	(-1000.00, 1200.00) GC
19.	43.93966	(12021212) AT	(3800.00, -1400.00) GC	44.	41.24765	(12021212) AT	(4000.00, -1600.00) GC
20.	43.81153	(12021212) AT	(4000.00, -1400.00) GC	45.	41.06545	(12030206) AT	(-800.00, 1000.00) GC
21.	43.57567	(12021212) AT	(3600.00, -1400.00) GC	46.	41.06026	(12021212) AT	(4800.00, -1400.00) GC
22.	43.48923	(12021212) AT	(4200.00, -1400.00) GC	47.	41.03297	(12021212) AT	(3200.00, -1400.00) GC
23.	43.46478	(12021212) AT	(3400.00, -800.00) GC	48.	40.98992	(12021212) AT	(4600.00, -1200.00) GC
24.	43.43862	(12021212) AT	(4200.00, -1200.00) GC	49.	40.97269	(12021212) AT	(4800.00, -1600.00) GC
25.	42.94276	(12021212) AT	(2200.00, -800.00) GC	50.	40.62115	(12030206) AT	(-1000.00, 1400.00) GC

*** THE MAXIMUM 50 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): STACK1 , STACK2 ,

** CONC OF NO2 IN MICROGRAMS/M**3 **

RANK	CONC	(YYMMDDHH) AT	RECEPTOR (XR,YR) OF TYPE	RANK	CONC	(YYMMDDHH) AT	RECEPTOR (XR,YR) OF TYPE
1.	9.55416	(12070424) AT	(-1000.00, -600.00) GC	26.	8.28625	(12070324) AT	(-1200.00, -800.00) GC
2.	9.40771c	(12072324) AT	(-200.00, -1200.00) GC	27.	8.24166	(12052024) AT	(-800.00, -600.00) GC
3.	9.35015c	(12072324) AT	(-200.00, -1400.00) GC	28.	8.23961c	(12060424) AT	(600.00, -1200.00) GC
4.	9.30539	(12070424) AT	(-1200.00, -800.00) GC	29.	8.21710	(12071024) AT	(-1200.00, -200.00) GC
5.	9.04886c	(12081224) AT	(-800.00, -800.00) GC	30.	8.21546	(12070624) AT	(-800.00, -800.00) GC
6.	8.97757	(12070424) AT	(-800.00, -600.00) GC	31.	8.18926	(12051924) AT	(-800.00, -800.00) GC
7.	8.87726c	(12051124) AT	(-600.00, -1000.00) GC	32.	8.17182c	(12072624) AT	(200.00, -1400.00) GC
8.	8.86009	(12070424) AT	(-1400.00, -800.00) GC	33.	8.17138	(12071024) AT	(-1400.00, -400.00) GC
9.	8.71616c	(12072624) AT	(200.00, -1200.00) GC	34.	8.16021	(12071024) AT	(-1400.00, -200.00) GC

10.	8.71455c(12072324) AT (	-200.00,	-1600.00)	GC	35.	8.14712 (12052024) AT (	-1200.00,	-800.00)	GC
11.	8.66670c(12051124) AT (	-600.00,	-1200.00)	GC	36.	8.10792 (12081624) AT (	-800.00,	-800.00)	GC
12.	8.66212c(12060424) AT (	400.00,	-1000.00)	GC	37.	8.06932c(12072624) AT (	400.00,	-1400.00)	GC
13.	8.66059 (12070524) AT (	-1000.00,	-600.00)	GC	38.	8.05995c(12072324) AT (	-400.00,	-1600.00)	GC
14.	8.63983 (12070424) AT (	-1000.00,	-800.00)	GC	39.	8.05953 (12070524) AT (	-1200.00,	-800.00)	GC
15.	8.63361 (12070424) AT (	-1200.00,	-600.00)	GC	40.	8.04468 (12052124) AT (	-1200.00,	-400.00)	GC
16.	8.61139 (12052024) AT (	-1000.00,	-800.00)	GC	41.	8.02690 (12070624) AT (	-1000.00,	-800.00)	GC
17.	8.50678c(12060424) AT (	400.00,	-1200.00)	GC	42.	8.01479 (12070324) AT (	-1000.00,	-600.00)	GC
18.	8.47286 (12050724) AT (	-1200.00,	-800.00)	GC	43.	7.99405 (12071024) AT (	-1600.00,	-400.00)	GC
19.	8.45907c(12051124) AT (	-400.00,	-1000.00)	GC	44.	7.98112 (12050724) AT (	-1400.00,	-800.00)	GC
20.	8.39517c(12072324) AT (	-200.00,	-1000.00)	GC	45.	7.98101c(12051224) AT (	-600.00,	-1000.00)	GC
21.	8.36585c(12060424) AT (	600.00,	-1400.00)	GC	46.	7.97302 (12050724) AT (	-1000.00,	-600.00)	GC
22.	8.35315c(12051124) AT (	-400.00,	-800.00)	GC	47.	7.97132c(12081224) AT (	-1000.00,	-800.00)	GC
23.	8.34076c(12072624) AT (	200.00,	-1000.00)	GC	48.	7.96241 (12050724) AT (	-1000.00,	-800.00)	GC
24.	8.33612 (12070524) AT (	-800.00,	-600.00)	GC	49.	7.93878 (12070324) AT (	-1000.00,	-800.00)	GC
25.	8.31414c(12081224) AT (	-1000.00,	-1000.00)	GC	50.	7.93590c(12072324) AT (	-200.00,	-1800.00)	GC

*** THE MAXIMUM 50 MONTH AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): STACK1 , STACK2 ,

** CONC OF NO2 IN MICROGRAMS/M**3 **

RANK	CONC (YYMMDDHH) AT	RECEPTOR (XR,YR)		OF TYPE	RANK	CONC (YYMMDDHH) AT	RECEPTOR (XR,YR)		OF TYPE
1.	3.61145c(12083124) AT (	-800.00,	-800.00)	GC	26.	2.70958c(12073124) AT (	-600.00,	-600.00)	GC
2.	3.49728c(12083124) AT (	-600.00,	-600.00)	GC	27.	2.70944c(12053124) AT (	-1200.00,	-1000.00)	GC
3.	3.49401c(12083124) AT (	-800.00,	-600.00)	GC	28.	2.70761c(12083124) AT (	-1200.00,	-1200.00)	GC
4.	3.47212c(12083124) AT (	-1000.00,	-800.00)	GC	29.	2.63334c(12083124) AT (	-400.00,	-600.00)	GC
5.	3.16836c(12083124) AT (	-1000.00,	-1000.00)	GC	30.	2.62722c(12083124) AT (	-1000.00,	-1200.00)	GC
6.	3.16828c(12083124) AT (	-600.00,	-800.00)	GC	31.	2.62488c(12073124) AT (	-800.00,	-800.00)	GC
7.	3.12058c(12083124) AT (	-1000.00,	-600.00)	GC	32.	2.62095c(12063024) AT (	-800.00,	-600.00)	GC
8.	3.06412c(12073124) AT (	-1000.00,	-600.00)	GC	33.	2.60889c(12083124) AT (	-1400.00,	-1200.00)	GC
9.	3.05022c(12083124) AT (	-1200.00,	-800.00)	GC	34.	2.60606c(12073124) AT (	-1400.00,	-800.00)	GC
10.	3.04125c(12053124) AT (	-800.00,	-600.00)	GC	35.	2.60493c(12053124) AT (	-600.00,	-800.00)	GC
11.	3.03927c(12083124) AT (	-1200.00,	-1000.00)	GC	36.	2.59280c(12053124) AT (	-1200.00,	-600.00)	GC
12.	3.03484c(12073124) AT (	-800.00,	-600.00)	GC	37.	2.58880c(12063024) AT (	-600.00,	-600.00)	GC
13.	3.03161c(12053124) AT (	-1000.00,	-800.00)	GC	38.	2.58688c(12073124) AT (	-1400.00,	-600.00)	GC
14.	3.01570c(12053124) AT (	-800.00,	-800.00)	GC	39.	2.57910c(12083124) AT (	-1200.00,	-600.00)	GC
15.	3.00718c(12083124) AT (	-800.00,	-1000.00)	GC	40.	2.57552c(12073124) AT (	-600.00,	-400.00)	GC
16.	2.91007c(12053124) AT (	-1000.00,	-600.00)	GC	41.	2.57492c(12093024) AT (	-800.00,	-600.00)	GC
17.	2.89726c(12053124) AT (	-600.00,	-600.00)	GC	42.	2.57161c(12083124) AT (	-1400.00,	-800.00)	GC
18.	2.86021c(12073124) AT (	-800.00,	-400.00)	GC	43.	2.56495c(12093024) AT (	-600.00,	-600.00)	GC
19.	2.85976c(12073124) AT (	-1200.00,	-600.00)	GC	44.	2.55750c(12053124) AT (	-1400.00,	-1000.00)	GC
20.	2.81523c(12053124) AT (	-1200.00,	-800.00)	GC	45.	2.55273c(12073124) AT (	-1200.00,	-400.00)	GC
21.	2.79537c(12073124) AT (	-1000.00,	-800.00)	GC	46.	2.52633c(12053124) AT (	-800.00,	-1000.00)	GC
22.	2.78804c(12073124) AT (	-1000.00,	-400.00)	GC	47.	2.52565c(12053124) AT (	-1400.00,	-800.00)	GC
23.	2.75790c(12073124) AT (	-1200.00,	-800.00)	GC	48.	2.50808c(12053124) AT (	-800.00,	-400.00)	GC
24.	2.73795c(12083124) AT (	-1400.00,	-1000.00)	GC	49.	2.49674c(12083124) AT (	-600.00,	-1000.00)	GC
25.	2.71429c(12053124) AT (	-1000.00,	-1000.00)	GC	50.	2.49462c(12083124) AT (	-600.00,	-400.00)	GC

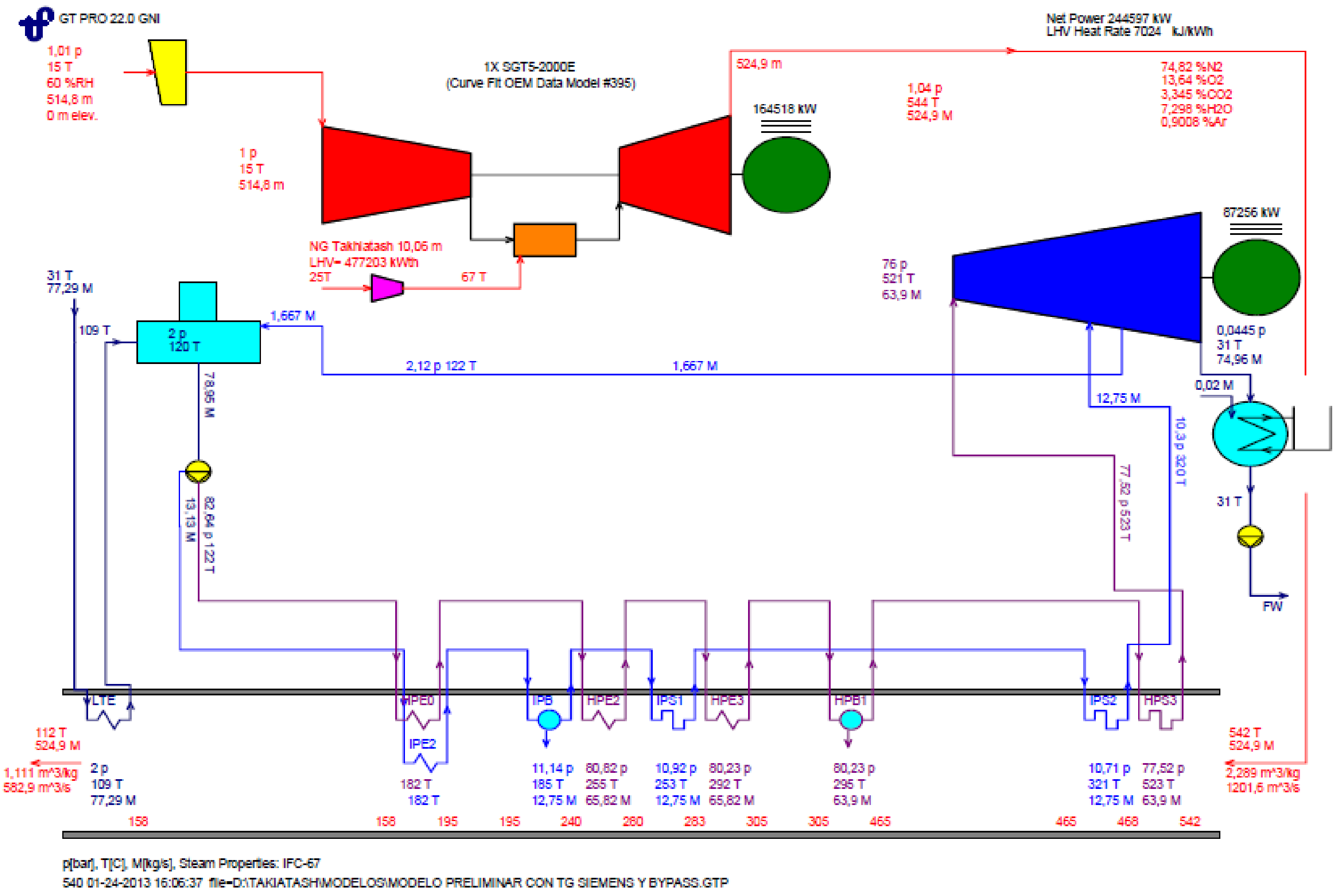
*** THE SUMMARY OF MAXIMUM PERIOD (8784 HRS) RESULTS ***

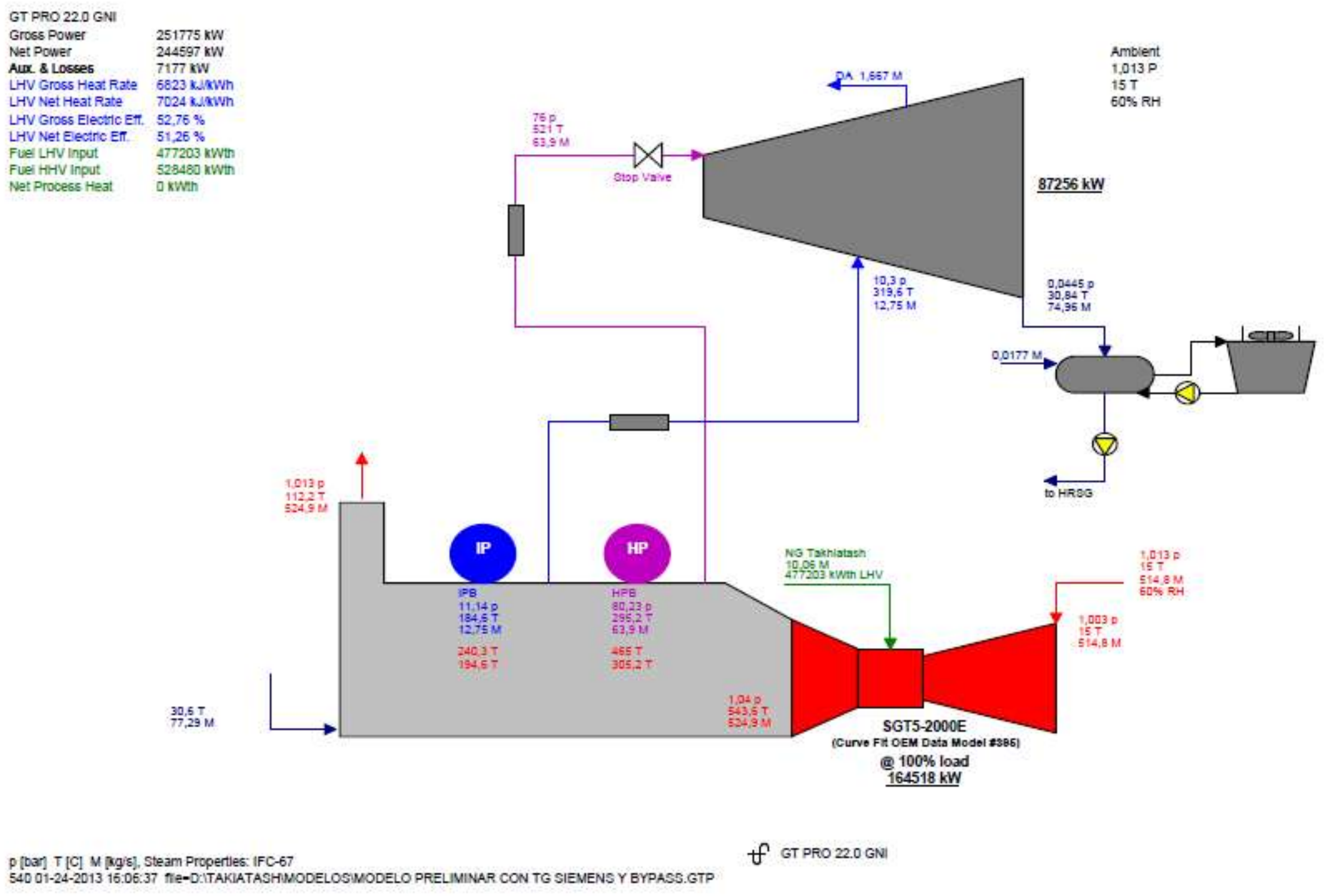
** CONC OF NO2 IN MICROGRAMS/M**3 **

NETWORK

GROUP ID		AVERAGE CONC	RECEPTOR (XR, YR, ZELEV, ZHILL, ZFLAG) OF TYPE GRID-ID						
ALL	1ST HIGHEST VALUE IS	1.57853 AT (	-800.00,	-600.00,	73.90,	73.90,	0.00)	GC	CAR1
	2ND HIGHEST VALUE IS	1.53499 AT (	-1000.00,	-600.00,	75.20,	75.20,	0.00)	GC	CAR1
	3RD HIGHEST VALUE IS	1.51040 AT (	-1000.00,	-800.00,	76.20,	76.20,	0.00)	GC	CAR1
	4TH HIGHEST VALUE IS	1.49258 AT (	-600.00,	-600.00,	76.20,	76.20,	0.00)	GC	CAR1
	5TH HIGHEST VALUE IS	1.49065 AT (	-800.00,	-800.00,	76.90,	76.90,	0.00)	GC	CAR1
	6TH HIGHEST VALUE IS	1.42876 AT (	-1200.00,	-800.00,	74.80,	74.80,	0.00)	GC	CAR1
	7TH HIGHEST VALUE IS	1.42062 AT (	-800.00,	-400.00,	75.60,	75.60,	0.00)	GC	CAR1
	8TH HIGHEST VALUE IS	1.40391 AT (	-1200.00,	-600.00,	74.60,	74.60,	0.00)	GC	CAR1
	9TH HIGHEST VALUE IS	1.35725 AT (	-1000.00,	-400.00,	75.40,	75.40,	0.00)	GC	CAR1
	10TH HIGHEST VALUE IS	1.33612 AT (	-600.00,	-400.00,	75.20,	75.20,	0.00)	GC	CAR1

Appendix III: Thermoflow results




GT PRO 22.0 GNI
Gross Power 251775 kW
Net Power 244597 kW
Aux. & Losses 7177 kW
LHV Gross Heat Rate 6823 kJ/kWh
LHV Net Heat Rate 7024 kJ/kWh
LHV Gross Electric Eff. 52,76 %
LHV Net Electric Eff. 51,26 %
Fuel LHV Input 477203 kWth
Fuel HHV Input 528480 kWth
Net Process Heat 0 kWth
Ambient
1,013 P
15 T
60% RH
DA 1,667 M
76 p
521 T
63,9 M
Stop Valve
87256 kW
10,3 p
319,6 T
12,75 M
0,0445 p
30,84 T
74,96 M
0,0177 M
to HRSG
1,013 p
112,2 T
524,9 M
IP
HP
IPB
11,14 p
184,6 T
12,75 M
240,3 T
194,6 T
HPB
80,23 p
295,2 T
63,9 M
465 T
305,2 T
NG Takhiatash
10,06 M
477203 kWth LHV
1,013 p
15 T
514,8 M
60% RH
1,003 p
15 T
514,8 M
30,6 T
77,29 M
1,04 p
543,6 T
524,9 M
SGT5-2000E
(Curve Fit OEM Data Model #386)
@ 100% load
164518 kW
p [bar] T [C] M [kg/s], Steam Properties: IFC-67
540 01-24-2013 16:06:37 file=D:\TAKIATASH\MODELOS\MODELO PRELIMINAR CON TG SIEMENS Y BYPASS.GTP
GT PRO 22.0 GNI

ANNEX IV: NOISE MONITORING CAMPAIGN

Translation of the original soil analysis report into English:

Explanatory note

On the measurements of noise at the Takhiatash TPP

Takhiatash
03.2013

According to the Contract No 124/13 from 26.02.2013 with LLC «ISLOHOTKONSALTSERVIS» the following department of environmental work and industrial hygiene staff of UE «Uzenergosozlash»: Lead engineer B. Mukhtarov and first category engineer N.H. Nadzhimuddinov together with the PIU leader at the Takhiatash TPP, P. Kutlumuradov, performed measurements of the levels of noise from the Takhiatash TPP near the settlements and in the areas surrounding the plant.

The measurements were performed on 4.03.2013 in the day and at night and then on 5.03.2013 in the day and evening. The weather was warm and only in the evening of 5 March did it get cold: wind rose and there was light rain which had no substantial impact on the results of the measurements.

The reports on the measurements are attached. The measurements showed that the levels of noise from the Takhiatash TPP are on average below the Maximum Allowable Levels (SanRaN RU №0267 – 09) and depend on the distance from the source of noise and the direction of the wind.

The survey performed on local residents showed that the noise from the operating plant is not disturbing, although during the starting of the boilers high-pressure steam is released and during that period of time (ranging from 10 minutes to 2 hours) the level of noise increases sharply and it is heard even at a distance of 4-5 km from the plant in Takhiatash.

While measuring indoors the level of noise decreases sharply and is practically impossible to measure.

The highest level of noise was measured in point No 6. It is a residential settlement of a former army unit and the houses are located in close proximity to the fence of the plant premises and near the location of the planned Combined-Cycle Plant.

Lead engineer	**B. Mukhtarov**
First category engineer	**N.H. Nadzhimuddinov**

SJSC «UZBEKENERGO» UE «UZENERGOSOZLASH»

DEPARTMENT OF ENVIRONMENTAL WORK AND INDUSTRIAL HYGIENE

Date March 2013 Location Takhiatash

R E P O R T

On the results of the measurements of the levels of noise

Location Takhiatash TPP

Source of noise

Method of measurement: GOST 12-1050-86 «Method of measuring noise at work places»

Allowable levels of noise: SanRaN UZ No 0267-09. «Sanitary norms and regulations on ensuring allowable noise in residential and public buildings and residential areas»

GOST 12.1.003-83 «Noise. General safety requirements»

Measuring devices Noise meter -003-M2 No 2431 .
Tested 09.07.2012
Certificate No 786/05

Measurements performed by a department of environmental work and industrial hygiene team including:

Lead engineer B. Mukhtarov
First category engineer N.H. Hadzhimuddinov

Representatives of the facility present at the measurements:

#	Date and time of measurement conducting	Type of noise	Level of noise pressure (dBa) in octane period Hz								eqv, dBa
			63	125	250	500	1000	2000	4000	8000	
1	2	3	4	5	6	7	8	9	10	11	12
Limits for the territory of the living area[1]											
	Day time		75	66	59	54	50	47	45	43	55
	Night time		67	57	49	44	40	37	35	33	45
Limits inside houses of the living area											
	Between 7 to 23 h		63	52	45	39	35	32	30	28	40
4 March 2013. Weather conditions: t=15 °C, Humidity – 51%, wind speed 0 m/s, without clouds											
Point 1. (close to greenhouses)											
	15:36 1st measurement		56	51	43	45	49	47	40	26	53
	2st measurement		55	52	44	44	49	47	40	25	54
	3st measurement		54	52	43	46	48	46	39	26	53
	Average noise level		5	52	43	45	49	47	40	26	53
	Exceeding allowed level		-20	-6	-16	-9	-1	0	-5	-17	-2
Point 2. Between mazut storage tanks											
	14:23 1st measurement		56	57	49	48	47	44	38	26	50
	2st measurement		55	56	50	47	46	45	39	25	51
	3st measurement		57	57	49	49	46	46	37	27	50
	Average noise level		56	57	49	48	46	45	38	26	50
	Exceeding allowed level		-19	-9	-10	-6	-4	-2	-7	-17	-5
Point 3. Close to WTP (XBO), sludge area											
	15:05 1st measurement		61	56	47	46	44	41	34	20	50
	2st measurement		60	56	47	45	43	41	35	20	51
	3st measurement		61	55	48	44	44	42	33	20	50
	Average noise level		61	56	47	45	44	41	34	20	50
	Exceeding allowed level		-14	-10	-12	-9	-6	-6	-11	-23	-5
Point 4. Between water intake and water discharge canals											
	14:35 1st measurement		62	54	46	41	46	46	41	22	58
	2st measurement		63	54	47	42	45	45	42	22	57
	3st measurement		62	53	48	40	46	46	43	21	58
	Average noise level		62	54	47	41	46	46	42	22	58
	Exceeding allowed level		-13	-12	-12	-13	-6	-1	-3	-21	**3**
Point 5. Close to the main entrance											
	15:42 1st measurement		57	51	42	48	52	53	44	31	55
	2st measurement		56	50	43	49	51	53	42	30	56
	3st measurement		57	49	42	47	52	54	43	31	55
	Average noise level		57	50	42	48	52	53	43	31	55
	Exceeding allowed level		-18	-16	-17	-6	**2**	**6**	-2	-2	0
Point 6. Living area closes point to TPP											
	15:15 1st measurement		66	64	56	52	52	51	46	29	57
	2st measurement		65	65	55	51	52	50	46	30	56
	3st measurement		67	63	55	53	53	51	45	29	57

[1] Sanitarian Rules and Norms № 0267-09. «Sanitarian Rules and Norms on providing allowed noise level into the living building, public building and territory of leaving area”

	Average noise level		66	64	55	52	52	51	46	29	57
	Exceeding allowed level		-9	-2	-4	-2	**2**	**4**	**1**	-14	**2**
	15:25 1st measurement		59	51	44	40	38	34	28	19	45
	2st measurement		60	50	45	41	39	35	27	20	44
	3st measurement		58	51	46	41	38	34	28	19	45
	Average noise level		59	51	45	41	38	34	28	19	45
	Exceeding allowed level		-4	-1	0	2	3	2	-2	-9	-5
Point 7. At the discharge canal											
	14:20 1st measurement		59	51	42	48	44	46	35	21	52
	2st measurement		60	51	43	47	43	45	36	21	51
	3st measurement		61	52	42	46	44	46	37	22	52
	Average noise level		60	51	42	47	44	46	36	21	52
	Exceeding allowed level		-15	-15	-17	-7	-6	-1	-9	-22	-3
Point 7’. At the discharge canal (Inside house)											
	14:32 1st measurement		-	-	-	-	-	-	-	-	20
	2st measurement		-	-	-	-	-	-	-	-	19
	3st measurement		-	-	-	-	-	-	-	-	20
	Average noise level		-	-	-	-	-	-	-	-	20
	Exceeding allowed level		-	-	-	-	-	-	-	-	-25
Point 8. In front of administration building											
	14:45 1st measurement		56	46	38	38	38	39	31	22	41
	2st measurement		55	47	39	38	38	39	30	21	42
	3st measurement		56	46	39	37	38	40	31	23	41
	Average noise level		56	46	39	38	38	39	31	22	41
	Exceeding allowed level		-19	-20	-20	-16	-12	-8	-14	-21	-14
4-5 March 2013. Weather conditions: t=11.9ºC, Humidity-56%, wind speed 0 m/s, cloudy.											
Point 1. (close to greenhouses).											
	23:50 1st measurement		56	55	54	53	52	52	45	32	62
	2st measurement		55	54	55	52	52	51	46	31	61
	3st measurement		54	54	54	52	51	51	45	32	63
	Average noise level		55	54	54	52	52	51	45	32	62
	Exceeding allowed level		-12	-3	**5**	**8**	**8**	**14**	**10**	-1	**17**
Point 2. Between mazut storage tanks											
	00:50 1st measurement		63	54	51	50	47	42	40	26	60
	2st measurement		62	55	52	51	48	41	41	25	61
	3st measurement		63	56	52	50	48	42	40	26	60
	Average noise level		63	55	52	50	48	42	40	26	60
	Exceeding allowed level		-4	-2	**3**	**6**	**8**	**5**	**5**	-7	**15**
Point 3. Close to WTP (XBO), sludge area											
	00:25 1st measurement		52	50	47	45	43	42	38	31	62
	2st measurement		51	49	48	46	43	41	38	30	62
	3st measurement		52	50	47	44	44	41	39	31	61
	Average noise level		52	50	47	45	43	41	38	31	62
	Exceeding allowed level		-15	-7	-2	**1**	**3**	**4**	**3**	**2**	**17**
Point 4. Between water intake and water discharge canals											
	01:03 1st		48	45	35	32	31	26	20	20	43

	measurement										
	2st measurement		47	45	36	31	31	25	20	20	45
	3st measurement		48	46	35	31	32	26	21	19	44
	Average noise level		48	45	35	31	31	26	20	20	44
	Exceeding allowed level		-19	-12	-14	-7	-9	-11	-15	-13	-1
Point 5. Close to the main entrance											
	23:15 1st measurement		52	48	45	41	38	45	38	31	53
	2st measurement		51	47	46	42	39	46	38	31	54
	3st measurement		52	48	47	42	39	44	39	32	55
	Average noise level		52	48	46	41	39	45	38	31	54
	Exceeding allowed level		-15	-9	-3	-3	-1	**3**	**3**	-2	**9**
Point 6. Living area closes point to TPP											
	00:15 1st measurement		65	64	62	58	58	57	51	39	64
	2st measurement		66	64	61	57	59	57	51	40	65
	3st measurement		65	65	63	59	58	58	52	39	64
	Average noise level		65	64	62	58	58	57	51	39	64
	Exceeding allowed level		-2	**7**	**13**	**6**	**18**	**20**	**16**	**6**	**19**
Point 7. At the discharge canal											
	00:40 1st measurement		51	40	32	30	31	33	31	27	40
	2st measurement		52	41	31	31	31	32	30	28	40
	3st measurement		52	40	33	30	32	33	31	27	41
	Average noise level		52	40	32	30	31	33	31	27	40
	Exceeding allowed level		-15	-17	-17	-14	-9	-4	-4	-6	-5
Point 8. In front of administration building											
	01:16 1st measurement		51	44	37	31	31	29	26	25	43
	2st measurement		52	45	38	31	30	28	26	24	42
	3st measurement		52	45	37	32	30	29	27	23	43
	Average noise level		52	45	37	31	30	29	26	24	43
	Exceeding allowed level		-15	-12	-12	-13	-10	-8	-9	-9	-2
5 March 2013											
Point 1 Weather conditions: t=14 ^{o}C, Humidity – 68%, wind speed 1 m/s, direction – south											
	10:11 1st measurement		57	56	48	43	56	54	46	33	60
	2st measurement		56	56	49	43	57	54	45	34	60
	3st measurement		57	55	48	44	57	53	46	33	61
	Average noise level		57	56	48	43	57	54	46	33	60
	Exceeding allowed level		-18	-10	-11	-11	**7**	**7**	**1**	-10	**5**
Point 1. During boiler start up. Weather conditions: t=18 ^{o}C, Humidity – 44%, wind speed 1 m/s, direction - east											
	16:55 1st measurement		66	64	51	55	64	61	55	36	68
	2st measurement		65	64	52	54	65	61	55	36	69
	3st measurement		65	63	51	55	64	60	54	37	68
	Average noise level		65	64	51	55	64	61	54	36	68
	Exceeding allowed level		-10	-2	-8	**1**	**14**	**14**	**10**	**7**	**13**
Point 2. Weather conditions: t=14 ^{o}C, Humidity – 68%, wind speed 1 m/s, direction – south											
	10:16 1st measurement		61	56	52	56	52	49	45	29	52
	2st measurement		62	56	51	56	52	50	44	29	51
	3st measurement		61	55	52	55	51	48	45	28	52

	Average noise level		61	56	52	56	52	49	45	29	52
	Exceeding allowed level		-14	-10	-7	**2**	**2**	**2**	0	-14	-3
Point 3. Close to WTP (XBO), sludge area											
	10:28 1st measurement		61	56	49	48	47	44	37	27	53
	2st measurement		60	56	50	48	46	43	37	26	51
	3st measurement		61	55	48	47	47	44	36	27	52
	Average noise level		61	56	49	48	47	44	37	27	52
	Exceeding allowed level		-14	-10	-10	-6	-3	-3	-8	-16	-3
Point 4. Between water intake and water discharge canals											
	10:50 1st measurement		56	51	41	43	47	48	45	31	51
	2st measurement		55	51	40	43	46	48	44	31	52
	3st measurement		56	50	41	44	47	47	45	32	51
	Average noise level		56	51	41	43	47	48	45	31	51
	Exceeding allowed level		-19	-15	-18	-11	-3	**1**	0	-12	-4
Point 5. Close to the main entrance											
	10:03 measurement		53	48	41	45	47	46	42	29	51
	2st measurement		54	49	40	45	47	45	43	29	52
	3st measurement		53	48	41	44	46	46	42	28	51
	Average noise level		53	48	41	45	47	46	42	29	51
	Exceeding allowed level		-22	-18	-18	-9	-3	-1	-3	-18	-4
Point 6. Living area closes point to TPP											
	10:22 1st measurement		67	64	66	66	54	50	45	32	58
	2st measurement		68	64	65	65	54	50	46	31	59
	3st measurement		67	63	66	65	53	51	45	32	58
	Average noise level		67	64	66	65	54	50	45	32	58
	Exceeding allowed level		-8	-2	**7**	**11**	**4**	**3**	0	-11	**3**
Point 7. At the discharge canal											
	10:40 1st measurement		55	49	35	46	42	44	38	27	51
	2st measurement		54	49	36	45	42	43	39	28	51
	3st measurement		55	48	35	44	41	44	38	29	52
	Average noise level		55	49	35	45	42	44	38	28	51
	Exceeding allowed level		-20	-17	-23	-9	-8	-3	-7	-15	-4
Point 8. In front of administration building											
	10:57 1st measurement		58	54	41	42	49	47	42	21	53
	2st measurement		58	53	41	43	48	47	42	20	53
	3st measurement		59	52	42	44	47	47	41	21	54
	Average noise level		58	53	41	43	48	47	42	21	53
	Exceeding allowed level		-17	-13	-18	-11	-2	0	-3	-22	-2
5 March evening. . Weather conditions: t=11 ^{o}C, Humidity – 72%, wind speed 10 m/s, direction – east-south-east											
Point 1. (close to greenhouses)											
	19:46 1st measurement		58	57	54	55	53	52	47	32	59
	2st measurement		59	57	53	55	53	52	47	32	59
	3st measurement		58	56	54	54	52	51	48	31	58
	Average noise level		58	57	54	55	53	52	47	32	59
	Exceeding allowed level		-17	-9	-5	**1**	**3**	**5**	**2**	-11	**4**
Point 2. Between mazut storage tanks											
	19:52 1st measurement		64	54	51	50	48	42	42	28	59

	2st measurement		63	53	50	50	48	42	41	28	58
	3st measurement		64	54	50	51	49	43	42	27	59
	Average noise level		64	54	50	50	48	42	42	28	59
	Exceeding allowed level		-11	-12	-9	-4	-2	-5	-3	-15	**4**
Point 3. Close to WTP (XBO), sludge area											
	20:08 1st measurement		51	49	46	46	44	43	38	31	63
	2st measurement		51	49	46	46	44	43	38	30	64
	3st measurement		50	48	45	45	43	42	39	31	63
	Average noise level		51	49	46	46	44	43	38	31	63
	Exceeding allowed level		-24	-17	-13	-8	-6	-4	-7	-12	**8**
Point 4. Between water intake and water discharge canals											
	20:18 1st measurement		48	43	35	33	30	28	21	20	44
	2st measurement		49	43	35	33	30	28	21	20	44
	3st measurement		48	44	36	34	31	29	20	20	43
	Average noise level		48	43	35	33	30	28	21	20	44
	Exceeding allowed level		-27	-23	-24	-21	-20	-19	-24	-23	-11
Point 5. Close to the main entrance											
	19:40 1st measurement		52	46	43	40	41	46	39	40	52
	2st measurement		51	46	43	40	40	46	40	41	52
	3st measurement		52	45	42	41	41	45	39	40	53
	Average noise level		52	46	43	40	41	46	39	40	52
	Exceeding allowed level		-23	-26	-16	-14	-9	-1	-6	-3	-3
Point 6. Living area closes point to TPP											
	19:57 1st measurement		64	64	62	59	58	57	52	40	58
	2st measurement		63	64	62	59	58	56	53	41	58
	3st measurement		64	63	63	60	57	57	52	40	57
	Average noise level		64	64	62	59	58	57	52	40	58
	Exceeding allowed level		-11	-2	**3**	**5**	**8**	**10**	**7**	-3	**3**
Point 7. At the discharge canal											
	20:15 1st measurement		52	42	37	33	30	32	33	27	42
	2st measurement		51	42	36	32	30	31	33	26	41
	3st measurement		51	41	36	31	31	32	32	27	42
	Average noise level		51	42	36	32	30	32	33	27	42
	Exceeding allowed level		-24	-24	-23	-22	-20	-15	-12	-16	-13
Point 8. In front of administration building											
	20:28 1st measurement		51	45	36	32	30	28	27	26	42
	2st measurement		52	46	36	31	30	29	26	26	41
	3st measurement		51	45	35	32	31	28	28	25	42
	Average noise level		51	45	36	32	30	28	27	26	42
	Exceeding allowed level		-24	-21	-23	-22	-20	-19	-18	-17	-12

ANNEX V: SOIL ANALYSIS

Translation of the original soil analysis report into English

«APPROVED BY»
Head of ANIDI (State Specialized Inspection of Analytical Control)

________Mirrakhimov M.M.
«___»_______ 2013

REPORT ON THE MEASUREMENTS No

3 pages

Determination of content of organochlorine pesticides in soil
(name of performed experiment)

Name of the laboratory: State Specialized Inspection of Analytical Control (ANIDI) № UZ.AMT.07.MAI. 429, 1001100 Tashkent, 13 A S. Rustavely str., phone: 255-08-67, fax: 255-23-89, e-mail: anidi@uznature.uz .
(address, phone, fax, accreditation certificate number)

Name of customer: LLC «ISLOHOTKONSALTSERVIS», Tashkent, 79 S. Azimov str., phone: (371) 232-43-47, fax: 233-88-22 .
(address, phone, fax)

Description and labelling data of the object of measuring: 13 samples from the Takhiatash TPP area. Date of sampling 02.03.13 Date of receipt of samples 09.03.2013 .
(batch number, sample number, date of receipt and date of soil testing)

Objective and tasks of measurement: determination of content of ingredients.

Regulatory documentation and plan on measurement objects: GOST 28168-89 «Soils Sampling», SanRaN RU No 0191-05 «Maximum allowable concentrations (MAC) and tentative allowable concentrations (TAC) of exogenous harmful substances in soil».

Regulatory documentation on methods of measurement: RD 52.18.180-89 Procedure of measurements of the mass fraction of halo-organic pesticides in soil samples.

Conditions of performing measurements: _ t = 22^0C and humidity-57% .
(temperature, humidity and other conditions)

Measurements performed by a subcontractor –

Test (measurements) results

Name of parameters (requirements)	Value of parameters (requirements)		Compliance with parameters (requirements)	Excess
	by Regulatory documentation	Actual mg/kg		
№1 α - HCH	Σ=0.1 mg/kg	not detected	Complying	-
γ - HCH		not detected		
DDE	DDT and its metabolites Σ=0.5 mg/kg	0.005	Complying	-
DDD		not detected		
DDT		Trace		
№2 α - HCH	Σ=0.1 mg/kg	not detected	Complying	-
γ - HCH		not detected		
DDE	DDT and its metabolites Σ=0.5 mg/kg	not detected	Complying	-
DDD		not detected		
DDT		not detected		
№3 α - HCH	Σ=0.1 mg/kg	not detected	Complying	-
γ - HCH		not detected		
DDE	DDT and its metabolites Σ=0.5 mg/kg	not detected	Complying	-
DDD		not detected		
DDT		not detected		
№4 α - HCH	Σ=0.1 mg/kg	not detected	Complying	-
γ - HCH		not detected		
DDE	DDT and its metabolites Σ=0.5 mg/kg	not detected	Complying	-
DDD		not detected		
DDT		not detected		
№5 α - HCH	Σ=0.1 mg/kg	not detected	Complying	-
γ - HCH		not detected		
DDE	DDT and its metabolites Σ=0.5 mg/kg	not detected	Complying	-
DDD		not detected		
DDT		not detected		
№6 - HCH	Σ=0.1 mg/kg	not detected	Complying	-
γ - HCH		not detected		
DDE	DDT and its metabolites Σ=0.5 mg/kg	not detected	Complying	-
DDD		not detected		
DDT		not detected		
№7 α - HCH	Σ=0.1 mg/kg	not detected	Complying	-
γ - HCH		not detected		
DDE	DDT and its metabolites Σ=0.5 mg/kg	not detected	Complying	-
DDD		not detected		
DDT		not detected		
№8 α - HCH	Σ=0.1 mg/kg	not detected	Complying	-
γ - HCH		not detected		
DDE	DDT and its metabolites Σ=0.5 mg/kg	not detected	Complying	-
DDD		not detected		
DDT		not detected		

Test (measurements) results

Name of parameters (requirements)		Value of parameters (requirements)		Compliance with parameters (requirements)	Excess
		by Regulatory documentation	Actual mg/kg		
№9	α - HCH	Σ=0.1 mg/kg	not detected	Complying	-
	γ - HCH		not detected		
	DDE	DDT and its metabolites Σ=0.5 mg/kg	not detected	Complying	-
	DDD		not detected		
	DDT		not detected		
№10	α - HCH	Σ=0.1 mg/kg	not detected	Complying	-
	γ - HCH		not detected		
	DDE	DDT and its metabolites Σ=0.5 mg/kg	not detected	Complying	-
	DDD		not detected		
	DDT		not detected		
№11	α - HCH	Σ=0.1 mg/kg	not detected	Complying	-
	γ - HCH		not detected		
	DDE	DDT and its metabolites Σ=0.5 mg/kg	0.012	Complying	-
	DDD		not detected		
	DDT		0.013		
№12	α - HCH	Σ=0.1 mg/kg	not detected	Complying	-
	γ - HCH		not detected		
	DDE	DDT and its metabolites Σ=0.5 mg/kg	not detected	Complying	-
	DDD		not detected		
	DDT		not detected		
№13	α - HCH	Σ=0.1 mg/kg	not detected	Complying	-
	γ - HCH		not detected		
	DDE	DDT and its metabolites Σ=0.5 mg/kg	not detected	Complying	-
	DDD		not detected		
	DDT		not detected		

Date of performing the measurements________14.03.13_________________________________

Person in charge of the measurement (head of department)___________________________________

Name (signature)

Measurements performed by____

Date of release of the report ____

«APPROVED BY»
Head of ANIDI (State Specialized Inspection of Analytical Control)

________Mirrakhimov M.M.
«___»_______ 2013

REPORT ON THE MEASUREMENTS No

4 pages

Determination of the content of heavy metals in soil
(name of performed experiment)

Name of the laboratory: State Specialized Inspection of Analytical Control (ANIDI) № UZ.AMT.07.MAI. 429, 1001100 Tashkent, 13 A S. Rustavely str., phone: 255-08-67, fax: 255-23-89, e-mail: anidi@uznature.uz .
(address, phone, fax, accreditation certificate number)

Name of customer: LLC «ISLOHOTKONSALTSERVIS», Tashkent, 79 S. Azimov str., phone: (371) 232-43-47, fax: 233-88-22 .
(address, phone, fax)

Description and labelling data of the object of measuring: 13 samples from the Takhiatash TPP area. Date of sampling 02.03.13 Date of receipt of samples 09.03.2013 .
(batch number, sample number, date of receipt and date of soil testing)

Objective and tasks of measurement: determination of content of ingredients.

Regulatory documentation and plan on measurement objects: GOST 28168-89 «Soils Sampling», SanRaN RU No 0191-05 «Maximum allowable concentrations (MAC) and tentative allowable concentrations (TAC) of exogenous harmful substances in soil».

Regulatory documentation on measuring methods: O'z O'U 0482:2009 Procedure of measurements of the mass fraction of lead in soil samples by the atomic absorption method. O'z O'U 0422:2009 Procedure of measurements of the mass fraction of mercury in soil samples by the atomic absorption method. O'z O'U 0510:2010 Procedure of measurements of the mass fraction of chromium in soil samples by the atomic absorption method. O'z O'U 0502:2009 Procedure of measurements of the mass fraction of cadmium in soil samples by the atomic absorption method. O'z O'U 0521:2011 Procedure of measurements of the mass fraction of arsenic in water and soil by the atomic absorption method. Ruling document 52.18.191-89 Procedure of measurements of the mass fraction of the acid-soluble forms of metals (lead, chromium, cadmium, copper, zink, cobalt, nickel and manganese) in soil samples by the atomic absorption method.

Conditions of performing measurements: t=22^{0}C, humidity-57%
.

(temperature, humidity and other environmental conditions)

Measurements performed by a subcontractor –

Test (measurements) results on heavy metals

Name of parameters (requirements)		Value of parameters (requirements)		Compliance with parameters (requirements)
		by Regulatory documentation	Actual	
Sample No1.	Pb	32.0	10.083	Complying
	Hg	2.1	0.049	Complying
	Cr	6.0	7.864	Not complying
	Cd	-	0.887	-
	Cu	3.0	21.236	Not complying
	Zn	23.0	47.360	Not complying
	Co	5.0	5.856	Not complying
	Ni	4.0	23.295	Not complying
	As	2.0	0.714	Complying
Sample No2.	Pb	32.0	7.429	Complying
	Hg	2.1	0.038	Complying
	Cr	6.0	5.837	Complying
	Cd	-	0.548	-
	Cu	3.0	10.688	Not complying
	Zn	23.0	27.984	Not complying
	Co	5.0	4.466	Complying
	Ni	4.0	18.751	Not complying
	As	2.0	0.645	Complying
Sample No3.	Pb	32.0	7.079	Complying
	Hg	2.1	0.037	Complying
	Cr	6.0	10.661	Not complying
	Cd	-	0.290	-
	Cu	3.0	25.848	Not complying
	Zn	23.0	49.184	Not complying
	Co	5.0	5.578	Not complying
	Ni	4.0	22.101	Not complying
	As	2.0	0.682	Complying
Sample No4.	Pb	32.0	7.469	Complying
	Hg	2.1	0.062	Complying
	Cr	6.0	7.418	Not complying
	Cd	-	0.335	-
	Cu	3.0	18.658	Not complying
	Zn	23.0	57.152	Not complying
	Co	5.0	5.244	Not complying
	Ni	4.0	22.476	Not complying
	As	2.0	0.764	Complying
Sample No5.	Pb	32.0	7.419	Complying
	Hg	2.1	0.044	Complying
	Cr	6.0	8.068	Not complying
	Cd	-	0.616	-
	Cu	3.0	15.584	Not complying

Name of parameters (requirements)		Value of parameters (requirements)		Compliance with parameters (requirements)
		by Regulatory documentation	Actual	
	Zn	23.0	40.240	Not complying
	Co	5.0	4.602	Complying
	Ni	4.0	20.125	Not complying
	As	2.0	0.910	Complying
Sample No6.	Pb	32.0	6.267	Complying
	Hg	2.1	0.047	Complying
	Cr	6.0	8.889	Not complying
	Cd	-	0.362	-
	Cu	3.0	32.298	Not complying
	Zn	23.0	51.232	Not complying
	Co	5.0	5.614	Not complying
	Ni	4.0	26.634	Not complying
	As	2.0	0.586	Complying
Sample No7.	Pb	32.0	5.472	Complying
	Hg	2.1	0.062	Complying
	Cr	6.0	13.966	Not complying
	Cd	-	0.378	-
	Cu	3.0	28.430	Not complying
	Zn	23.0	51.808	Not complying
	Co	5.0	6.278	Not complying
	Ni	4.0	33.792	Not complying
	As	2.0	0.882	Complying
Sample No8.	Pb	32.0	8.742	Complying
	Hg	2.1	0.056	Complying
	Cr	6.0	8.177	Not complying
	Cd	-	0.316	-
	Cu	3.0	24.962	Not complying
	Zn	23.0	51.520	Not complying
	Co	5.0	7.608	Not complying
	Ni	4.0	29.785	Not complying
	As	2.0	0.906	Complying
Sample No9.	Pb	32.0	10.731	Not complying
	Hg	2.1	0.048	Complying
	Cr	6.0	11.444	Not complying
	Cd	-	0.359	-
	Cu	3.0	32.278	Not complying
	Zn	23.0	64.000	Not complying
	Co	5.0	9.471	Not complying
	Ni	4.0	35.499	Not complying
	As	2.0	0.750	Complying
Sample No10.	Pb	32.0	5.147	Complying
	Hg	2.1	0.054	Complying
	Cr	6.0	6.293	Not complying
	Cd	-	0.186	-
	Cu	3.0	10.154	Not complying
	Zn	23.0	33.024	Not complying
	Co	5.0	4.134	Complying
	Ni	4.0	18.330	Not complying
	As	2.0	0.448	Complying
Sample No11.	Pb	32.0	5.031	Complying

Name of parameters (requirements)		Value of parameters (requirements)		Compliance with parameters (requirements)
		by Regulatory documentation	Actual	
	Hg	2.1	0.059	Complying
	Cr	6.0	7.394	Not complying
	Cd	-	0.208	-
	Cu	3.0	15.834	Not complying
	Zn	23.0	42.176	Not complying
	Co	5.0	5.474	Not complying
	Ni	4.0	21.969	Not complying
	As	2.0	0.860	Complying
Sample No12.	Pb	32.0	3.342	Complying
	Hg	2.1	0.048	Complying
	Cr	6.0	31.115	Not complying
	Cd	-	0.290	-
	Cu	3.0	9.200	Not complying
	Zn	23.0	25.392	Not complying
	Co	5.0	2.705	Complying
	Ni	4.0	12.983	Not complying
	As	2.0	0.910	Complying
Sample No13.	Pb	32.0	6.377	Complying
	Hg	2.1	0.064	Complying
	Cr	6.0	8.599	Not complying
	Cd	-	0.444	-
	Cu	3.0	18.066	Not complying
	Zn	23.0	49.472	Not complying
	Co	5.0	5.459	Not complying
	Ni	4.0	22.921	Not complying
	As	2.0	0.976	Complying

Date of performing the measurements________15.03.13______________________________

Person in charge of the measurement (head of department)___________________________________

Name (signature)

Measurements performed by____

(Name)

Date of release of the report ____

«APPROVED BY»
Head of ANIDI (State Specialized Inspection of Analytical Control)
_______Mirrakhimov M.M.
«___»_______ 2013

REPORT ON THE MEASUREMENTS No

3 pages

Determination of the content of dry residue, moisture, phenol, humus, pH and oil products in soil
(name of performed experiment)

Name of laboratory State Specialized Inspection of Analytical Control (ANIDI) № UZ.AMT.07.MAI. 429, 100100 Tashkent, 13 A S. Rustavely str., phone: 255-08-67, fax: 255-23-89, e-mail: anidi@uznature.uz .
(address, phone, fax, accreditation certificate number)

Name of customer: LLC «ISLOHOTKONSALTSERVIS», Tashkent, 79 S. Azimov str., phone: (371) 232-43-47, fax: 233-88-22 .
(address, phone, fax)

Description and labelling data of the object of measuring: 13 samples from the Takhiatash TPP area. Date of sampling 02.03.13 Date of receipt of samples 09.03.2013 .
(batch number, sample number, date of receipt and date of soil testing)

Objective and tasks of measurements determination of content of ingredients.

Regulatory documentation and plan on measurement objects: GOST 28168-89 «Soils Sampling», SanRaN RU No 0191-05 «Maximum allowable concentrations (MAC) and tentative allowable concentrations (TAC) of exogenous harmful substances in soil».

Regulatory documentation on measurements GOST 26423-85: Method of determination of electrical conductivity, pH and dry residue in aqueous extract. Ruling document 118.3897485.13-92. Methodical guidelines on determination of the content of oil products in soil by means of fluorescence spectroscopy. O'z O'U 0455:2009 Procedure of measurements of the mass fraction of phenol in soil samples by means of photoelectric colorimetry. GOST 26213-91 Method of determination of organic substance (humus).

Conditions of performing the measurements t=22^{0}C, humidity-57%.
(temperature, humidity and other environmental conditions)

Measurements performed by a subcontractor

Test (measurements) results

Name of parameters (requirements)		Value of parameters (requirements)		Compliance of parameters with (requirements)
		by Regulatory documentation	Actual	
Sample No1	dry residue %	-	3.085	-
	moisture %		15.7	
	pH	-	6.0	-
	phenol mg/kg	-	0.024	-
	humus %	-	0.55	-
	Oil products mg/kg	-	17.2	-
Sample No2	dry residue %	-	2.002	-
	moisture %		10.0	
	pH	-	6.0	-
	phenol mg/kg	-	0.031	-
	humus %	-	0.34	-
	Oil products mg/kg	-	34.1	-
Sample No3	dry residue %	-	1.516	-
	moisture %		9.6	
	pH	-	6.0	-
	phenol mg/kg	-	0	-
	humus %	-	0.65	-
	Oil products mg/kg	-	0	-
Sample No4	dry residue %	-	2.952	-
	moisture %		10.7	
	pH	-	6.05	-
	phenol mg/kg	-	0	-
	humus %	-	1.03	-
	Oil products mg/kg	-	0	-
Sample No5	dry residue %	-	2.269	-
	moisture %		7.2	
	pH	-	6.10	-
	phenol mg/kg	-	0.002	-
	humus %	-	0.88	-
	Oil products mg/kg	-	0.8	-
Sample No6	dry residue %	-	3.351	-
	moisture %	-	14.2	-
	pH	-	0.003	-
	phenol mg/kg	-	0.003	-
	humus %	-	1.25	-
	Oil products mg/kg	-	4.8	-
Sample No7	dry residue %	-	2.458	-
	moisture %		9.5	
	pH	-	6.0	-
	phenol mg/kg	-	0.005	-
	humus %	-	0.80	-
	Oil products mg/kg	-	6.7	-
Sample No8	dry residue %	-	1.226	-
	moisture %		23.9	
	pH	-	6.12	-
	phenol mg/kg	-	0.007	-
	humus %	-	0.62	-
	Oil products mg/kg	-	17.7	-
Sample No9	dry residue %	-	3.55	-
	moisture %		21.1	
	pH	-	6.15	-

Name of parameters (requirements)	Value of parameters (requirements)		Compliance of parameters with (requirements)
	by Regulatory documentation	Actual	
phenol mg/kg	-	0.006	-
humus %	-	0.9	-
Oil products mg/kg	-	10.4	-
Sample No10 dry residue %	-	1.326	-
moisture %		4.5	
pH	-	6.0	-
phenol mg/kg	-	0.005	-
humus %	-	0.43	-
Oil products mg/kg	-	8.9	-
Sample No11 dry residue %	-	1.067	-
moisture %		4.4	
pH	-	6.03	-
phenol mg/kg	-	0.032	-
humus %	-	0.55	-
Oil products mg/kg	-	71.3	-
Sample No12 dry residue %	-	1.543	-
moisture %		2.9	
pH	-	6.05	-
phenol mg/kg	-	0.034	-
humus %	-	0.78	-
Oil products mg/kg	-	74.1	-
Sample No13 dry residue %	-	2.478	-
moisture %		9.8	
pH	-	6.10	-
phenol mg/kg	-	0.029	-
humus %	-	0.77	-
Oil products mg/kg	-	53.3	-

Date of performing the measurements _________12-13.03.2013
____

Person in charge of the measurement (head of department)_________________________________

Name (signature)

Measurements performed by____

Name (signature)

Date of release of the report ____

Interpretation of the results and conclusions

a) COMPARISON AGAINST LOCAL REGULATIONS

All detected organochlorine pesticides concentrations in soil are much below their respective MACs. Nevertheless, the concentrations of some metals exceed their respective MACs.

The Environmental Baseline Study of the Takhiatash TPP area also mentions that generally, the soil is affected by salinity, as well as by weak, but occurring, presence of heavy metals (1-1.5 MAC). Connection of the presence of metals with contaminant sources cannot be established, due to the lack of large industrial facilities in the area. The spatial connection of pollution halo with agglomeration of Takhiatash town was established only for chromium, molybdenum, arsenic and selenium. Thus, in Nukus along the railway only a few points with arsenic up to 20 mg/kg were recorded against the regional average content of 9.5 mg/kg. Selenium content in the soil is high in the region due to the typical metallogeny.

MACs, as based on their scientific substantiation criteria, reflect all possible ways of indirect effects of contaminants on the environment (plants, animals and humans), soil biological activity and the process of self-purification. In other words, MACs are based on the principle of a soil that would be fit for all possible functions, ranging from heavy industry to a domestic vegetable garden and including being an ecosystem. Concentrations of contaminants exceeding the MACs do not necessary mean the likelihood of exposure to soil contamination at levels of potential concern to human health, due to the use of this site for human activity.

The principle of a multifunctional soil has been abandoned in most countries and nowadays a balance is established between the protection of the soil and its use for economic and social purposes. New soil policies set soil quality criteria for different soil functions.

b) COMPARISON AGAISNT INTERNATIONAL REGULATIONS

The concentrations of contaminants in the 13 soil samples were also compared against their respective maximum values for industrial soil quality class, established in the Soil Quality Regulation[2] of The Netherlands. The reason for choosing the Dutch soil quality criteria is that they are considered worldwide among the leading international approaches to setting soil screening values.

The values for a standard soil (with 25% of clay and 10% of organic matter) must be converted to the values for the soil of the Takhiatash TPP area, according to its contents of organic matter and clay. The results of the analyses show that the arithmetic mean of the organic matter (humus) content in the topsoil is 0.73%. Clay content was not analyzed, but the environmental baseline study mentions that the topsoil is clay loam, which means that the clay content should be 27.5-40%. A content of 27.5% is adopted, as it represents the worst conditions.

The following soil type correction formula is used for converting the values for organic compounds:

$$(MW)b,g,bs = (MW)sb \times \text{\% organic matter} / 10$$

Where:
(MW)b,g,bs = maximum value that applies to the place of use, corrected on the basis of the arithmetic mean of the organic matter content as measured in the soil

[2] *Soil Quality Regulation*. State Secretary for Housing, Planning and the Environment and State Secretary for Transport, Public Works and Water Management of The Netherlands (2006).

(MW)sb = maximum value for the standard soil
% organic matter = measured percentage of organic matter in the soil to be assessed. A content of 2% is adopted for soil with a measured organic matter content of less than 2%.

The corrected values for organic compounds are shown in the following table.

VALUES FOR ORGANIC COMPOUNDS		
Contaminant	**Maximum value for standard soil (mg/kg)**	**Corrected maximum value (mg/kg)**
α - HCH	0.5	0.1
γ - HCH	0.5	0.1
DDE	1.3	0.26
DDD	34	6,8
DDT	1	0.2
Phenol	1.25	0.25
Oil products	500	100

The following soil type correction formula is used for converting the values for metals:

(MW)b,g,bs = (MW)sb x {(A + (B x % clay) + (C x % organic matter)} / {(A + (B x 25) + (C x 10)}

Where:

- (MW)b,g,bs = maximum value that applies to the place of use, corrected on the basis of the arithmetic mean of the clay and organic matter content, as measured in the soil or the earth or dredging sludge to be used
- (MW)sb = maximum value or background value for standard soil, which applies as the usage requirement for the place of use
- % clay = measured percentage of clay in the soil to be assessed
- % organic matter = measured percentage of organic matter in the soil to be assessed
- A,B,C = substance-dependent constants for metals (see below)

SUBSTANCE-DEPENDENT CONSTANTS FOR METALS			
Substance	**A**	**B**	**C**
Arsenic	15	0.4	0.4
Cadmium	0.4	0.007	0.021
Chromium	50	2	0
Cobalt	2	0.28	0
Copper	15	0.6	0.6
Mercury	0.2	0.0034	0.0017
Lead	50	1	1
Nickel	10	1	0

SUBSTANCE-DEPENDENT CONSTANTS FOR METALS			
Substance	**A**	**B**	**C**
Zinc	50	3	1.5

The corrected values for metals are shown in the following table.

VALUES FOR METALS		
Contaminant	**Maximum value for standard soil (mg/kg)**	**Corrected maximum value (mg/kg)**
Pb	530	488
Hg	4.8	4.7
Cr	180	189
Cd	4.3	3.3
Cu	190	169
Zn	720	687
Co	190	205
Ni	95	102
As	76	69

The following tables present all sample numbers, contaminant concentrations and reference standard maximum values.

ORGANOCHLORINE PESTICIDES			
Sample Number	**Contaminant**	**Concentration (mg/kg)**	**Reference standard maximum value (mg/kg)**
1	α - HCH	not detected	0.1
	γ - HCH	not detected	0.1
	DDE	0.005	0.26
	DDD	not detected	6,8
	DDT	Trace	0.2
2	α - HCH	not detected	0.1
	γ - HCH	not detected	0.1
	DDE	not detected	0.26
	DDD	not detected	6,8
	DDT	not detected	0.2
3	α - HCH	not detected	0.1
	γ - HCH	not detected	0.1

ORGANOCHLORINE PESTICIDES			
Sample Number	**Contaminant**	**Concentration (mg/kg)**	**Reference standard maximum value (mg/kg)**
	DDE	not detected	0.26
	DDD	not detected	6,8
	DDT	not detected	0.2
4	α - HCH	not detected	0.1
	γ - HCH	not detected	0.1
	DDE	not detected	0.26
	DDD	not detected	6,8
	DDT	not detected	0.2
5	α - HCH	not detected	0.1
	γ - HCH	not detected	0.1
	DDE	not detected	0.26
	DDD	not detected	6,8
	DDT	not detected	0.2
6	α - HCH	not detected	0.1
	γ - HCH	not detected	0.1
	DDE	not detected	0.26
	DDD	not detected	6,8
	DDT	not detected	0.2
7	α - HCH	not detected	0.1
	γ - HCH	not detected	0.1
	DDE	not detected	0.26
	DDD	not detected	6,8
	DDT	not detected	0.2
8	α - HCH	not detected	0.1
	γ - HCH	not detected	0.1
	DDE	not detected	0.26
	DDD	not detected	6,8
	DDT	not detected	0.2
9	α - HCH	not detected	0.1
	γ - HCH	not detected	0.1
	DDE	not detected	0.26
	DDD	not detected	6,8

ORGANOCHLORINE PESTICIDES			
Sample Number	**Contaminant**	**Concentration (mg/kg)**	**Reference standard maximum value (mg/kg)**
	DDT	not detected	0.2
10	α - HCH	not detected	0.1
	γ – HCH	not detected	0.1
	DDE	not detected	0.26
	DDD	not detected	6,8
	DDT	not detected	0.2
11	α - HCH	not detected	0.1
	γ - HCH	not detected	0.1
	DDE	0.012	0.26
	DDD	not detected	6,8
	DDT	0.013	0.2
12	α - HCH	not detected	0.1
	γ - HCH	not detected	0.1
	DDE	not detected	0.26
	DDD	not detected	6,8
	DDT	not detected	0.2
13	α - HCH	not detected	0.1
	γ - HCH	not detected	0.1
	DDE	not detected	0.26
	DDD	not detected	6,8
	DDT	not detected	0.2

METALS			
Sample Number	**Contaminant**	**Concentration (mg/kg)**	**Reference standard maximum value (mg/kg)**
1	Pb	10.083	488
	Hg	0.049	4.7
	Cr	7.864	189
	Cd	0.887	3.3
	Cu	21.236	169
	Zn	47.360	687
	Co	5.856	205
	Ni	23.295	102
	As	0.714	69
2	Pb	7.429	488
	Hg	0.038	4.7
	Cr	5.837	189
	Cd	0.548	3.3
	Cu	10.688	169
	Zn	27.984	687
	Co	4.466	205
	Ni	18.751	102
	As	0.645	69
3	Pb	7.079	488
	Hg	0.037	4.7
	Cr	10.661	189
	Cd	0.290	3.3
	Cu	25.848	169
	Zn	49.184	687
	Co	5.578	205
	Ni	22.101	102
	As	0.682	69
4	Pb	7.469	488
	Hg	0.062	4.7
	Cr	7.418	189
	Cd	0.335	3.3
	Cu	18.658	169

METALS			
Sample Number	**Contaminant**	**Concentration (mg/kg)**	**Reference standard maximum value (mg/kg)**
	Zn	57.152	687
	Co	5.244	205
	Ni	22.476	102
	As	0.764	69
5	Pb	7.419	488
	Hg	0.044	4.7
	Cr	8.068	189
	Cd	0.616	3.3
	Cu	15.584	169
	Zn	40.240	687
	Co	4.602	205
	Ni	20.125	102
	As	0.910	69
6	Pb	6.267	488
	Hg	0.047	4.7
	Cr	8.889	189
	Cd	0.362	3.3
	Cu	32.298	169
	Zn	51.232	687
	Co	5.614	205
	Ni	26.634	102
	As	0.586	69
7	Pb	5.472	488
	Hg	0.062	4.7
	Cr	13.966	189
	Cd	0.378	3.3
	Cu	28.430	169
	Zn	51.808	687
	Co	6.278	205
	Ni	33.792	102
	As	0.882	69
8	Pb	8.742	488

METALS			
Sample Number	Contaminant	Concentration (mg/kg)	Reference standard maximum value (mg/kg)
	Hg	0.056	4.7
	Cr	8.177	189
	Cd	0.316	3.3
	Cu	24.962	169
	Zn	51.520	687
	Co	7.608	205
	Ni	29.785	102
	As	0.906	69
9	Pb	10.731	488
	Hg	0.048	4.7
	Cr	11.444	189
	Cd	0.359	3.3
	Cu	32.278	169
	Zn	64.000	687
	Co	9.471	205
	Ni	35.499	102
	As	0.750	69
10	Pb	5.147	488
	Hg	0.054	4.7
	Cr	6.293	189
	Cd	0.186	3.3
	Cu	10.154	169
	Zn	33.024	687
	Co	4.134	205
	Ni	18.330	102
	As	0.448	69
11	Pb	5.031	488
	Hg	0.059	4.7
	Cr	7.394	189
	Cd	0.208	3.3
	Cu	15.834	169
	Zn	42.176	687

METALS			
Sample Number	**Contaminant**	**Concentration (mg/kg)**	**Reference standard maximum value (mg/kg)**
	Co	5.474	205
	Ni	21.969	102
	As	0.860	69
12	Pb	3.342	488
	Hg	0.048	4.7
	Cr	31.115	189
	Cd	0.290	3.3
	Cu	9.200	169
	Zn	25.392	687
	Co	2.705	205
	Ni	12.983	102
	As	0.910	69
13	Pb	6.377	488
	Hg	0.064	4.7
	Cr	8.599	189
	Cd	0.444	3.3
	Cu	18.066	169
	Zn	49.472	687
	Co	5.459	205
	Ni	22.921	102
	As	0.976	69

OTHER SUBSTANCES			
Sample Number	**Contaminant**	**Concentration (mg/kg)**	**Reference standard maximum value (mg/kg)**
1	Phenol	0.024	0.25
	Oil products	17.2	100
2	Phenol	0.031	0.25
	Oil products	34.1	100
3	Phenol	not detected	0.25
	Oil products	not detected	100
4	Phenol	not detected	0.25
	Oil products	not detected	100
5	Phenol	0.002	0.25
	Oil products	0.8	100
6	Phenol	0.003	0.25
	Oil products	4.8	100
7	Phenol	0.005	0.25
	Oil products	6.7	100
8	Phenol	0.007	0.25
	Oil products	17.7	100
9	Phenol	0.006	0.25
	Oil products	10.4	100
10	Phenol	0.005	0.25
	Oil products	8.9	100
11	Phenol	0.032	0.25
	Oil products	71.3	100
12	Phenol	0.034	0.25
	Oil products	74.1	100
13	Phenol	0.029	0.25
	Oil products	53.3	100

c) CONCLUSIONS

In the judgment of the environmental professional, the results of the analysis of 13 soil samples from the Takhiatash TPP area support a professional opinion that there are not “unacceptable” levels of contaminants in soil for its intended industrial use and, consequently, the site that do not require further assessment or investigation, regarding potential soil contamination.

ANNEX VI: WATER QUALITY INTAKE AND DISCHARGE ANALYSIS

Original water analysis report translated into English:

«APPROVED BY»
Head of ANIDI (State Specialized Inspection
of Analytical Control)
_________Mirrakhimov M.M.
«___» _________2013

REPORT ON THE MEASUREMENTS No
2 pages

Determination of the content of heavy metals, oil products, suspended solids, pH index and residual chlorine in water samples

(name of performed experiment)

Name of the laboratory: State Specialized Inspection of Analytical Control (ANIDI) 14.05.2007.№ UZ.AMT.07.MAI.429.100100
Tashkent 13 A S. Rustaveli str., phone: 255-08-67, fax: 255-23-89, e-mail:___ anidi@uznature.uz________________________

(address, phone, fax, accreditation certificate number)

Name of customer: LLC «ISLOHOTKONSALTSER». Taskent 79 S. Azimov str., phone:232-4347; fax: 233-88-22.__________________________

(address, phone, fax)

Name of measurements: water samples No 1,2 from the Takhiatash TPP. Date of sampling 6.03.13 Date of reception –11.03.2013________________________

(number of sample, date of reception, date of sampling)

Objective and tasks of measurement: determination of content of ingredients.

Regulatory documentation on measuring methods: O’z O’U 0482:2009; O’z O’U 0502:2010; O’z O’U 0521:2011; O’z O’U 0422:2009 Procedure of measurements of the mass fraction of lead, cadmium, arsenic and mercury in water and soil by the atomic absorption method. Ruling document 118.3897485.20-93 Methodical Guidelines on performing measurements of the mass fraction of zink by the photometric method. O’z O’U 0414:2009 Procedure of measurements of the mass fraction of copper in natural and waste water by the photometric method. Y.V.Novikov, K.O. Lastochkina, Z.N.Boldina.Methods for studying the quality of water in reservoirs. Determination of elements (iron, chromium) by the atomic absorption spectrometric method. M., 1990, pages 239-250. Ruling document 118.3897485.11-92 Detrmination of the content of oil products in soil, natural and waste water by means of fluorescence spectroscopy. Ruling document 118.3897485.6-92 Gravimetric determination of the quantity of suspended solids in waste water. O’z O’U 0556:2012 Procedure of measurement of pH in natural, collector and drainage and waste water by the electrometric method. GOST 18190-72 on determination of residual available chlorine.________

Regulatory documentation and plan on measurement objects: Summary of MAC and tentative safe reference action levels (TSRAL) of harmful substances for water in fishery water bodies. Water Supervision Standards 33-5.3.01-85 Instruction on sampling for analysis of waste water.__

Conditions of performing the measurements: Temperature- 23 ^{0}C, humidity – 60 %
(temperature, humidity and other conditions)

Measurements performed by a subcontractor:_______-_______________________________

Results from performed measurements

№	Name of parameters	Value of parameters		Compliance of parameters with
		MAC, (standard), mg/dm^3	Actual (mg/dm^3)	
1	Influent channel Pb	0.1	0.0001	complying
	Cd	0.005	0.00032	complying
	Cu	0.001	0.0065	Not complying
	Zn	0.01	0.0110	Not complying
	Fe	0.05	0.6435	Not complying
	Cr (3+)	-	0.0070	-
	As	0.05	0.0220	complying
	Hg	0.00001	not detected	complying
	pH	6.5-8.5	7.78	complying
	Suspended solids	15.0	10.0	complying
	Residual chlorine	-	not detected	-
	Oil products	0.05	0.08	Not complying
2	Effluent channel Pb	0.1	0.0001	complying
	Cd	0.005	0.00035	complying
	Cu	0.001	0.0059	Not complying
	Zn	0.01	0.0096	complying
	Fe	0.05	0.7155	Not complying
	Cr (3+)	-	0.0065	-
	As	0.05	0.0126	complying
	Hg	0.00001	not detected	complying
	pH	6.5-8.5	7.94	complying
	Suspended solids	15.0	120	Not complying
	Residual chlorine	-	not detected	-
	Oil products	0.05	0.22	Not complying

Date of performing the measurements: 12-14.03.13__________

Person in charge of the measurements _________________Polyakova N.S.
(head of department) (signature)
(name)
Measurements performed by _______________ Polyakova N.S.
(signature) (name)
Date of release of the report ____

ANNEX VII: STATEMENT ON ENVIRONMENTAL IMPACT (‘ZVOS’ STAGE II NATIONAL ENVIRONMENTAL APPROVAL)

STATE COMMITTEE FOR NATURE PROTECTION OF THE REPUBLIC OF UZBEKISTAN
5 Mustakillik sq. Tashkent 100017
Tel. +998 71 2394342, 2391171, Fax: 2391494
http://www.uznature.uz, e-mail: info@uznature.uz

7 November 2012, Ref. # 18/963

C O N C L U S I O N

of State Environmental Appraisal

Subject of appraisal: EIA of construction of combined cycle gas turbine (CCGT) with a capacity of 230-250 MW at Takhiatash TPP

Owner: Takhiatash TPP JSC

Designed by: Teploelektroproekt JSC

To: Mr. B.T.Madreimov, Director, Takhiatash TPP JSC
cc: Mr. P.J.Aytmuratov, Chairman, State Nature Protection Committee of Karakalpakstan
Ms. T. B. Baymatova, Technical Director, Teploelektroproekt JSC

The materials of the first phase of Environmental Impact Assessment if the construction of Combined Cycle Gas Turbine with a capacity of 230-250 MW at Takhiatash TPP were submitted for State Environmental Appraisal.

The enterprise is located on the outskirts of the town of Takhiatash in Khodjeyli district, in 3 kilometres from the centre of the town. The nearest residential development is located 130 metres north of the plant.

The Takhiatash TPP specialises in generating electricity to satisfy the needs of the country's north-west. Installed generation capacity of the plant is 730 MW; in 2011, the plant has generated 3276 mln kWh electricity and 3240 GCal/h heat. Natural gas is used as primary fuel at the plant, heating oil is backup fuel. Natural gas consumption in 2011 was at 1156.4 mln m^3, heating oil was not used.

Current technological setup at the TPP is as follows:

- Four K-100-90 turbines, 100 MW each;
- Four TGM-151 boilers and two TGM-151-B boilers, with steam generating capacity of 220 tons per hour

The modular plant includes two 210 MW units with two TGME-206 boilers and K-215-310 steam turbine with a capacity of 215 MW. All boilers are connected to a single 150 metres high stack.

The process equipment has been in service for over 25 years (some facilities – for 43 years) and is morally and physically outdated; as a result, its reliability and efficiency has substantially reduced, there is a high risk of emergency situations.

Operation of the power plant results in emission of carbon and nitrogen oxides, sulphur and nitrogen dioxides and benzapyrene into atmosphere; nitrogen and sulphur oxides contribute to most of the emissions. Total emissions are at 3798.45 tons per year.

Atmospheric air in the area concerned is characterised by high pollutants content; according to the Hydrometeorological Centre, maximum concentrations of nitrogen dioxide reached levels as high as 0.6 times MAC, dust – up to 2.0 MAC, other substances are within allowable limits. The Takhiatash TPOP and automotive transport are main contributor to nitrogen dioxide pollution, high dust concentrations are caused by dust carryover from the dry Aral Sea bed. As a result of emissions from the Takhiatash TPP nitrogen dioxide concentrations beyond boundaries of the plant reach 0.4 MAC, i.e. allowable limits are exceeded by 1.2 times.

The proposed project envisages modernisation of the Takhiatash TPP, with construction of a Combined Cycle Gas Turbine with a capacity of 230-250 MW, and replacement of worn out equipment of Nr. III and Nr. IV boiler units including four TGM boiler plants and three turbogenerators with a total capacity of 310 MW. The installed capacity of the power plant shall be reduced down to 668 MW.

The projected equipment shall be installed on the southern side of the Takhiatash TPP, at the end of main building. Construction of CCGT shall involve removal of guardhouse, gatehouse, some production facilities and replacement of rail track. A land plot of 21.0 hectares shall be acquired to set new boundaries of the plant's protected territory.

As part of CCGT construction it is planned to organise a new mud disposal field for the water treatment plant as well as an evaporation pond for chemical flushing of the waste heat boiler next to the existing mud disposal field.

Projected gas consumption after CCGT commissioning shall be at 1070.4 mln m^3 per year, i.e. shall reduce by 36.8 mln m^3 per year. Meanwhile, annual power generation shall increase by 724.6 mln KWh due to improved efficiency of the plant.

Flue gas from the CCGT shall be diverted to a dedicated 60 m high stack. Pollutant emissions shall reduce down to 2879.0 tons per years (by 919.45 tons per year), and maximum concentrations of nitrogen dioxide beyond the boundaries of the TPP shall be at 0.22 MAC (net of normal environmental pollution).

The impact onto the atmosphere during the pilot tests of the CCGT shall increase (due to simultaneous operation together with existing boiler equipment); according to calculations, maximum concentrations of nitrogen dioxide shall reach the levels as high as 0.45 MAC. In order to avoid excessive atmospheric pollution, it is planned to implement stage-by-stage shutdown of boilers during the pilot tests in accordance with the schedule approved by the management of Takhiatash TPP.

Construction of the CCGT is planned to take place in 2014-2018, pilot tests shall last from January 2018 till December 2019. According to the schedule, boilers Nr 1-4 shall be shut down first, in the first decade of January 2018 since they are the most worn out boilers connected to a relatively low stack of 80 m and contribute to the most of atmospheric pollution; during the second decade of 2018, boilers Nr 5 and 6 connected to a 150 m stack shall be shut down.

If everything is completed as scheduled, the impact onto the atmosphere shall reduce gradually: **maximum nitrogen dioxide concentrations during the first decade shall be at 0.26 MAC, starting from the second decade and throughout the pilot tests phase the level shall be at 0.24 MAC. Dismantling of boiler plants Nr 1-4, 5, 6 is planned to take place from January till December 2019.**

Water is supplied to the TPP from municipal water supply networks and from surface waters of Suenli Canal originating from Amudarya River. Water is treated at Chemical water treatment plants Nr 1 and Nr 2 before being used as boiler feed water. Given high salinity, hardness and turbidity of surface water, the TPP rehabilitation project envisages to arrange for pre-treatment of boiler feed water using a sedimentation basin and a slurry dump. Maximum water flow for use as a feed for the CCGT shall be at 916 tons per hour, thus existing chemical water treatment plants have sufficient capacity to ensure water consumption at the projected facility.

A double-section sedimentation basin for boiler feed water with a throughput of 1000 m^3 per hour shall be organised in an earth ditch with protruding embankments made of clayey soil. The technology provides for diversion of silt to the slurry damp area during cleaning procedures, the water released from the slurry is returned back to the process.

As a result of decommissioning of Nr III and Nr IV boiler plants and introduction of recirculated cooling water system, the annual water consumption is expected to drop by 173.6 mln m^3 (from 451 to 277.4 mln m^3). The volume of water circulated in the cooling system of the CCGT shall be at 12862 m^3 per hour.

The overall flow of waste water shall decrease by 1.7 times after replacement of worn-out boiler plants at the CCGT. Waster process waters contaminated by oil products, purge water and waste water after chemical treatment are dumped into the offtake canal using the old arrangement. Before discharge, contaminated water shall be cleaned of oil products at existing mechanical treatment facilities (oil traps).

Replacement of worn equipment with a CCGT shall not result in any changes in the quantity and quality of waste water.

The CCGT shall be installed in an acoustic enclosure, provided with an integrated air cleaner complete with filtering and air heating systems ensuring efficient cleaning of air supplied to the CCGT's suction pipe.

The analysis of the Takhiatash TPP's operation over many years allows one to conclude that physical and moral wear/tear of the process equipment was the main reason for occurrence of emergency situations. Therefore, implementation of the project for **construction of combined cycle gas turbine to replace worn out boiler units shall help in improving environmental situation in the area concerned.**

The environmental appraisal of the materials submitted established their compliance with the requirements of the nature protection related legislation applicable to the scope and content of the first stage of EIA, and we find it advisable to proceed with the final stage – Environmental Impact Statement (EIS), for the purpose of **establishing limits of emissions of pollutants and contaminants to the environment, of production waster formation and disposal broken down for different years, in accordance with the schedule for shutting down and decommissioning obsolete boiler equipment.**

The State Environmental Appraisal of the State Nature Protection Committee of the Republic of Uzbekistan **approves** the draft environmental impact statement for the project for modernisation of Takhiatash TPP involving construction of combined cycle gas turbine with a capacity of 230-250 MW, to replace physically and morally obsolete boiler equipment (boiler plants Nr 1-4, 5, 6).

The State Committee for Nature Protection of the Republic of Karakalpakstan is to follow up on compliance by the enterprise with the requirements of nature protection related legislation throughout installation of the CCGT at the territory previously occupied by ancillary facilities of the Takhiatash TPP, to replace **physical and morally obsolete boiler plants Nr 1-4, 5, 6**, with acquisition of additional 21.0 hectares of land to be added to the enterprise's protected territory, and with relocation of rail track.

Chairman: **N.UMAROV**

Prepared by:
T.Ishmukhamedova
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20/2yil «7» ноября № 18/963з

ЗАКЛЮЧЕНИЕ
Государственной экологической экспертизы

По объекту: ОВОС строительства парогазовой установки ПГУ мощностью 230-250 МВт на Тахиаташской ТЭС
Заказчик: ОАО «Тахиаташская ТЭС»
Разработчик: ОАО «Теплоэлектропроект»

Директору ОАО «Тахиаташская ТЭС»
МАДРЕИМОВУ Б.Т.
копии: Председателю Госкомприроды
Республики Каракалпакстан
АЙТМУРАТОВУ П.Ж.
Техническому директору ОАО «Теплоэлектропроект»
БАЙМАТОВОЙ Т.Б.

На государственную экологическую экспертизу представлены материалы первого этапа оценки воздействия на окружающую среду строительства парогазовой установки мощностью 230-250 МВт на Тахиаташской ТЭС.

Предприятие располагается на окраине г.Тахиаташ Ходжейлийского района в 3 км от его центра. Ближайшая жилая застройка находится в 130 м. к северу от предприятия.

Тахиаташская ТЭС специализируется на выработке электрической энергии для обеспечения северо-западного региона республики. Установленная мощность станции по электроэнергии – 730 МВт, в 2011 году предприятие выработало 3276 млн. кВт.ч и теплоэнергии – 3240 Гкал/ч. В качестве основного топлива на ТЭС используется природный газ, резервным топливом является мазут. Расход природного газа в 2011 году составил 1156.4 млн.м^3, мазут не использовался.

На существующее положение технологическое оборудование ТЭС представлено:

- тремя турбинами К-100-90 мощностью 100 МВт каждая;
- четырьмя котлоагрегатами ТГМ-151 и двумя котлоагрегатами ТГМ-151-Б паропроизводительностью 220 т/час.

В состав блочной станции входят два блока по 210 МВт с двумя котлоагрегатами ТГМЕ-206 и паровой турбиной К-215-130 мощностью 215 МВТ. Все котлоагрегаты подключены к одной дымовой трубе высотой 150 м.

Технологическое оборудование эксплуатируется более 25 лет (отдельных сооружений – 43 года), морально и физически устарело, в связи с чем значительно снижена их надежность и высока вероятность аварийной ситуации.

При эксплуатации станции в атмосферу поступают оксиды углерода и азота, диоксиды азота и серы и бенз(а)пирен; основная доля приходится на оксиды азота и серы. Выброс загрязняющих веществ составляет 3798.45 т/год.

Атмосферный воздух в рассматриваемом районе характеризуется повышенным содержанием загрязняющих веществ; по данным Центра гидрометеорологической службы максимальные концентрации диоксида азота составляли 0.6ПДК, по пыли 2.0ПДК, по остальным веществам – ниже допустимых значений. Основной вклад в загрязнение атмосферы диоксидом азота вносят Тахиаташская ТЭС и автомобильный транспорт, высокие концентрации пыли спровоцированы пылепереносом с осушенного дна Аральского моря. Выбросами Тахиаташской ТЭС за ее пределами формируются концентрации диоксида азота, достигающие 0.4ПДК, то есть наблюдается превышение допустимых норм в 1.2 раза.

Предлагаемым проектом предусматривается модернизация Тахиаташской ТЭС со строительством парогазовой установки производительностью 230-250 МВт и заменой изношенного котельного оборудования III и IV очередей, включающего четыре котлоагрегата ТГМ и три турбоагрегата общей мощностью 310 МВт. При этом установленная мощность станции снизится до 668 МВт.

Проектируемое оборудование устанавливается с южной стороны Тахиаташской ТЭС к торцу главного корпуса. Строительство ПГУ связано с демонтажом караульных помещений, здания КПП, помещений производственного назначения, а также переносом железнодорожных путей. Для установления новых границ охранной зоны предприятия потребуется дополнительный отвод участка земли площадью 21.0 га.

В рамках строительства ПГУ планируется разместить новый шламоотвал ХВО предварительной очистки воды и пруд-испаритель химической промывки котла-утилизатора рядом с существующим шламоотвалом.

Нормативно-расчетный расход газа после ввода в эксплуатацию ПГУ составит 1070.4 млн.м^3/год, то отмечается снижение на 36.8 млн.м^3/год. При этом годовая выработка электроэнергии за счет увеличения КПД установки увеличится на 724.6 млн.кВт.ч.

Дымовые газы от парогвзовой установки будут отводиться через индивидуальную трубу высотой 60 м. Выбросы загрязняющих веществ снижаются до 2879.0 т/год (на 919.45 т/год), а максимальные концентрации диоксида азота, формируемые выбросами ТЭС за ее пределами, составят 0.22ПДК (без учета фона).

На период опытно-промышленной апробации ПГУ (при совместной работе с существующим котельным оборудованием) нагрузка на атмосферный воздух увеличится; согласно расчетам максимальные концентрации диоксида азота достигнут значений 0.45ПДК. В целях недопущения сверхнормативного загрязнения атмосферы проектом предусмотрено поэтапное отключение котлов на период испытания ПГУ согласно разработанному графику, утвержденному руководством Тахиаташской ТЭС.

Строительство ПГУ намечается на 2014-2018 г.г., с января 2018 г. по декабрь 2019 г. планируется ее опытно-промышленная апробация. В соответствии с графиком в первую декаду января 2018 г. отключению подлежат котлоагрегаты №№ 1-4 как наиболее изношенные, подключенные к сравнительно низкому источнику (высота трубы 80 м) и вносящие основной вклад в загрязнение атмосферы; во вторую декаду 2018 г. отключаются котлы №№ 5-6, подключенные к источнику высотой 150 м.

При соблюдении графика прогнозируется плавное снижение нагрузки на окружающую среду: **в первую декаду января 2018 г. максимальные концентрации диоксида азота составят 0.26ПДК, начиная со второй декады и на весь период апробации ПГУ – 0.24ПДК. Демонтаж котлоагрегатов №№ 1 -4, 5, 6 предусматривается с января по декабрь 2019 года.**

Источником водоснабжения ТЭС являются городские сети водопровода и поверхностные воды канала Суенли, берущего начало из реки Амударьи. Для подпитки котельного оборудования вода подготавливается на установках ХВО-1 и ХВО-3. Учитывая высокую минерализацию, жесткость и мутность поверхностных вод, в рамках модернизации ТЭС предусмотрена организация предварительной очистки добавочной (подпиточной) воды с обустройством отстойника и пульпоотвала. Максимальный расход воды на подпитку устанавливаемой ПГУ составит 916 т/час, то есть существующие ХВО после предварительной очистки обеспечат потребность в воде проектируемой установки.

Двухсекционный отстойник добавочной воды, рассчитанный на прохождение 1000 $м^3$/час, предусматривается в земляном котловане с насыпными ограждающими дамбами из суглинка. По технологии ил, образующийся при очистке отстойника, направляется в пульпоотвал, из которого высвободившаяся вода возвращается в производство.

За счет вывода из эксплуатации котельных агрегатов III и IV очередей и внедрения на ПГУ системы оборотного водоснабжения ожидается сокращение годового потребления воды на 173.6 млн.$м^3$ (с 451 млн.$м^3$ до 277.4 млн.$м^3$). Циркуляционный объем оборотного водоснабжения для проектируемой ПГУ составит 12852 $м^3$/час.

Общий расход сточных вод после замены изношенных котлоагрегатов на ПГУ снизится в 1.7 раза. Производственные сточные воды, загрязненные нефтепродуктами, продувочные воды, а также от ХВО сбрасываются в отводящий канал по той же принятой схеме. Перед сбросом загрязненные сточные воды проходят очистку от нефтепродуктов на существующих сооружениях механической очистки (маслоловушках).

Замена изношенного оборудования на парогазовую установку ПГУ не повлечет изменений в количестве и качественном составе образующихся отходов.

ANNEX VIII. ENVIRONMENTAL MITIGATION MEASURES AND MONITORING PLAN

Appendix 1: Mitigation measures

A. Design and Preconstruction Phase

MITIGATION MEASURE N° 1	
IMPACT CONCERNED	Hazards for health and safety of the personnel and the surrounding population.
DEFINITION OF THE MEASURE	Development of an Environmental, Health and Safety (EHS) Plan for the construction, operation and decommissioning phases.
OBJECTIVE	Reduce potential impact in environment and risks to personnel and population
DESCRIPTION OF THE MEASURE / ISSUES THAT IT INCLUDES	The EHS plans will be based on the general (April, 2007) and Thermal Power Plants (December, 2008) EHS IFC guidelines and in the national legislation (Law about Labor (1993), Law about Industrial Safety of dangerous industrial bodies(2006) of RUz and existing regulation on Fire safety (2004), Safety standards for operation of electrical devises (2006), Rules for appliance and test of security facilities used in electrical devises (2002), Safety standards for operation of heat-mechanic thermal-trans mission equipment. (1991), the Order of Uzbek Supervision Agency of RUz in Power industry “Uzgos nadzor” “About confirmation of rules for personal work organizing (2002);KMK, “KMK 3.01.02-00”, “Safety engineering during construction”), whichever is more stringent. For the EHS decommissioning plan, especial attention should be paid to the handling and management of asbestos materials. In this regard, handling should: 1. Be only performed by specially trained personnel. Training of specialized personnel and the maintenance and removal methods applied should be equivalent to those required under applicable regulations in the United States and Europe (examples of North American training standards are available at: http://www.osha.gov/SLTC/asbestos/training.html) 2. Follow host country requirements, or in their absence, internationally recognized procedures (Examples include the American Society for Testing and Materials (ASTM) E 1368 - Standard Practice for Visual Inspection of Asbestos Abatement Projects; E 2356 - Standard Practice for Comprehensive Building Asbestos Surveys; and E 2394 - Standard Practice for Maintenance, Renovation and Repair of Installed Asbestos

MITIGATION MEASURE N° 1	
	Cement Products). EHS will include an emergency or contingency plan and rescue operations.
ORGANISATION RESPONSIBLE FOR ITS MANAGEMENT	Safeguard unit of the PMU (construction and decommissioning phases) TPP EMT (operation phase)
PERIOD AND DOCUMENT IN WHICH IT IS SPECIFIED	Construction, operation and decommissioning phases EHS construction plan EHS decommissioning plan EHS operation plan
PRECAUTIONS FOR IMPLEMENTATION AND MANAGEMENT	None.
MAINTENANCE	None.
COST	25000 $US per EHS construction plan. Cost should be covered by contract sum. 25000 $US per EHS decommissioning plan. Cost should be covered by contract sum 40000 $Us per EHS operation plan

MITIGATION MEASURE N° 2	
IMPACT CONCERNED	All impacts during Decommissioning.
DEFINITION OF THE MEASURE	Design a Decommissioning Plan for the existing units III and IV at Takhiatash TPP.
OBJECTIVE	Reduce potential impact in environment and risks to personnel and population
DESCRIPTION OF THE MEASURE / ISSUES THAT IT INCLUDES	A detailed Decommissioning Plan will be thought and carefully designed in order to define every single point of this activity. The demolition and deconstruction work has to be carefully planned and executed. In order to cover all the points related to these kind of works, the following points must be taken into account: - Legal framework related to decommissioning. - Description of the location of the project. - Description of all the existing facilities to be decommissioned. - Scope of the Decommissioning Plan. - Decommissioning strategy/works. - Description of the works. - Environmental assessment of the project. - Relevant environmental factors. Regarding environmental issues of the Decommissioning project, the following points must be considered in the Plan: • Hazardous Materials Management.

MITIGATION MEASURE N° 2	
	• Spill Prevention. • Emergency Response. • Stormwater pollution prevention. • Revegetation. • Noise Control. • Traffic control. • Fugitive Dust Control. • Water conservation. Specific consideration should be paid to hazardous waste materials. Close Hazardous waste storage is 30 km far away from the TPP and existing bunkers are full. Construction of new bunker in the existing hazardous waste storage or construction of new hazardous waste storage on or off site the TPP must be considered.
ORGANISATION RESPONSIBLE FOR ITS MANAGEMENT	EPC CCPU & Decommissioning Contractor
PERIOD AND DOCUMENT IN WHICH IT IS SPECIFIED	Decommissioning phase
PRECAUTIONS FOR IMPLEMENTATION AND MANAGEMENT	None
MAINTENANCE	None
COST	97500 $US. Cost should be covered by contract sum

MITIGATION MEASURE N° 3	
IMPACT CONCERNED	All the impacts.
DEFINITION OF THE MEASURE	Contractual environmental requirements
OBJECTIVE	Assurance that sufficient environmental management will be followed by contactors.
DESCRIPTION OF THE MEASURE / ISSUES THAT IT INCLUDES	PMU will provide the successful contractor with the translated EIA, including the EMP. As specified by law, the contractor will be required to retain an ecologic safeguard expert with EIA experience to prepare a Construction Environmental Action Plan (CEAP) and obtain all relevant permits. The contractor will not be permitted to mobilize the workers without an approved CEAP and the appropriate permits in place. Contractual environmental requirements that must be included in contracts are: Ensure specific contractual requirement, e.g. withholding of payment or penalty clauses, to ensure contractor's

	implementation of environmental mitigation measures. Contracts to require contractor to have designated staff to oversee environmental issues and mitigation. Contracts to include the requirement for the contractor to provide environmental induction to all staff.
ORGANISATION RESPONSIBLE FOR ITS MANAGEMENT	Safeguard unit of the PMU DCS EPC CCPU & Decommissioning contractor
PERIOD AND DOCUMENT IN WHICH IT IS SPECIFIED	Construction and Decommissioning phases. Purchase specifications and contracts. Bidding documents have to include assurance that EMP will be followed. The EIA including EMP must be attached as part of bidding documents.
PRECAUTIONS FOR IMPLEMENTATION AND MANAGEMENT	None
MAINTENANCE	None
COST	Environmental safeguard expert: 57000 $US/year. Cost should be covered by contract sum.

MITIGATION MEASURE N° 4	
IMPACT CONCERNED	All the impacts.
DEFINITION OF THE MEASURE	Institutional strengthening program
OBJECTIVE	Assurance that sufficient environmental management will be followed by the institutions (SNPC).
DESCRIPTION OF THE MEASURE / ISSUES THAT IT INCLUDES	The Project Director will provide the SNPC inspectors with the EMP and any supporting reports for use in their inspection process. PMU will organize a 1-2 day workshop and provide special training on environmental compliance monitoring and reporting, focusing on gaps indentified in this EIA. For this purpose PMU will hire an international and national consultant supervision staff (safeguards expert). In the consulting phase the establishing of an environmental management team and a management program will be provided.
ORGANISATION RESPONSIBLE FOR ITS MANAGEMENT	Safeguard unit of the PMU
PERIOD AND DOCUMENT IN WHICH IT IS SPECIFIED	Training documentation
PRECAUTIONS FOR IMPLEMENTATION AND MANAGEMENT	None
MAINTENANCE	None
COST	5000 $US for workshop

MITIGATION MEASURE N° 5	
IMPACT CONCERNED	Greenhouse gases emission reduction by the replacement of an obsolete with an energy efficient technology.
DEFINITION OF THE MEASURE	Carbon financing
OBJECTIVE	Carbon reduction strategy
DESCRIPTION OF THE MEASURE / ISSUES THAT IT INCLUDES	As an improving efficiency project, GHG emission will be reduced by the replacement of the obsolete units III and IV with the new combine cycle unit. This will allow undertaking a Clean Development Mechanism procedure for the project under the United Nations Framework Convention on Climate Change. This mechanism allows improvement of the emission performance to be reflected in carbon credits, which can then be sold. This fact open the possibility of securing a contribution to the cost of installation A PDD will have to be developed and approved previously to commissioning.
ORGANISATION RESPONSIBLE FOR ITS MANAGEMENT	PMU
PERIOD AND DOCUMENT IN WHICH IT IS SPECIFIED	Preconstruction phase PDD
PRECAUTIONS FOR IMPLEMENTATION AND MANAGEMENT	None.
MAINTENANCE	None.
COST	Included in the project

MITIGATION MEASURE N° 6	
IMPACT CONCERNED	Hazards for health and safety of the personnel and the surrounding population.
DEFINITION OF THE MEASURE	Structural safety of the buildings
OBJECTIVE	Reduce potential risks to workers and public during access to project facilities.
DESCRIPTION OF THE MEASURE / ISSUES THAT IT INCLUDES	The following measures should be taken into account to ensure the structural safety: • Physical separation methods around the project site in order to protect the public against hazards arising from dangerous substances or process failures, as well as nuisance caused by noise levels, odors and various emissions. Integration of technical establishment criteria and safety criteria to prevent from failures due to natural hazards. To this end, all project structures must be designed in accordance with technical and study criteria determined by risks specific to the site, including, among others, seismic activity (in accordance with Uzbek Constructions Norms and Regulations), slope stability, the wind

MITIGATION MEASURE N° 6	
	load, and various other dynamic loads. • The use of asbestos, PCBs and ozone depleting substances in refrigeration systems will not be permitted. • Application of locally or internationally recognized construction standards [ILO-OSH (2001), International Code Council (ICC)] in order to ensure that the buildings are designed and constructed in accordance with solid architectural and technical practices, including certain aspects for intervention in the case of fire. • Ensure unhindered access to the facilities and availability of roads to them in case of emergencies. • The entities in charge of researching and building the plants must certify the applicability and relevance of structural criteria used. Moreover, the new plant will be built according to international standards. Universal Design would apply to all types of common places (ramps, elevators, bathroom for people with disabilities, etc.).
ORGANISATION RESPONSIBLE FOR ITS MANAGEMENT	Safeguard unit of the PMU DCS
PERIOD AND DOCUMENT IN WHICH IT IS SPECIFIED	Purchase specifications and contracts. Bidding documents have to include assurance that EMP will be followed. The EIA including EMP must be attached as part of bidding documents.
PRECAUTIONS FOR IMPLEMENTATION AND MANAGEMENT	None.
MAINTENANCE	None.
COST	Included in the project

MITIGATION MEASURE N° 7	
IMPACT CONCERNED	Potential soil and water contamination due to improper storage or manipulation of the work materials and/or waste
DEFINITION OF THE MEASURE	Installation of transformers without PCB.
OBJECTIVE	Avoid the installation of transformers that contained PCB.
DESCRIPTION OF THE MEASURE / ISSUES THAT IT INCLUDES	The insulating oil shall comply with the international standard IEC 60296 and shall free from PCB. The reference method is IEC 61619. The detection limit for a single peak is 0,1 mg/kg In accordance with the Stockholm Agreement, it is recommended to install transformers with zero contain of PCB.

ORGANISATION RESPONSIBLE FOR ITS MANAGEMENT	Safeguard unit of the PMU DCS
PERIOD AND DOCUMENT IN WHICH IT IS SPECIFIED	Purchase specifications and contracts. Bidding documents have to include assurance that EMP will be followed. The EIA including EMP must be attached as part of bidding documents.
PRECAUTIONS FOR IMPLEMENTATION AND MANAGEMENT	The transformer shall have an oil conservator tank that shall have an oil level gauge with maximum and minimum oil level and alarms.
MAINTENANCE	None
COST	Good practice. No cost.

MITIGATION MEASURE N° 8	
IMPACT CONCERNED	Outdoor air quality improvement due to the emission reduction by the replacement of an obsolete with an energy efficient technology
DEFINITION OF THE MEASURE	Construction of a 60 m stack.
OBJECTIVE	Minimize contaminating gas emissions and make sure that national and World Bank (World Health Organization) air quality standards are fulfilled.
DESCRIPTION OF THE MEASURE / ISSUES THAT IT INCLUDES	The project includes the construction of a 60 m stack, in accordance with the result obtained which in accordance with the Environmental Protection Agency (EPA) atmosphere pollutant dispersion model (AERMOD). Stack height calculated with the Good International Industry Practices (GIIP) formula is 112,5 m. Constructor should analyze if with a 60 m stack height, excessive ground level concentrations due to downwash, wakes and eddy effects is avoided as current design stack location is close to the existing TPP buildings. If the ground level concentration is in excess, mitigation measures, including increasing stack height, should be adapted (see mitigation measure # 11) The stack will be provided with sampling doors, platforms, access routes, lighting and supports, etc. placed at correct height for manually sampling emission gases. Particularly stack should be constructed taking into account EN: 15259:2007 “Stationary source emission requirements for the measuring sections and sites and for the measurements objective, plan and report” or similar.
ORGANISATION RESPONSIBLE FOR ITS MANAGEMENT	Safeguard unit of the PMU DCS
PERIOD AND DOCUMENT IN WHICH IT IS SPECIFIED	Purchase specifications and contracts. Bidding documents have to include assurance that EMP will be followed. The EIA including EMP must be attached as part of bidding documents.

MITIGATION MEASURE N° 8	
PRECAUTIONS FOR IMPLEMENTATION AND MANAGEMENT	Application of appropriate marking systems to ensure proper visibility of the facility and avoid potential aircraft accidents.
MAINTENANCE	None.
COST	Included in the project

MITIGATION MEASURE N° 9	
IMPACT CONCERNED	Outdoor air quality improvement due to the emission reduction by the replacement of an obsolete with an energy efficient technology
DEFINITION OF THE MEASURE	Use of low NO_x emission technology
OBJECTIVE	Minimization of NO_x emissions
DESCRIPTION OF THE MEASURE / ISSUES THAT IT INCLUDES	The project includes use of low NO_x emission burners. Design will be take into account compliance with emission limits contained in the World Bank Thermal Power Plant Guidelines (2008) for combustion turbines (51 mg/Nm3, dry basis, 3% O2).
ORGANISATION RESPONSIBLE FOR ITS MANAGEMENT	Safeguard unit of the PMU DCS
PERIOD AND DOCUMENT IN WHICH IT IS SPECIFIED	Purchase specifications and contracts. Bidding documents have to include assurance that EMP will be followed. The EIA including EMP must be attached as part of bidding documents.
PRECAUTIONS FOR IMPLEMENTATION AND MANAGEMENT	None.
MAINTENANCE	Regular maintenance of installations.
COST	Included in the project

MITIGATION MEASURE N° 10	
IMPACT CONCERNED	Outdoor air quality improvement due to the emission reduction by the replacement of an obsolete to an energy efficient technology Hazards for health and safety of the personnel and the surrounding population..

MITIGATION MEASURE N° 10	
DEFINITION OF THE MEASURE	Installation of a Continuous Emissions Monitoring System (CEMS) and recording equipment.
OBJECTIVE	Monitoring and continuous recording of atmospheric emissions produced by the CCPU to guaranty emission standards fulfillment.
DESCRIPTION OF THE MEASURE / ISSUES THAT IT INCLUDES	The project includes the installation of a Continuous Emission Monitoring System (CEMS) to check compliance with the emissions national and international (World Bank Thermal Plants IFC Guidelines 2008) standards. At national level, emissions are approved by SNPC licenses on "Maximum allowed discharge of pollutants in air". This license should be re-approved every 3-5 years. Considered pollutants to analyze and record continuously and automatically are: SO_2, NO_x and CO. NO_x should be measured in NO_2 and NO in accordance with national emission standards. The continuous measurements carried out will include the measurement of the oxygen content, and should also include temperature, pressure and water vapor content of the exhaust gases. The continuous measurement of the water vapor content of the exhaust gas shall not be necessary, provided that the sampled exhaust gas is dried before the emissions are analyzed.
ORGANISATION RESPONSIBLE FOR ITS MANAGEMENT	Safeguard unit of the PMU DCS
PERIOD AND DOCUMENT IN WHICH IT IS SPECIFIED	Purchase specifications and contracts. Bidding documents have to include assurance that EMP will be followed. The EIA including EMP must be attached as part of bidding documents.
PRECAUTIONS FOR IMPLEMENTATION AND MANAGEMENT	Sample and analysis methods should apply national or international methods, such as those published by the ISO.
MAINTENANCE	Maintenance and calibration specified by the manufacturer of the equipment.
COST	Included in the project

MITIGATION MEASURE N° 11	
IMPACT CONCERNED	Outdoor air quality improvement due to the emission reduction by the replacement of an obsolete to an energy efficient technology Hazards for health and safety of the personnel and the surrounding population.
DEFINITION OF THE MEASURE	Air quality levels will be controlled by means of an air quality and a meteorological station
OBJECTIVE	Measuring levels of air pollutants inmission. Collection of data to know the local weather system for the interpretation of air pollution data collected in monitoring station. Monitoring the current impact of emissions in the values of inmission of pollutants emitted.
DESCRIPTION OF THE MEASURE / ISSUES THAT IT INCLUDES	The project includes an air quality and a meteorological station. Air quality station includes SO2, NOx, and Particulate Matter. In order to include both national and international air quality standards the following parameters should be measured: • Particulate matter should be measured as TPM, PM10 and PM2,5. • NOX should be measured as NO2 and NO. • CO should be measured also. Air quality station should be located in the predicted maximum ground level concentration point. To locate this point a specific study should be carried out taking into account results of the atmospheric dispersion model, power supply, location within the national territory, etc. Meteorological station includes relative humidity, wind direction/speed, barometric pressure. Monitoring station should be located within the TPP terrains in order to gather information of the meteorological dispersion conditions of the exhaust gas. Air quality and meteorological stations must be installed and in operation in the pre-construction phase in order to gather air quality baseline data prior to construction of the stack. Assessment of the data recorded will be used to check if the height of the stack complies with air quality standards. In case of exceeding air quality standards, mitigation measures should be undertaken (e.g. stack height increase). Data will be saved by the recording device integrated into analyzer case and transferred to Main Control Room panels. The database compiled in there could be transfer to UES TSO (Unified Energy System Transmission System Operator of the Republic of Uzbekistan).
ORGANISATION	Safeguard unit of the PMU

MITIGATION MEASURE N° 11	
RESPONSIBLE FOR ITS MANAGEMENT	DCS
PERIOD AND DOCUMENT IN WHICH IT IS SPECIFIED	Purchase specifications and contracts. Bidding documents have to include assurance that EMP will be followed. The EIA including EMP must be attached as part of bidding documents.
PRECAUTIONS FOR IMPLEMENTATION AND MANAGEMENT	Implementation of national and international methods of collection and analysis of samples. Check that the measuring instruments are set and approved by a competent body, and properly calibrated and contrasted by organizations authorized by it. Check the correct operation and calibration of equipment installed and the state of the computer systems.
MAINTENANCE	Maintenance and calibration specified by the manufacturer of the equipment.
COST	Included in the project Air quality station location study: 25000 $US

MITIGATION MEASURE N° 12	
IMPACT CONCERNED	Increase in noise levels as a result of operating the new Takhiatash CCPU.
DEFINITION OF THE MEASURE	Building and/or Installing noise attenuation devices.
OBJECTIVE	Eliminate or reduce the noise transmitted to the outside through the operation of new plant and associated facilities.
DESCRIPTION OF THE MEASURE / ISSUES THAT IT INCLUDES	In accordance with the project, the following acoustic noise and vibration reduction measures have been included: Fans, smoke exhausters and pumps will be installed on resiliently supported base. Pumps, pie-lines, fans and air conduits will be separated by flexible joints. Cases of air conduits will be covered with special vibro-acoustic plaster. Also, the following measures will be installed in the ventilation units - Installation of vibration absorbers under centrifugal fans of input, extraction systems and air conditioning system - Installation of splitter silencers and sound traps at air pipelines - Connection of fans to the grid via flexible connectors - Speed of air flow in air pipelines will depend on facility type and number of personnel there in order to prevent aerodynamic noise - Air ventilation chamber structures installed in buildings with low permissible noise level, will be covered with heavy sound

MITIGATION MEASURE N° 12	
	insulation Also the following measures should be taken into account: - Boilers: they will have the elements required to reduce noise. Thermal sealing will be designed so as to reduce noise. - Air intake conduits will be coated with noise-reducing materials. - Steam by-pass conduits and the super heater will be coated with acoustic noise reducing materials. - The safety valves and pipes for purge recovery will have silencers. - For all fluids discharged into the atmosphere under pressure (gas and steam) noise reduction silencers should be planned. For the new unit, the weighted acoustic pressure A, measured at 1.5 m from the floor or from the ground, at a distance of 1 m from the noise source, will not exceed 80 dB (A) under normal operating conditions. Noise and vibration mitigation measures will fulfil whichever is more stringent between: 1) SanR&N No 0120-01 “Sanitarian norms for noise level at the working places”; 2) Table 2.3.1. Noise limits for various working environments of the World Bank IFC general EHS guidelines (2007). If any of the equipment exceeds the values prescribed, necessary measures will be taken.
ORGANISATION RESPONSIBLE FOR ITS MANAGEMENT	Safeguard unit of the PMU DCS
PERIOD AND DOCUMENT IN WHICH IT IS SPECIFIED	Purchase specifications and contracts. Bidding documents have to include assurance that EMP will be followed. The EIA including EMP must be attached as part of bidding documents.
PRECAUTIONS FOR IMPLEMENTATION AND MANAGEMENT	None
MAINTENANCE	Regular maintenance of installations.
COST	Included in the project

MITIGATION MEASURE N° 13	
IMPACT CONCERNED	Potential soil and water contamination due to improper storage or manipulation of the work materials and/or waste.
DEFINITION OF THE MEASURE	Double-walled composite for underground storage tanks.
OBJECTIVE	Avoid contamination or alteration of groundwater and soil from spills of oil.

MITIGATION MEASURE N° 13	
DESCRIPTION OF THE MEASURE / ISSUES THAT IT INCLUDES	Underground emergency drain oil tank in the engine room of the turbine building must be design double-walled composite, o specially coated storage and piping systems. A mean of detecting leaks between the two walls should be provided.
ORGANISATION RESPONSIBLE FOR ITS MANAGEMENT	Safeguard unit of the PMU DCS
PERIOD AND DOCUMENT IN WHICH IT IS SPECIFIED	Purchase specifications and contracts. Bidding documents have to include assurance that EMP will be followed. The EIA including EMP must be attached as part of bidding documents.
PRECAUTIONS FOR IMPLEMENTATION AND MANAGEMENT	None
MAINTENANCE	Checking the state of preservation of tanks and their water tightness.
COST	Included in the project

MITIGATION MEASURE N° 14	
IMPACT CONCERNED	Potential soil and water contamination due to improper storage or manipulation of the work materials and/or waste.
DEFINITION OF THE MEASURE	Hazardous materials and wastes storage design to avoid spillages or overflowing
OBJECTIVE	Avoid contamination or alteration of groundwater and soil from spills of oil or chemicals.
DESCRIPTION OF THE MEASURE / ISSUES THAT IT INCLUDES	In the project, the design characteristics for the storage facilities (chemical and materials storage; drummed oil storage) are: external wall three-layer cladding “sandwich-panel”; rolled roofing material; asphalt-concrete perimeter works with the width of less than 1 m around the buildings. Hazardous materials or wastes (chemicals, oil, etc) will be carried out in sealed holding tanks with a secondary containment with sufficient capacity to retain the discharge caused by the rupture of the 110% largest container or 25% of the combined tank volumes stored. These secondary containments will be made of impervious, chemically resistant material and should also consider means to prevent contact between incompatible materials in the event of a release Adequate ventilation where volatile hazardous materials or wastes are stored should be provided. The holding tanks will also ensure the containment of flows due to loading and unloading of hazardous materials and products. Oil tanks will include pumps shutting off devices to prevent

MITIGATION MEASURE N° 14	
	overfilling and oil level will be monitored in a continuous basis.
ORGANISATION RESPONSIBLE FOR ITS MANAGEMENT	Safeguard unit of the PMU DCS
PERIOD AND DOCUMENT IN WHICH IT IS SPECIFIED	Purchase specifications and contracts. Bidding documents have to include assurance that EMP will be followed. The EIA including EMP must be attached as part of bidding documents.
PRECAUTIONS FOR IMPLEMENTATION AND MANAGEMENT	None
MAINTENANCE	Checking the state of preservation of tanks and their water tightness.
COST	Included in the project

MITIGATION MEASURE N° 15	
IMPACT CONCERNED	Water resources intake reduction Potential improvement of the aquatic ecosystems as a consequence of partial replacement of an open cooling water system to a closed one.
DEFINITION OF THE MEASURE	Design of a closed cooling water system for the new CCPU
OBJECTIVE	To reduce water intake flow and temperature increase impact
DESCRIPTION OF THE MEASURE / ISSUES THAT IT INCLUDES	In accordance with the “Law on water and water use” of Uzbekistan the process water supply of the new CCPU will in accordance with the closed cooling water system. Therefore, the option for open cooling water system for the new CCPU is not considered as it is not an environmentally friendly solution.
ORGANISATION RESPONSIBLE FOR ITS MANAGEMENT	Safeguard unit of the PMU DCS
PERIOD AND DOCUMENT IN WHICH IT IS SPECIFIED	Purchase specifications and contracts. Bidding documents have to include assurance that EMP will be followed. The EIA including EMP must be attached as part of bidding documents.
PRECAUTIONS FOR IMPLEMENTATION AND MANAGEMENT	None
MAINTENANCE	None
COST	Included in the project

MITIGATION MEASURE N° 16	
IMPACT CONCERNED	Potential increase of soil salinity due to the cooling towers steam plume deposition Potential hygienic risks for the health and safety of personnel and the surrounding population.
DEFINITION OF THE MEASURE	Cooling tower design.
OBJECTIVE	Minimize the drift loss rate in cooling towers
DESCRIPTION OF THE MEASURE / ISSUES THAT IT INCLUDES	In order to minimize the entrainment of drops in the exhaust air, cooling towers shall incorporate drift eliminators, which are devices placed inside the tower to prevent drops from going out with the air. The drift eliminator system's performance will be such as to ensure drift loss rate of 0.001%. A proper design of the cooling tower shall be applied in order to reduce soiling. The location and direction of the cooling towers should be carried out taking into account wind direction and speed in order to have an optimum efficiency and therefore reducing size of cooling steam plume.
ORGANISATION RESPONSIBLE FOR ITS MANAGEMENT	Safeguard unit of the PMU DCS
PERIOD AND DOCUMENT IN WHICH IT IS SPECIFIED	Purchase specifications and contracts. Bidding documents have to include assurance that EMP will be followed. The EIA including EMP must be attached as part of bidding documents.
PRECAUTIONS FOR IMPLEMENTATION AND MANAGEMENT	None
MAINTENANCE	The specific maintenance conditions for the cooling towers
COST	Included in the project

MITIGATION MEASURE N° 17	
IMPACT CONCERNED	Alteration of the water quality as a consequence of effluent discharge.
DEFINITION OF THE MEASURE	Design of effluent treatment system to fulfill discharge standards.
OBJECTIVE	Avoid surface water contamination.

MITIGATION MEASURE N° 17	
DESCRIPTION OF THE MEASURE / ISSUES THAT IT INCLUDES	The effluents generated by operation of the new facilities of CCPU are: ▪ **Domestic effluents** Domestic wastewater or sanitary effluents is discharged, without treatment, though pipe line to the Takhiatash Municipal Waste Water Treatment Plant. This plant should fulfill sewage effluent standards of the general IFC EHS guidelines (2007) and otherwise the necessary facilities should be included in order to fulfill these standards previously to the discharge to the Municipal Waste Water Treatment Plant. ▪ **Rainfall effluents** Rainwater will be collected along the territory and discharged into existing storm water sewer system. ▪ **Oil and Chemical effluents** A new treatment of effluents will be provided for the new CCPU without using the existing effluent treatment installation. From the effluent treatment effluents are driven to the chemical treatment plant slime lagoons and then into the TPP waste channel. This pond will be made of impervious, chemical resistant material. Material used for the construction will have to resist high differences of temperature between stations in order not to crack. ▪ **Circulation system blowdown** Cooling tower blowdown water as relatively clean is discharged into the outlet channel of Takhtiatash TPP without treatment. Effluent treatment system and cooling water system of the new CCPU will be designed in order to fulfill new MAD for the CCPU and Thermal Power Plants EHS IFC guidelines (2008), whichever is more stringent. If natural water quality intake already excess standards, effluent treatment system and cooling water system will be designed in order not to increase levels of pollution.
ORGANISATION RESPONSIBLE FOR ITS MANAGEMENT	Safeguard unit of the PMU DCS
PERIOD AND DOCUMENT IN WHICH IT IS SPECIFIED	Purchase specifications and contracts. Bidding documents have to include assurance that EMP will be followed. The EIA including EMP must be attached as part of bidding documents.
PRECAUTIONS FOR IMPLEMENTATION AND MANAGEMENT	None
MAINTENANCE COST	Regular maintenance of installations. Included in the project

MITIGATION MEASURE N° 18	
IMPACT CONCERNED	Water resources intake reduction Potential effects on water resources due to the increase of water consumed for the new Unit. Alteration of the water quality as a consequence of effluent discharge. Potential improvement of the aquatic ecosystems as a consequence of partial replacement of an open cooling water system to a closed one.
DEFINITION OF THE MEASURE	Implementing an effluent continuous control system
OBJECTIVE	Comprehensive control of effluent to avoid pollution of surface waters due to poor operation of effluent treatment at the power plant.
DESCRIPTION OF THE MEASURE / ISSUES THAT IT INCLUDES	Project includes automatic measurement of pH and temperature in the cooling water system. These measurements should be located at the intake and discharge points. Conductivity and flow should be measured on the same basis also. Check that the global monitoring and recording equipment works properly and that the discharge limits are met at any time.
ORGANISATION RESPONSIBLE FOR ITS MANAGEMENT	Safeguard unit of the PMU DCS
PERIOD AND DOCUMENT IN WHICH IT IS SPECIFIED	Purchase specifications and contracts. Bidding documents have to include assurance that EMP will be followed. The EIA including EMP must be attached as part of bidding documents.
PRECAUTIONS FOR IMPLEMENTATION AND MANAGEMENT	Check that the global monitoring and recording equipment works properly.
MAINTENANCE	Regular maintenance of equipment
COST	Included in the project

ITIGATION MEASURE N° 19	
IMPACT CONCERNED	Alteration of the water quality as a consequence of effluent discharge. Potential improvement of the aquatic ecosystems as a consequence of partial replacement of an open cooling water system to a closed one.
DEFINITION OF THE MEASURE	Implementation of an optimized chemical dosing system for cooling water treatment and control.
OBJECTIVE	Avoidance of altering water quality and aquatic habitat conditions in the vicinity of the discharge point.
DESCRIPTION OF THE MEASURE / ISSUES THAT IT INCLUDES	The water treatment for the cooling system of the new CCPU shall be designed with a biocide (sodium hypochlorite) dosage performed by a control and global

ITIGATION MEASURE N° 19	
	monitoring equipment with automatic dosage calibration. Total residual chlorine should be measured at the discharge point continuously. This will lead to process optimization and, therefore, a minimum requirement of chemicals additives, achieving a minimum concentration at discharge with consequent environmental benefits.
ORGANISATION RESPONSIBLE FOR ITS MANAGEMENT	Safeguard unit of the PMU DCS
PERIOD AND DOCUMENT IN WHICH IT IS SPECIFIED	Purchase specifications and contracts. Bidding documents have to include assurance that EMP will be followed. The EIA including EMP must be attached as part of bidding documents.
PRECAUTIONS FOR IMPLEMENTATION AND MANAGEMENT	Check that the global monitoring and recording equipment works properly.
MAINTENANCE	Regular maintenance of equipment
COST	Included in the project

MITIGATION MEASURE N° 20	
IMPACT CONCERNED	Potential effects on, and disturbances to, the aquatic ecosystem through the installation of the water extraction system.
DEFINITION OF THE MEASURE	Water intake system environmental design
OBJECTIVE	Avoid impact on aquatic habitat.
DESCRIPTION OF THE MEASURE / ISSUES THAT IT INCLUDES	Water intake mouth will be provided with two constructions for trash racks and screens, which will act as fish protection structures. Maximum through-screen design intake velocity should be reduced to 0,1524 m/s
ORGANISATION RESPONSIBLE FOR ITS MANAGEMENT	Safeguard unit of the PMU DCS
PERIOD AND DOCUMENT IN WHICH IT IS SPECIFIED	Purchase specifications and contracts. Bidding documents have to include assurance that EMP will be followed. The EIA including EMP must be attached as part of bidding documents.
PRECAUTIONS FOR IMPLEMENTATION AND MANAGEMENT	None
MAINTENANCE	None
COST	Good practice. Not specific cost but to include this recommendation on the design.

MITIGATION MEASURE N° 21	
IMPACT CONCERNED	Potential impact on the landscape due to the physical presence of new CCPU.
DEFINITION OF THE MEASURE	Landscape design for the new unit and auxiliary installations.
OBJECTIVE	Minimize the impact on the landscape caused by the physical presence of the new plant.
DESCRIPTION OF THE MEASURE / ISSUES THAT IT INCLUDES	Materials, colors and shapes shall be selected for their ability to integrate harmoniously into the surrounding landscape. Care should be taken over the finishing of fronting structures for buildings, so that they integrate into the landscape, avoiding colors and shapes that are reflective or conspicuous. The new buildings will be made on the same patterns as existing ones. Particular attention will be given to corrosion protection of plant, equipment and buildings particularly where exposed to the elements. All plates for fabrication will be their surfaces protected from further corrosion after fabrication.
ORGANISATION RESPONSIBLE FOR ITS MANAGEMENT	Safeguard unit of the PMU DCS
PERIOD AND DOCUMENT IN WHICH IT IS SPECIFIED	Purchase specifications and contracts. Bidding documents have to include assurance that EMP will be followed. The EIA including EMP must be attached as part of bidding documents.
PRECAUTIONS FOR IMPLEMENTATION AND MANAGEMENT	Use of materials, colors and shapes respecting the environment
MAINTENANCE	Checking the adaptation to the environment of the selected solution. The maintenance and preservation facilities will be done correctly.
COST	Included in the project. Good practice. Not specific cost but to include this recommendation on the design.

B. Construction of CCPU and Decommissioning of units III and IV

MITIGATION MEASURE N° 22	
IMPACT CONCERNED	All the impacts
DEFINITION OF THE MEASURE	The Safeguard unit of the PMU for the site will be the highest ranking team in charge of all environmental aspects both in the construction and decommissioning phases. EMT will be in charge of: - File control of contractors. - Check of the list of documents and environmental conditions provided to contractors. - Monitoring the progress and control the environmental behavior of contractors. - Supervision of compliance with the EMP, EHS plan and Non Compliance annotation reported. - Proposal for corrective or preventive measures corresponding to the resolution of non-compliance.
OBJECTIVE	Controls performed during the actual work development which ensures the implementation of the mitigation measures detailed in the EMP.
DESCRIPTION OF THE MEASURE / ISSUES THAT IT INCLUDES	A communication and evaluation procedure will be developed to oversee contractors' environmental behavior. Supervision of contractors’ activity and verification that procedures and requirements are properly applied. Supervision observance of measures set out by the EMP under applicable legal conditions. Ensure that contractor liaises with local community on approach to mitigation.
ORGANISATION RESPONSIBLE FOR ITS MANAGEMENT	Safeguard unit of the PMU.
PERIOD AND DOCUMENT IN WHICH IT IS SPECIFIED	EMP construction plan EMP decommissioning plan.
PRECAUTIONS FOR IMPLEMENTATION AND MANAGEMENT	The activities of the Safeguard unit of the PMU will be supervised by the EHSGH that will conduct a review of all documentation.
MAINTENANCE	None.
COST	Included in the project

MITIGATION MEASURE N° 23	
IMPACT CONCERNED	Hazards for health and safety of the personnel and the surrounding population.
DEFINITION OF THE MEASURE	Continuous execution of the EHS plan for construction and decommissioning phases
OBJECTIVE	Avoid environmental impacts, health and safety risk.
DESCRIPTION OF THE MEASURE / ISSUES THAT IT INCLUDES	Special precautionary provisions to be taken into account in relation with contamination risks of air, water and soils and work safety prescriptions. • Specify waste management • Specify lay-out and function of latrines or chemical toilets, and detail clean-up operations. • Implementation of rodent control measures and monitoring. • Providing essential personal protective equipment • Implement accident reporting and investigation procedures with reporting of the root cause of individual cases, and analysis of weekly and monthly statistics. • Periodic audit of accident reports and safety system. • Carry out regular awareness campaigns among work staff, The staff involved in the construction of new CCPU as well as the decommissioning of the units III and IV will be aware of safety, health and environment so they understand the risks associated with the activity undertaken and realize how to do their tasks with the least possible risk to their health and the environment. For this purpose a Training Program will be developed considering: • Education and training of workers on regulations on environment, work safety and risk prevention and to obey them. • Conduct regular safety awareness campaigns for both the workforce and the general public, including specific hazards associated with the spread of HIV/AIDS.
ORGANISATION RESPONSIBLE FOR ITS MANAGEMENT	EMT
PERIOD AND DOCUMENT IN WHICH IT IS SPECIFIED	EMP construction plan EMP decommissioning plan.
PRECAUTIONS FOR IMPLEMENTATION AND MANAGEMENT	Particular emphasis will be laid on site worker training.
MAINTENANCE	None
COST	Cost should be covered by contracts sums

MITIGATION MEASURE N° 24	
IMPACT CONCERNED	All impacts during Decommissioning.
DEFINITION OF THE MEASURE	Implementation of the Decommissioning Plan for the existing units III and IV at Takhiatash TPP.
OBJECTIVE	The Decommissioning Plan will include the best available decommissioning management procedures and technologies.
DESCRIPTION OF THE MEASURE / ISSUES THAT IT INCLUDES	The equipment of the existing units III and IV, will be decommissioned in accordance with an agreed Decommissioning Plan. This will provide for the protection so as not to pose an unacceptable risk to human health, safety, and the environment due to the presence of pollutants
ORGANISATION RESPONSIBLE FOR ITS MANAGEMENT	Decommissioning contractor
PERIOD AND DOCUMENT IN WHICH IT IS SPECIFIED	Decommissioning Plan
PRECAUTIONS FOR IMPLEMENTATION AND MANAGEMENT	None
MAINTENANCE	None
COST	Cost should be covered by contracts sums

MITIGATION MEASURE N° 25	
IMPACT CONCERNED	Potential hygienic risks for the health and safety of personnel and the surrounding population.
DEFINITION OF THE MEASURE	Contractor's grievance mechanism development
OBJECTIVE	Avoid nuisances and impacts to neighboring activities and households.
DESCRIPTION OF THE MEASURE / ISSUES THAT IT INCLUDES	• Include in contract clauses contractor's responsibility to mitigate nuisances, noise, vibration, and dust impacts and other nuisances to neighbors. • Ensure that contractor incorporates good construction management practices • Ensure that contractor liaises with local community on approach to mitigation. • Clarify by signboards on construction sites and/or stickers on equipment outlining how affected parties can lodge complaints. • Ensure that contractor records complaints and responses, conducts resolution monitoring, and includes information on complaints in regular progress reports. • Audit complaint files and verify closeout
ORGANISATION RESPONSIBLE FOR ITS MANAGEMENT	Safeguard unit of the PMU EPC CCPU & Decommissioning contractor

MITIGATION MEASURE N° 25	
PERIOD AND DOCUMENT IN WHICH IT IS SPECIFIED	Grievance mechanism within EMP construction and decommissioning plans
PRECAUTIONS FOR IMPLEMENTATION AND MANAGEMENT	None
MAINTENANCE	None
COST	Included in the Environmental Safeguard Expert tasks

MITIGATION MEASURE N° 26	
IMPACT CONCERNED	Potential hygienic risks for the health and safety of personnel and the surrounding population.
DEFINITION OF THE MEASURE	Determining the necessary measures for dealing with potential risks arising from soil contamination
OBJECTIVE	Avoid environmental, health and safety risk due to the management of contaminated soil
DESCRIPTION OF THE MEASURE / ISSUES THAT IT INCLUDES	When ground contamination is suspected during any phase of the project, or that this contamination is confirmed, the cause must be identified and rectified. If when starting the construction of new CCPU, soil pollution is observed, the contaminated land should be managed in order to avoid risks to human health and ecological receptors. The objective will be to reduce the level of contamination on the site to prevent human exposure to contamination. For determining the necessary measures for dealing with potential risks, the method specified in paragraph”1.8. "Polluted sites and soils" in the Health and Safety Environmental Guidelines of the World Bank (December 2008) shall be applied. This method of assessment will determine if the three risk factors named "contaminants", "receptors" and "ways of contamination”, co-exist or are likely to co -exist on the project site within the current or future use of the land. When it is determined that the three risk factors are present, the following measures must be taken : 1. Risk identification: • Place identification. • Sampling and testing of contaminated materials in accordance with the set up technical procedures. • Evaluation of analytical results in accordance with local and national regulation concerning contaminated sites. In the absence of such regulations or standards on the environment, other sources of standards or guidelines may be consulted

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- Examination of potential human and / or ecological receptors , and ways of exposure

2. <u>Temporary risk management:</u>

Temporary measures of risk management must be taken at all levels of the project life cycle, when the presence of soil contamination could be an immediate danger, for example:

- Presence of an explosive atmosphere caused by a contaminated site.
- The accessible and excessive contamination, due to the power of contaminants, could give rise in case of short-term exposure to an acute toxicity, with long-term irreversible effects, to a sensitization or also to the accumulation of bio accumulative and toxic persistent substances.
- Concentrations of pollutants higher than Risk Based Concentrations of Risk (RBC, USEPA).

3. <u>Detailed risk assessment</u>

This evaluation will facilitate decisions on risk management in contaminated sites. Among the specific objectives of risk assessment, the following will be indicated :

- Identification of receptors
- Determine whether the presence of contaminants are in proportions that are potentially harmful to health
- Determine how the receptors are exposed to contaminants
- Identify the types of adverse effects arising from exposure to contaminants
- Quantify the extent of health risks based on a quantitative analysis of exposure to contaminants and toxicity
- Determine how current and future land use affects expected risks.
- Quantify the potential risks to the environment and / or health arising from the migration of contaminants off-site
- Determine the likely stability, increase or decrease of risk over time in the absence of any rehabilitation measure

4. <u>Permanent measures to reduce risks</u>

- Risk mitigation strategies for sources of contamination and exposure levels (examples):
  - For soil, sediment, sludge, groundwater, surface water and leach ate: Biological / physical / chemical / thermal treatment in situ or off site, containment,

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MITIGATION MEASURE N° 26	
	natural attenuation, depending on different situations. – For the soil vapour intrusion: Vapour extraction, depressurization under the foundations, installation of a waterproof barrier, etc.. • Risk mitigation strategies for exposure course (examples): – Provision of alternative access to water when needed. – Recovery of soil contaminated by a minimum of 1 m of uncontaminated soil to prevent any contact with humans, and the penetration in contaminated soil of plant roots and small mammals. – Paving of contaminated soil as a temporary measure to prevent a path allowing direct contact, or the production and inhalation of dust. – Use of a ditch system to intercept and pump and treatment technologies to prevent the discharge of contaminated groundwater from affecting other sites. Precautions for health and safety will always have to be considered to minimize exposure to risks. Furthermore, staff working on contaminated land must be specially trained on health and safety, for activities related to contaminated soil.
ORGANISATION RESPONSIBLE FOR ITS MANAGEMENT	Safeguard unit of the PMU EPC CCPU & Decommissioning contractor
PERIOD AND DOCUMENT IN WHICH IT IS SPECIFIED	Specific procedure of the EHS construction and decommissioning plans
PRECAUTIONS FOR IMPLEMENTATION AND MANAGEMENT	Organize periodic servicing in accordance with predetermined plan.
MAINTENANCE	None.
COST	To be estimated if soil pollution is found out

MITIGATION MEASURE N° 27	
IMPACT CONCERNED	Potential elimination of vegetation during land and vegetation clearing. Potential soil compaction.
DEFINITION OF THE MEASURE	Topsoil stripped and safely stockpile where it is available for re-use.
OBJECTIVE	Top covering layer of soil available when reaching completion of the project.
DESCRIPTION OF THE MEASURE / ISSUES THAT IT INCLUDES	Top soil coming from earthmoving will be properly stockpiled and preserved in order to be re -use in recovering works. This material will be spread out and cover areas to revegetate after finishing civil works.

	The shape of these piles won't be higher than 2 meters, 5,5 meters width on the base. Neither the height of these piles, nor the width on the base will exceed 2 and 5,5 meters respectively. The slope of heaps will be never higher than 1/1 proportion.
ORGANISATION RESPONSIBLE FOR ITS MANAGEMENT	EMT
PERIOD AND DOCUMENT IN WHICH IT IS SPECIFIED	EMP construction Construction plan
PRECAUTIONS FOR IMPLEMENTATION AND MANAGEMENT	In order to avoid damage, the dimension of the piles will be strictly respected as well as the fact that top soil won't be mixed with different kind of materials. The location of the heaps will be never close to riverbeds or strong wind areas.
MAINTENANCE	To preserve the quality of this land it could take place fertilizing, seeding and watering works. Complementary irrigation will take place when especially dry conditions.
COST	Good practice. Not specific cost.

MITIGATION MEASURE N° 28	
IMPACT CONCERNED	Discrete and local increase in particulate matter suspended in air.
DEFINITION OF THE MEASURE	Dust control
OBJECTIVE	Maintain air and surface vegetation free of dust. Avoid alteration of air quality. Avoid the visible presence of dust.
DESCRIPTION OF THE MEASURE / ISSUES THAT IT INCLUDES	Water sprinkling for establishing dust and preventing dust dispersal over wind exposed areas that contain heaps of earth or other substances; excavated or stockpiled soil and sand before loading; terrain or areas which vehicles frequently access, and in neighboring sensitive areas which could be affected. Trucks carrying sandy materials/waste should be covered over with tarpaulins or any other means for avoiding particle dispersion. The device must cover the entire truck. Speed of vehicles shall be limited particularly on unpaved areas Provide for wheel washing at site exit Provide for road cleaning to remedy an spread due to site traffic
ORGANISATION RESPONSIBLE FOR ITS MANAGEMENT	EMT
PERIOD AND DOCUMENT IN WHICH IT IS SPECIFIED	EMP construction and decommissioning phases. Construction plan
PRECAUTIONS FOR IMPLEMENTATION AND MANAGEMENT	Taking as a threshold to do the watering, the visible presence of dust by simple visual observation. Pay attention when filling and emptying buckets of trucks to avoid raising dust.
MAINTENANCE	Maintain in good preservation the tarpaulins used to cover dump trucks. Use an appropriate cover, making sure not to leave any openings.
COST	Included in the project.

MITIGATION MEASURE N° 29	
IMPACT CONCERNED	Degradation of air quality due to exhaust emissions from construction and decommissioning equipment.
DEFINITION OF THE MEASURE	Control of gas emissions generated by construction and decommissioning vehicles.
OBJECTIVE	Maintain good air quality in terms of air pollutants in the construction phase and decommissioning.
DESCRIPTION OF THE MEASURE / ISSUES THAT IT INCLUDES	In order to control and reduce gas emissions as far as possible, the engines of on-site vehicles should be serviced and tuned by a competent entity. All heavy equipment and machinery shall be fitted in full compliance with the national SNPC and local regulations with regards to emissions and noise.

MITIGATION MEASURE N° 29	
	Application of mechanical maintenance programs recommended by manufacturers. Inform drivers of the benefits of good driving practices that reduce vehicle fuel consumption and the risk of accidents. Emphasize the importance of avoiding sudden accelerations and respect the speed limits.
ORGANISATION RESPONSIBLE FOR ITS MANAGEMENT	EMT
PERIOD AND DOCUMENT IN WHICH IT IS SPECIFIED	EMP construction and decommissioning phases.
PRECAUTIONS FOR IMPLEMENTATION AND MANAGEMENT	Check that all licenses of machines are up to date and that they have been through the appropriate inspections and that only properly registered and well-maintained vehicles are used. Check that all the machines meet the standards on emissions of pollutants, noise and vibration. The authorized service is responsible for servicing.
MAINTENANCE	The site manager will make sure that all machinery is in good condition and will ensure they have the corresponding certificates.
COST	Good practice. Not specific cost

MITIGATION MEASURE N° 30	
IMPACT CONCERNED	Potential increase in the noise level
DEFINITION OF THE MEASURE	Mitigation of noise emissions.
OBJECTIVE	Minimize inconvenience to staff and population by noise coming from action on the site.
DESCRIPTION OF THE MEASURE / ISSUES THAT IT INCLUDES	In order to reduce noise emission, the following criteria should be adapted: 1) Construction and decommissioning activities which cause excessive noise will be programmed for normal working hours. As a rule, the operation of heavy equipment shall be conducted in the time span 7am-7pm only, unless otherwise agreed with local residents (enforce speed limits, and restrict operation hours through roadside villages and settlements). All events used during start up activities will be adequately silenced to avoid excessive noise. Activities such as steam blowouts and testing safety valves will be programmed for normal working hours. 2) For machine and personnel movement on site: - When site operations begin, verify that construction

MITIGATION MEASURE N° 30	
	vehicles have undergone the corresponding technical inspections. For any vehicle with mechanical engine, transmission, body and any other element capable of producing sounds and vibrations and, in particular, the silencing of exhaust gases, must be in good operating condition. - All the equipment, which generates excessive noise, such as compressor, jackhammers shall be enclosed to prevent noise nuisance. -As far as possible, drivers of all the vehicles on site should adapt their speed so as to reduce noise. -Workers should be informed of measures for minimizing noise emissions. 3) For the loading and unloading: -Sand, brickbats, gravel etc. should be carried out low and as close as possible to the ground. -Site activities should be scheduled so as to avoid combined action of several equipment types that cause high noise levels over prolonged periods.
ORGANISATION RESPONSIBLE FOR ITS MANAGEMENT	EMT
PERIOD AND DOCUMENT IN WHICH IT IS SPECIFIED	EMP construction and decommissioning phases.
PRECAUTIONS FOR IMPLEMENTATION AND MANAGEMENT	To inform and educate site personnel on the obligation to respect other employees, the surrounding population and possible wildlife area. Respect of servicing periods of equipment used.
MAINTENANCE	None.
COST	Good practice. Not specific cost

MITIGATION MEASURE N° 31	
IMPACT CONCERNED	Potential soil compaction Potential reduction in the total area of fauna habitats in the work area Potential elimination of vegetation
DEFINITION OF THE MEASURE	Marking off and beaconing of activity areas.
OBJECTIVE	Minimizing of the ground area affected by the building work, avoiding acting on other sectors.

MITIGATION MEASURE N° 31	
DESCRIPTION OF THE MEASURE / ISSUES THAT IT INCLUDES	Scheduling and planning of access points and occupation areas should be carried out for site machinery and personnel. For this purpose, the following criteria should be followed: - Action areas should be scheduled and marked off. - The parcel of land to be used for hosting the new unit should be marked with beacons, as well as the areas to be used for storing materials, the site yard and the areas set aside for vehicle and equipment maintenance so that workers will not be confused as to boundaries. - Out of the work area, moving machinery, the deposit of materials or any type of waste will not be allowed.
ORGANISATION RESPONSIBLE FOR ITS MANAGEMENT	EMT
PERIOD AND DOCUMENT IN WHICH IT IS SPECIFIED	EMP construction and decommissioning phases. Construction and Decommissioning plans.
PRECAUTIONS FOR IMPLEMENTATION AND MANAGEMENT	EMT will check at any time that actions take place only in areas marked for work.
MAINTENANCE	EMT will conduct periodic servicing of the roads, ensuring that they retain the characteristics of the initial width and signaling.
COST	Good practice. Not specific cost

MITIGATION MEASURE N° 32	
IMPACT CONCERNED	Potential soil and water contamination due to improper storage or manipulation of the work materials and/or waste.
DEFINITION OF THE MEASURE	Waste management
OBJECTIVE	Avoid contamination of soil and groundwater, by discharge and improper management of waste generated by staff and machinery used for carrying out the work.
DESCRIPTION OF THE MEASURE / ISSUES THAT IT INCLUDES	A waste management hierarchy that consider prevention, reduction, reuse, recovery, recycling, removal and finally disposal of wastes should be considered. Final disposal must be undertaken in an environmentally sound manner. Prior to start of construction or decommissioning, develop an inventory of waste fractions expected to be generated during construction or decommissioning for approval of

MITIGATION MEASURE N° 32	
	disposal routes and sites. Minimizing hazardous waste generation must be carried out by implementing stringent waste segregation to prevent the commingling of non-hazardous and hazardous waste to be managed. This classification should be based in the Basel Convention signed by Uzbekistan. Areas where construction and decommissioning work are carried out, labor camps also should be equipped with drums and other suitable containers for collecting hazardous and non hazardous wastes. Their location should be conspicuously marked and made known to all site workers. For hazardous wastes: • Waste is stored in a manner that prevents the commingling or contact between incompatible wastes, and allows for inspection between containers to monitor leaks or spills. (sufficient space between incompatibles or physical separation such as walls or containment curbs) • Store in closed containers away from direct sunlight, wind and rain • Secondary containment is included wherever liquid wastes are stored in volumes greater than 220 liters. The available volume of secondary containment should be at least 110 percent of the largest storage container, or 25 percent of the total storage capacity (whichever is greater), in that specific location. Should be constructed with materials appropriate for the wastes being contained and adequate to prevent loss to the environment • Provide adequate ventilation where volatile wastes are stored. After being collected, waste shall be processed depending on type. The current management of wastes of the TPP can be used but some of the procedures should be corrected to fulfill international good practices: • Non-hazardous wastes: -Recycled: Iron, metal debris, steel, stubs, wool debris, waste rubber and tires, waste paper and other recyclable waste fractions can be selling to the enterprises currently being used in the operation of the existing units. -Disposed: Rest of non-hazardous wastes that are not being recycled as household and similar waste and waste such as concrete, brick, etc. should be transported to a properly designed, permitted and operated landfill.

MITIGATION MEASURE N° 32	
	One option is to improve Municipal landfill currently being used by the TPP to avoid soil and groundwater pollution. Hazardous -Disposed: ✓There will be a temporary storage of hazardous wastes. ✓Hazardous wastes will be properly separated and not mixed, avoiding difficult mixtures of hazardous wastes that do complicate their management. ✓Types of wastes generated will be packaged and labeled in homologated containers. ✓Incineration of hazardous wastes is prohibited in facilities without flue gas treatment system for control of acid gases, particulate matter, and other air pollutants. ✓The disposal of wastes is always done at an authorize agent. It there is not a hazardous waste landfill or storage which have the technical capability to manage the waste in a manner that reduces immediate and future impact to the environment neither the permits, certifications, and approvals of applicable government authorities, an specific facility must be constructed or adapted to provide sound long-term storage of wastes on-site or at an alternative appropriate location up until external commercial options become available. In this respect, mazut storage tanks located at 35 km from the TPP can be used as long-term hazardous waste storage considering specific adaptation measures (see “precautions for implementation and management”) ✓The documentation concerning the delivery of waste to the manager will be stored. ✓A record of the produced and managed wastes will be made, and of their destination. ✓Direct discharge will be never allowed on the ground.
ORGANISATION RESPONSIBLE FOR ITS MANAGEMENT	EMT
PERIOD AND DOCUMENT IN WHICH IT IS SPECIFIED	EMP construction and decommissioning phases. Construction and decommissioning plans.
PRECAUTIONS FOR IMPLEMENTATION AND MANAGEMENT	To take into account IFC Waste Management Facilities Environmental, Health and Safety Guidelines (December, 2007). Verifying the absence of debris, garbage or losses along the project areas or in any other unauthorized place. Daily check of the status of collection elements, by emptying them if necessary.

MITIGATION MEASURE N° 32	
	All elements of waste collection will be positioned as far as possible from waterways. Ensure that all personnel are informed of standards and guidelines for responsible handling of materials and waste. EMT must have a traceability of all documents. If a malfunction is found, a form of non-compliance will be written. For the disposition of hazardous wastes in the mazut storage the following measures should be followed: • Remaining mazut should be completely removed or stabilizated in such a way to avoid potential mixture with the hazardous waste to storage • Reparation of the potential cracks and fissures that concrete wall, floor and roof could have. • Divide the tanks into different cells to separate wastes with different properties • Cement should have low-permeability and be chemically resistant. Otherwise a liner gathering these characteristics should be installed. • Install a leachate collection and removal system if needed • Install a groundwater monitoring wells network (see mitigation measure nº 55)
MAINTENANCE	Presence of appropriate quantity and quality of collection elements, from their exchange in case of loss of initial conditions for tightness.
COST	Hazardous temporary storage on site: 25000$US Mazut storage adaptation (long-term hazardous waste storage) 100000 $US/tank. It is estimated that just one tank will be needed for the construction and decommissioning phases

MITIGATION MEASURE N° 33	
IMPACT CONCERNED	Potential soil, subsoil, groundwater and surface water pollution by accidental spillages or wrong waste management. Hazards for the health and safety of the surrounding population.
DEFINITION OF THE MEASURE	Proper transporting methods for hazardous materials
OBJECTIVE	Avoid risks of Transportation for the prevention or minimization of the consequences of catastrophic spills of hazardous materials.
DESCRIPTION OF THE MEASURE / ISSUES THAT IT INCLUDES	On-site and Off-site transportation of waste should be conducted so as to prevent or minimize spills, releases, and exposures to employees and the public.

MITIGATION MEASURE N° 33	
	It must be ascertained that the officers in charge of dangerous residue management apply procedures in order to ensure compliance with local hazardous materials transport laws and applicable international requirements (such as United Nations and other international standards as well as local requirements for overland transport etc). These officers must fulfill the Transport 3.5 condition in World Bank Directives (April 2007) and shall include in their methodology transport procedures of hazardous matters (Hazmat), which must include : - Proper labeling of containers, including the identity and quantity of content, hazards, and details of the sender - Ensure that the volume, nature, integrity and protection of packaging and containers used to transport appropriate for the type and quantity of hazardous materials and modes of transport involved - Ensure the proper specifications for transportation vehicles - Training of employees involved in transporting dangerous goods on transport procedures and emergency procedures - Using the labeling and posters (external signs on transport vehicles), as required - Provide the required emergency response on call 24 hours/day.
ORGANISATION RESPONSIBLE FOR ITS MANAGEMENT	EMT
PERIOD AND DOCUMENT IN WHICH IT IS SPECIFIED	EMP construction and decommissioning phases. This procedure will be extended to the operation phase.
PRECAUTIONS FOR IMPLEMENTATION AND MANAGEMENT	Organize periodic servicing in accordance with predetermined plan.
MAINTENANCE	Maintenance specific to the operational phase.
COST	Good practice. Included in the Environmental Safeguard Expert task.

MITIGATION MEASURE N° 34	
IMPACT CONCERNED	Potential soil and water contamination due to improper storage or manipulation of the work materials and/or waste.
DEFINITION OF THE MEASURE	Spill prevention measures and arrangement of impervious areas for fueling, maintenance and repair of machinery
OBJECTIVE	Avoid contamination of factors water and soil by spills and discharge generated by fueling, maintenance and repair of the machinery.

MITIGATION MEASURE N° 34	
DESCRIPTION OF THE MEASURE / ISSUES THAT IT INCLUDES	A special specific area should be set aside for site vehicle servicing, washing, filling, oil changing and other operations. This area should be conspicuously marked and made known to all site workers. The area shall possess a paved ground surface, or where applicable, an impermeable surface along with an effluent collecting system to avoid soil contamination (oil spill catch basins or oil catch pans provided at all service areas). Setting up suitable secondary retention systems for the storage and temporary storage of fuel and other fluids such as lubricating oils and hydraulic fluids. All fuel use areas where spills and leakage are possible, e.g. the generator, must have drip basins installed to prevent any leakage. Fueling equipment must be fitted with proper fuel nozzles and devices to avoid accidental spills. Solid and liquid waste (fuel substances, used parts) will be properly managed. A spill response procedure shall be developed: In the case of an accidental spill, if the ground is paved, an absorbent will be used (for example sawdust) in order to capture the waste substance. The absorbent when gathered up must be processed as a hazardous waste substance. If the ground is not paved, it will be immediately removed, and the terrain affected will be cleaned up. Spill response kits at all storage areas and work sites must be provided. Workers will need to be trained in transport techniques and the correct manipulation of fuel substances and chemical products, as well as how to deal with spills.
ORGANISATION RESPONSIBLE FOR ITS MANAGEMENT	EMT
PERIOD AND DOCUMENT IN WHICH IT IS SPECIFIED	EMP construction and decommissioning phases. Construction and decommissioning plans.
PRECAUTIONS FOR IMPLEMENTATION AND MANAGEMENT	Strict control of workers on machines for them to perform maintenance tasks in the appropriate areas and provided for this purpose. Periodic inspections and revisions "without notice" to verify that the tasks described are performed in areas specifically provided for this purpose.
MAINTENANCE	Periodic review of the state of the water tightness and drainage systems.
COST	15000 $US for secondary containments and special specific area for machinery.

MITIGATION MEASURE N° 35	
IMPACT CONCERNED	Potential soil and groundwater pollution by accidental spillages or wrong waste management.
DEFINITION OF THE MEASURE	Proper oil management existing transformer to be moved
OBJECTIVE	Avoid risks of oil spills in the relocation of the existing transformer.
DESCRIPTION OF THE MEASURE / ISSUES THAT IT INCLUDES	Power output of the new generator will be connected to the existing substation which will be adapted. For the adaptation of the substation to the new unit, existing transformer could be moved. If so, transformer oil must be managed in an environmental friendly way and taking good international practice in order not to cause soil pollution.
ORGANISATION RESPONSIBLE FOR ITS MANAGEMENT	EMT
PERIOD AND DOCUMENT IN WHICH IT IS SPECIFIED	EMP construction
PRECAUTIONS FOR IMPLEMENTATION AND MANAGEMENT	In case of spill, spill response procedure should be applied and used oil, as well as absorbent used in order to capture oil, should be managed as hazardous waste.
MAINTENANCE	None.
COST	Good practice. Included in the construction waste management

MITIGATION MEASURE N° 36	
IMPACT CONCERNED	Potential soil and water contamination due to improper storage or manipulation of the work materials and/or waste
DEFINITION OF THE MEASURE	A washing area will be provided for concrete truck chutes with mobile equipment for cleansing and containing waste.
OBJECTIVE	Avoid the generation of equipment cleaning leftover concrete and other waste in the work zone and in the surroundings.
DESCRIPTION OF THE MEASURE / ISSUES THAT IT INCLUDES	A washing area for concrete truck chutes and other equipment cleansing waste will be set up, where concrete trucks will cleanse chutes of concrete residue. Personnel will be trained in the proper use of this equipment.
ORGANISATION RESPONSIBLE FOR ITS MANAGEMENT	EMT
PERIOD AND DOCUMENT IN WHICH IT IS SPECIFIED	EMP construction Construction plan.
PRECAUTIONS FOR IMPLEMENTATION AND MANAGEMENT	None

MITIGATION MEASURE N° 36	
MAINTENANCE	When the wash rack is full of chutes, removal and shipment of concrete to an authorized landfill.
COST	18000 $US

MITIGATION MEASURE N° 37	
IMPACT CONCERNED	Potential contamination of surface water by sanitary water from workers
DEFINITION OF THE MEASURE	Black waste water generated by the workers will be controlled through the installation of adequate sanitation systems.
OBJECTIVE	Avoid discharge of non purified sanitary water and ensure their proper management.
DESCRIPTION OF THE MEASURE / ISSUES THAT IT INCLUDES	Relevant sanitary and hygiene services will be implemented. These services will be in charge of collecting and treating black waste water.
ORGANISATION RESPONSIBLE FOR ITS MANAGEMENT	EMT
PERIOD AND DOCUMENT IN WHICH IT IS SPECIFIED	EMP construction and decommissioning phases.
PRECAUTIONS FOR IMPLEMENTATION AND MANAGEMENT	The effluent will be managed by approved enterprises. Discharge of black waste water to water bodies without treatment will be prohibited. These effluents should be treated at the Takhiatash municipal waste water treatment plant. A delivery note/receipt must be keept.
MAINTENANCE	Check that the collection and /or management system finally selected works properly.
COST	5000 $US/year

MITIGATION MEASURE N° 38	
IMPACT CONCERNED	Increase of suspended solids in water as a result of construction works.
DEFINITION OF THE MEASURE	Controlling suspended solids to surface waters.
OBJECTIVE	Avoid increasing suspended solids in Suenly canal.
DESCRIPTION OF THE MEASURE / ISSUES THAT IT INCLUDES	During construction works close to the Suenly canal, barriers drain systems and decantation areas should be implemented in order to minimise suspended solids in overflows. During construction of the new intake pump station and discharge pipeline within the existing intake and discharge canals, an environmental appropriate method for construction and dredging will be implemented. Rigorous controls will be implemented on the site during construction of the pumping station.
ORGANISATION	EMT

MITIGATION MEASURE N° 38	
RESPONSIBLE FOR ITS MANAGEMENT	
PERIOD AND DOCUMENT IN WHICH IT IS SPECIFIED	EMP construction Construction plan.
PRECAUTIONS FOR IMPLEMENTATION AND MANAGEMENT	Checking the efficiency of these systems during the completion of building works and after completion analyzing measurements carried out in the water intake area on the operation of the existing units.
MAINTENANCE	None.
COST	Good practice to consider into the construction design.

MITIGATION MEASURE N° 39	
IMPACT CONCERNED	Potential degradation of the local geomorphology. Potential increase of erosion risk due to construction works.
DEFINITION OF THE MEASURE	Verifying sources of materials of the site.
OBJECTIVE	Avoid extracting mineral resources of rivers and side of the road nearby to use as building materials.
DESCRIPTION OF THE MEASURE / ISSUES THAT IT INCLUDES	No mineral resources and fill material will be extracted from nearby watercourses or side roads. Mineral resources from the outside will be regulated by the authorities. Ensure good landscaping and erosion control practices, including proper site re-contouring and replacement of topsoil.
ORGANISATION RESPONSIBLE FOR ITS MANAGEMENT	PMU
PERIOD AND DOCUMENT IN WHICH IT IS SPECIFIED	Purchase specifications and contracts Construction plan
PRECAUTIONS FOR IMPLEMENTATION AND MANAGEMENT	Check that suppliers of building materials have the relevant authorizations in order.
MAINTENANCE	None.
COST	Good practice. No specific cost.

MITIGATION MEASURE N° 40	
IMPACT CONCERNED	Potential soil compaction. Potential elimination of vegetation Hazards for safety of the personnel and the surrounding population
DEFINITION OF THE MEASURE	Traffic management plan.
OBJECTIVE	Prevent the increase in traffic from producing discomfort to the surrounding population.

MITIGATION MEASURE N° 40	
	Minimize the surface affected by works.
DESCRIPTION OF THE MEASURE / ISSUES THAT IT INCLUDES	Development of a traffic management plan, to mitigate impact on local traffic conditions during construction. • Traffic control will be carried out, including observance of distances between transport vehicles on communication roads belonging to the power plant. • Confine heavy construction related traffic to the least sensitive access roads to the construction sites to avoid accidents and nuisance to dwellers along the road and other road users. • No transport or operation of heavy equipment at night. Driving will be only allowed on roads or paths which have been built for this purpose in order to avoid soil compacting. • Require contractors to prepare and organize work implementation schedules and tasks for proper registration for the vehicles and heavy equipments, driving licenses, requires skills and experience. • Strict adherence to regulations, especially regarding speeding and overloading • Provide for contingency planning and rescue operations. • Conduct regular safety awareness campaigns for both the workforce and the general public, particularly focusing on local schools. • Traffic regulation measures will be implemented, including traffic signals, and personnel will be placed in charge of reporting hazardous situations.
ORGANISATION RESPONSIBLE FOR ITS MANAGEMENT	EMT in close consultation with local authority
PERIOD AND DOCUMENT IN WHICH IT IS SPECIFIED	EMP construction and decommissioning phases.
PRECAUTIONS FOR IMPLEMENTATION AND MANAGEMENT	Control and constant updating required.
MAINTENANCE	None.
COST	Included in the Environmental Safeguard Expert task.

MITIGATION MEASURE N° 41	
IMPACT CONCERNED	Potential increase in the noise level of the construction sites.
DEFINITION OF THE MEASURE	Noise measurement campaign
OBJECTIVE	Noise level measurement in order to include mitigation measures if needed
DESCRIPTION OF THE MEASURE / ISSUES THAT IT	As there are residential receptors of noise close to the plant boundary (within 100 m), a noise campaign will be

MITIGATION MEASURE N° 41	
INCLUDES	undertaken every 6 months in continuation of the campaign carried out in this EIA during construction and decommissioning phases, in order to check fulfillment of noise standards (Uzbek construction noise norms (KMK 2.01.08-96 “Protection from noise”); Admissible noise level into the living area, both inside and outside the buldings (SanR&N No.0267-09); and general EHS IFC guideline (2007) standards). Noise campaign will continue in operation phase every year. If noise mitigation measures considering in construction, operation and decommissioning phases and are not enough to fulfill noise standards, other mitigation measures will be considered.
ORGANISATION RESPONSIBLE FOR ITS MANAGEMENT	EMT
PERIOD AND DOCUMENT IN WHICH IT IS SPECIFIED	EMP construction, operation and decommissioning phases.
PRECAUTIONS FOR IMPLEMENTATION AND MANAGEMENT	An approved measuring enterprise should be in charge of the noise measurements campaign. Noise monitoring program must be conducted by trained specialists. Monitors should be located approximately 1.5 m above the found and no closer than 3 m to any reflecting surface.
MAINTENANCE	Noise monitoring should be carried out using a Type 1 or 2 sound level meter meeting all appropriate IEC standards. Sound level meter should be calibrated every year.
COST	Option 1: Cost of a new noise measurement equipment: 3000-15000 $US Option 2: Cost of measuring campaign: 2000 $US/year (construction and operation)

MITIGATION MEASURE N° 42	
IMPACT CONCERNED	Alteration of the water quality as a consequence of effluent discharge.
DEFINITION OF THE MEASURE	Extension of the current water quality monitoring
OBJECTIVE	Water quality monitoring in order to check if effluents fulfill standards.
DESCRIPTION OF THE MEASURE / ISSUES THAT IT INCLUDES	Currently, water quality monitoring is carried out every 15 days at the intake and discharge points. Not all the World Bank effluent standards (Thermal Power Plants EHS IFC guidelines, 2008) are measured and in order to have a background water quality of these parameters, a water quality analysis has been carried out within the baseline of

	this EIA. Nevertheless this measurement is not sufficient and an extension of the baseline should be undertaken. For this purpose, the inclusion of the following parameters in the current measurements within the construction phase should be considered in order to gather information to conclude a baseline previously to the operation of the new CCPU: total residual chlorine, Cr, Cu, Zn, Pb, Cd, Hg and As. The water quality measurements will continue during the operation phase in order to check if standards (national MAD for the TPP or World Bank, whichever is more stringent) are being fulfilled. If there is no variation between intake and discharge points observed after one year, the monitoring of these new parameters could be discontinued.
ORGANISATION RESPONSIBLE FOR ITS MANAGEMENT	EMT
PERIOD AND DOCUMENT IN WHICH IT IS SPECIFIED	EMP construction and operation phases.
PRECAUTIONS FOR IMPLEMENTATION AND MANAGEMENT	Monitoring programs should apply national or international methods for sample collection and analysis, such as those published by the International Organization of Standardization. Samplings should be conducted by, or under, the supervision of trained individuals.
MAINTENANCE	Analysis equipment should meet all appropriate IEC standards and should be calibrated at least once a year.
COST	Option 1: Cost of a new equipment: 57000 $US Option 2: Cost of analysis of the new parameters in the intake and discharge points: 500 $US/analysis (12000 $US/year) (construction and operation phases)

MITIGATION MEASURE N° 43	
IMPACT CONCERNED	Potential impact on historical and archaeological heritage
DEFINITION OF THE MEASURE	Archaeological follow-through during construction phase.
OBJECTIVE	Detect and avoid the impact on archaeological deposits
EFFICIENCY	High.
DESCRIPTION OF THE MEASURE / ISSUES THAT IT INCLUDES	If Physical Cultural Resources (PCR) are encountered during construction, they will suffer no additional disruption until they have been evaluated by a competent expert and avoidance, minimization or mitigating measures are developed. The type and level of detail of the assessment should be proportionate to the nature and scale of the project´s potential adverse impact on the chance find. In this case, a chance finds procedure should be developed that outline the roles, responsibilities and response times required by project staff and any relevant heritage authority; agreed consultation procedures; record keeping and expert verification procedures; chain of custody instructions for movable finds; and clear criteria for temporary work

	stoppages. ADB environmental safeguards should be followed on this purpose.
ORGANISATION RESPONSIBLE FOR ITS MANAGEMENT	EMT where appropriate, an archaeologist expressly authorized.
PERIOD AND DOCUMENT IN WHICH IT IS SPECIFIED	EMP construction
PRECAUTIONS FOR IMPLEMENTATION AND MANAGEMENT	In case of appearance of archaeological remains during construction, it shall be notified, in order to achieve its proper evaluation before continuing with the project in the sector concerned.
MAINTENANCE	None.
COST	To be estimated in case of PCD findings

MITIGATION MEASURE N° 44	
IMPACT CONCERNED	Hiring of personnel during construction works and decommissioning. Reactivation of the local economy.
DEFINITION OF THE MEASURE	Economic impact on the municipality and the region affected by the project.
OBJECTIVE	Sharing positive fallout of the construction/decommissioning project with the region.
DESCRIPTION OF THE MEASURE / ISSUES THAT IT INCLUDES	During the construction of the new CCPU facility as well as the decommissioning of the existing units III and IV, as far as possible and depending on availability, work positions created by the project will be filled by local personnel. Similarly, materials, machines and services will be purchased in the area surrounding Takhiatash TPP. The project should include gender-inclusive core labor standards to promote female employment opportunities with non-discrimination, equal pay for work of equal value. All this will be carried out without delaying works, nor affecting quality.
ORGANISATION RESPONSIBLE FOR ITS MANAGEMENT	PMU by agreements with equipment suppliers and contractors.
PERIOD AND DOCUMENT IN WHICH IT IS SPECIFIED	EMP construction and decommissioning phases
PRECAUTIONS FOR IMPLEMENTATION AND MANAGEMENT	None. As much as possible to recruit unskilled worker from local areas
MAINTENANCE	None.
COST	Good practice. No cost

MITIGATION MEASURE N° 45	
IMPACT CONCERNED	Potential damage to road infrastructure caused by heavy duty construction and decommissioning traffic.
DEFINITION OF THE MEASURE	Any services interrupted or modified will be returned to their initial status.

OBJECTIVE	Restoring the original conditions of services and easements affected by the construction or decommissioning phases, especially roads and paths.
DESCRIPTION OF THE MEASURE / ISSUES THAT IT INCLUDES	Services that were interrupted or modified by the project's construction or decommissioning works will be returned to their initial status, and any damage incurred will be made good.
ORGANISATION RESPONSIBLE FOR ITS MANAGEMENT	PMU in close consultation with local authority
PERIOD AND DOCUMENT IN WHICH IT IS SPECIFIED	Construction Plan Decommissioning Plan.
PRECAUTIONS FOR IMPLEMENTATION AND MANAGEMENT	If it is necessary to temporarily change the easements or infrastructure, they will remain operational with the necessary temporary alternatives. If it is necessary to move an item during the site building, it will have to be stored properly for its repositioning at the end of the construction work that concerns it. During the restoration of paths and roads and repositioning of affected items, care must be taken not to dump any type of discharge outside the areas marked for this purpose by ensuring its correct repositioning and management.
MAINTENANCE	Check the proper functionality of the infrastructure, service or damaged item after its recovery.
COST	390000 $US

MITIGATION MEASURE N° 46	
IMPACT CONCERNED	Potential modification of landscape during the construction and decommissioning
DEFINITION OF THE MEASURE	Removal of temporary installations and revegetation when construction and decommissioning phases are over.
OBJECTIVE	Avoid impact on the landscape caused by the temporary facilities on the site.
DESCRIPTION OF THE MEASURE / ISSUES THAT IT INCLUDES	All the temporary structures required in the course of construction operations and decommissioning, or their vestiges will be removed as soon as the works are over. After that the following steps will be undertaken: • Respread saved topsoil • Revegetate areas • Complete stabilization before onset of rains It is recommended to include a green area in the vicinity of the TPP terrains. For this aim, an assessment of which is the most suitable area should be done. Species of trees/bushes/grasses to be planted will depend of soil and climate characteristics. Endemic species should be considered in order to guarantee the good development of the green area.
ORGANISATION RESPONSIBLE FOR ITS MANAGEMENT	EMT

PERIOD AND DOCUMENT IN WHICH IT IS SPECIFIED	Construction Plan. Decommissioning Plan.
PRECAUTIONS FOR IMPLEMENTATION AND MANAGEMENT	None.
MAINTENANCE	There will be maintenance of the overall state of preservation of all equipment necessary for the operation, especially posters, signs, lights and fencing.
COST	Revegetation within TPP terrains: 13000 $US/hectare (26000 $US estimated in total) Green area at the vicinity of the TPP: 20000$US/hectare (40000$US estimated in total)

C. Operating phase

MITIGATION MEASURE N° 47	
IMPACT CONCERNED	All the impacts
DEFINITION OF THE MEASURE	Continuous execution of the EMP Plan during operation phase
OBJECTIVE	An Environmental Management Team in charge of the continuous execution of the EMP during the operating phase of the TPP must be included in the Takhiatash TPP organization structure.
DESCRIPTION OF THE MEASURE / ISSUES THAT IT INCLUDES	The staff of the EMT of the TPP will responsible and will be in charge of monitor, control, supervise and report all the environmental aspects of the operation of the power plant in order to ensure implementation of the EMP.
ORGANISATION RESPONSIBLE FOR ITS MANAGEMENT	EMT
PERIOD AND DOCUMENT IN WHICH IT IS SPECIFIED	EMP operation.
PRECAUTIONS FOR IMPLEMENTATION AND MANAGEMENT	Control and constant updating required. A specific training course should be provided to this EMP in order to gather the technical requirements.
MAINTENANCE	None.
COST	Staff of the TPP. Design of materials and providing training course: 30000$US

MITIGATION MEASURE N° 48	
IMPACT CONCERNED	All the impacts
DEFINITION OF THE MEASURE	Continuous execution of the EHS Plan during operation phase
OBJECTIVE	Strongly follow regulation on environment, health and safety plan. Establish comprehensive safety regulations; • Install proper alarm systems. • Ground all electrical equipment and provide circuit breakers. • Provide back-up water supplies for fire fighting. • Provide fire extinguishers at strategic locations around the site and monitor them for functionality. • Follow existing regulations on safety.
DESCRIPTION OF THE MEASURE / ISSUES THAT IT INCLUDES	The staff be trained in environment, health and safety, so that they understand the risks associated with the activity they perform and are aware of how to perform their tasks with the least possible risk to their health and the environment. It is recommended to conduct a consulting and training program for key personnel of Takhiatash CCPU. This will ensure that highly qualified staff will take over the

MITIGATION MEASURE N° 48	
	responsibility and will work on environmental, health and safety management and monitoring. The training program should be performed in coordination with the responsible local authorities. In the training phase the following items could be included: Environmental monitoring of thermal power plants and potential mitigation measures; emissions equipment (requirements, specifications, operation, and maintenance); wastewater analysis and waste management; worker safety and health aspects; etc.
ORGANISATION RESPONSIBLE FOR ITS MANAGEMENT	EMT
PERIOD AND DOCUMENT IN WHICH IT IS SPECIFIED	EHS operation EMP operation.
PRECAUTIONS FOR IMPLEMENTATION AND MANAGEMENT	Control and constant updating required.
MAINTENANCE	None.
COST	Staff of the TPP. Design of materials and providing training course: 30000 $US

MITIGATION MEASURE N° 49	
IMPACT CONCERNED	Greenhouse gases emission reduction by the replacement of an obsolete with an energy efficient technology.
DEFINITION OF THE MEASURE	Greenhouse gases annual quantification
OBJECTIVE	Control of greenhouse gases emissions
DESCRIPTION OF THE MEASURE / ISSUES THAT IT INCLUDES	Direct emissions from the facilities owned or controlled within the physical project boundary and indirect emissions associated with the off-site production of power used by Takhiatash TPP will be quantified. Quantification and monitoring of GHG emissions will be conducted annually in accordance with internationally recognized methodologies. There are many internationally recognized methodologies that can be used to estimate and monitor a project's direct GHG emissions, with the most authoritative methodologies found in the 2006 IPCC "Guidelines for National Greenhouse Gas Inventories". To take into account the following guidelines: Volume 1: General Guidance and Reporting Volume 2: Energy

MITIGATION MEASURE N° 49	
ORGANISATION RESPONSIBLE FOR ITS MANAGEMENT	EMT
PERIOD AND DOCUMENT IN WHICH IT IS SPECIFIED	EMP operation
PRECAUTIONS FOR IMPLEMENTATION AND MANAGEMENT	None
MAINTENANCE	None
COST	Staff of the TPP

MITIGATION MEASURE N° 50	
IMPACT CONCERNED	Outdoor air quality improvement due to the emission reduction by the replacement of an obsolete to an energy efficient technology Hazards for health and safety of the personnel and the surrounding population..
DEFINITION OF THE MEASURE	Annual stack emission testing
OBJECTIVE	An annual emission test will be undertaken in order to have direct measurement of emission levels to counter check the CEMS.
DESCRIPTION OF THE MEASURE / ISSUES THAT IT INCLUDES	At least an annual stack emission testing will be carried out. If annual stack emission testing results show constantly (3 consecutive years) a significantly (less than 75%) better than the required levels, frequency of annual stack emission testing can be reduced from annual to every two or three years.
ORGANISATION RESPONSIBLE FOR ITS MANAGEMENT	EMT
PERIOD AND DOCUMENT IN WHICH IT IS SPECIFIED	EMP operation
PRECAUTIONS FOR IMPLEMENTATION AND MANAGEMENT	An approved measuring enterprise should be in charge of the stack emissions test. International methodologies to measure pollutants must be followed (EN 15259:2007; ISO 10498 for SOx; ISO 7996 for NOx; ISO 10473 for particulate matter; ISO 4224 for CO; or similar level)
MAINTENANCE	Test equipment should be calibrated under international standards.

MITIGATION MEASURE N° 50	
COST	Currently on going in the boiler. This practice could be extended to the stack at the indicated place and methodologies on the international standards.

MITIGATION MEASURE N° 51	
IMPACT CONCERNED	Potential soil, subsoil, groundwater and surface water pollution by accidental spillages or wrong waste management.
DEFINITION OF THE MEASURE	Maintain good state of preservation of the sludge ponds, fuel, oil or other chemicals storages/containers.
OBJECTIVE	Avoid contamination or alteration of soil and groundwater resources from licks and spills.
DESCRIPTION OF THE MEASURE / ISSUES THAT IT INCLUDES	Implementation of an inspection program to maintain the mechanical integrity of pressurized containers, tanks, pipe systems, ventilation and dump valve systems, brace infrastructure, automatic emergency stop systems, controls and pumps and related process equipment. Periodical monitoring will be carried out to maintain the structural integrity (coatings and retention systems) of sludge ponds, oil, fuel and chemical storages/containers to avoid leaks. Where applicable, adequate repairs will be carried out. Spill response and emergency plans to address accidental releases should be prepared and implemented
ORGANISATION RESPONSIBLE FOR ITS MANAGEMENT	EMT
PERIOD AND DOCUMENT IN WHICH IT IS SPECIFIED	EMP operation
PRECAUTIONS FOR IMPLEMENTATION AND MANAGEMENT	Organize periodic servicing in accordance with predetermined plan.
MAINTENANCE	Maintenance specific to the operational phase.
COST	Staff of the TPP

MITIGATION MEASURE N° 52	
IMPACT CONCERNED	Potential increase of soil salinity due to the cooling towers steam plume deposition
DEFINITION OF THE MEASURE	Monitoring of soil salination levels at spray locations coming from the cooling towers plume steam
OBJECTIVE	Control of the soil salination effects
DESCRIPTION OF THE MEASURE / ISSUES THAT IT INCLUDES	Initial check of water and salt precipitation rates in the cooling towers. The measurements would be made along the area in which, after the observation of the steam plume, deposition is more likely to occur. Measurements shall be preferably carried out during spring and summer seasons. This check would be also made after significant changes

	in the towers, such as changes in components or in the operating system, which may lead to a substantial increase in the salts emission rate finally adopted. The first measures, to be implemented during the first two years of operation of the plant, would be gathered in a report, which would also establish: 1) Comparison of the results with the reference levels 2) Need for corrective actions 3) New scope of the Environmental Monitoring Plan
ORGANISATION RESPONSIBLE FOR ITS MANAGEMENT	EMT
PERIOD AND DOCUMENT IN WHICH IT IS SPECIFIED	EMP operation A baseline campaign should be done previously to the commissioning of the CPU.
PRECAUTIONS FOR IMPLEMENTATION AND MANAGEMENT	Organize periodic servicing in accordance with predetermined plan.
MAINTENANCE	None
COST	4000 $US/campaign

MITIGATION MEASURE N° 53	
IMPACT CONCERNED	Alteration of the water quality as a consequence of effluent discharge
DEFINITION OF THE MEASURE	Control of the composition of the cooling water treatment additives
OBJECTIVE	Avoid discharge to harmful substances to the water bodies
DESCRIPTION OF THE MEASURE / ISSUES THAT IT INCLUDES	Elimination of metals such as chromium and zinc from chemical additives used to control scaling and corrosion in cooling towers Use the minimum required quantities of chlorinated biocides in place of brominated biocides or alternatively apply intermittent shock dosing of chlorine as opposed to continuous low level feed
ORGANISATION RESPONSIBLE FOR ITS MANAGEMENT	EMT
PERIOD AND DOCUMENT IN WHICH IT IS SPECIFIED	EMP operation Purchase specifications and contracts
PRECAUTIONS FOR IMPLEMENTATION AND MANAGEMENT	None
MAINTENANCE	None
COST	Good practice. No cost

MITIGATION MEASURE N° 54	
IMPACT CONCERNED	Potential soil, subsoil, groundwater and surface water pollution by accidental spillages or wrong waste management.
DEFINITION OF THE MEASURE	Management of waste generated by operation of the plant.
OBJECTIVE	Prevent contamination of soil and water due to improper management of waste generated by the new plant.

MITIGATION MEASURE N° 54	
DESCRIPTION OF THE MEASURE / ISSUES THAT IT INCLUDES	Waste is to be managed according to the procedures contained in the law about Wastes of RUz (No.362-II of 05.004.2002), follow approved by SNPC licenses on “Wastes Disposal limits”. Also, Basel Convention signed by Uzbekistan and general and waste management facilities EHS IFC guidelines should be fulfilled, whichever is more stringent. A waste management hierarchy that consider prevention, reduction, reuse, recovery, recycling, removal and finally disposal of wastes should be considered. Final disposal must be undertaken in an environmentally sound manner. Prior to start operation a waste inventory procedure as specified in Guideline O’z RH 84.3.15:2005 must be completed. This document will also serve as a basis for Waste Data Sheets. For this purpose, waste classification should be based in national legislation and Basel Convention signed by Uzbekistan, whichever is more stringent. Minimizing hazardous waste generation must be carried out by implementing stringent waste segregation to prevent the commingling of non-hazardous and hazardous waste to be managed. Takhiatash TPP should be equipped with drums and other suitable containers for collecting hazardous and non hazardous wastes. Their location should be conspicuously marked and made known to all site workers. For hazardous wastes: • Waste is stored in a manner that prevents the commingling or contact between incompatible wastes, and allows for inspection between containers to monitor leaks or spills. (sufficient space between incompatibles or physical separation such as walls or containment curbs) • Store in closed containers away from direct sunlight, wind and rain • Secondary containment is included wherever liquid wastes are stored in volumes greater than 220 liters. The available volume of secondary containment should be at least 110 percent of the largest storage container, or 25 percent of the total storage capacity (whichever is greater), in that specific location. Should be constructed with materials appropriate for the wastes being contained and adequate to prevent loss to the environment • Provide adequate ventilation where volatile wastes are stored. After being collected, waste shall be processed depending

MITIGATION MEASURE N° 54	
	on type. Sludge from waste treatment plant and water supply treatment needs to be evaluated on a case-by-case basis to establish whether it constitutes a hazardous or a non-hazardous waste. The treatment method and the disposal location will be decided by the administrative unit in addition to the disposal fee. The current management of wastes of the TPP can be used but some of the procedures should be corrected to fulfill international good practices: <u>Non-hazardous wastes:</u> -Reuse: Solid precipitation of the settling tank and pulp dump will be use in agricultural needs as fertilizer only if analyses of the pulp characteristics conclude that there are not hazardous or toxic compounds that could be a health risk. Should not be accepted a waste that contains organics that are contaminated by potentially hazardous chemicals and/or pathogenic substances and micro-organisms that will not be rendered harmless by the process or may constitute a health or environmental risk. -Recycled: Iron, metal debris, stubs, wool debris, waste rubber and tires, waste paper and other recyclable waste fractions can be selling to the enterprises currently being used in the operation of the existing units. -Recover: Only non-hazardous wastes can be burned in existing boiler furnaces. -Disposed: Rest of non-hazardous wastes that are not being recycled as household and similar should be transported to a properly designed, permitted and operated landfill. One option is to improve Municipal landfill currently being used by the TPP to avoid soil and groundwater pollution.. <u>Hazardous</u>: Hazardous waste storage, transfer, disposal and treatment will be done by an authorized waste management facility. The contractors handling, treating and disposing hazardous waste should be reputable and legitimate enterprises, licensed by the relevant regulatory agencies and following good international industry practice for the waste being handled (ensuring compliance with applicable local and international regulations).

MITIGATION MEASURE N° 54	
	-Recycled: Fluorescent lights shall be delivered to a specialized organization on lamp utilization as it is being doing up to now. -Recover: Hazardous wastes cannot be burned at existing boiler furnaces as they are not provided with exhaust gas treatment. Hazardous wastes can be burned or incinerated just in approved installations with the proper treatment for exhaust gases in order not to introduce hazardous compounds into the atmosphere. -Disposed: - There will be a temporary storage of hazardous wastes. - Hazardous wastes will be properly separated and not mixed, avoiding difficult mixtures of hazardous wastes that do complicate their management. - Types of wastes generated will be packaged and labeled in homologated containers. - The documentation concerning the delivery of waste to the manager will be stored. - A record of the produced and managed wastes will be made, and of their destination. - Direct discharge will be never allowed on the ground. - If there is not a hazardous waste landfill or storage which have the technical capability to manage the waste in a manner that reduces immediate and future impact to the environment neither the permits, certifications, and approvals of applicable government authorities, an specific facility must be constructed or adapted to provide sound long-term storage of wastes on-site or at an alternative appropriate location up until external commercial options become available. Mazut storage adapted as hazardous wastes storage for the construction and decommissioning phases can be used for the operation phase if recommendations indicated in mitigation measure nº 32 have been undertaken.
ORGANISATION RESPONSIBLE FOR ITS MANAGEMENT	EMT
PERIOD AND DOCUMENT IN WHICH IT IS SPECIFIED	EMP operation
PRECAUTIONS FOR IMPLEMENTATION AND MANAGEMENT	A waste management hierarchy that consider prevention, reduction, reuse, recovery, recycling, removal and finally disposal of wastes should be considered. This includes an update of the waste management policy every time a new procedure for prevention, reduction, reuse, recovery, recycling and removal can be introduced in the process or operation management. The trends in waste generation by type and quantity of waste shall be monitored.

MITIGATION MEASURE N° 54	
	When a new waste stream is generated, this must be fully characterised, periodic characterisation must be documented, and the waste must be properly handled, in particular hazardous waste. The performance of regular audits on the waste segregation and collection practices shall be undertaken. Records tracking hazardous waste received, stored, or sent out should include: name and identification number, physical condition, quantity, method and date of storage, location of waste at the facility and amount deposited in each area.
MAINTENANCE	The storage site of waste must be big enough to store the waste until they are properly managed and must include an appropriate number of containers (in quantity and quality). These will be exchanged in case of detection of loss of initial conditions for tightness. Regular visual inspections of all the waste storage and collection areas shall be conducted to ensure that the waste management is appropriate, the number of containers is sufficient, and the containers are properly sealed.
COST	Long-term hazardous waste storage (mazut storage adapted): 100000 $US/tank.

MITIGATION MEASURE N° 55	
IMPACT CONCERNED	Potential soil, subsoil, groundwater and surface water pollution by accidental spillages or wrong waste management.
DEFINITION OF THE MEASURE	Extension and improvement of the existing groundwater monitoring network.
OBJECTIVE	Comprehensive groundwater control to early detection of potential licks or spillages in order to avoid soil and groundwater pollution
DESCRIPTION OF THE MEASURE / ISSUES THAT IT INCLUDES	Improve functioning of the existing wells established at TPP and provide additional network of observation wells in areas which could mean risks on the quality of groundwater and soil as it would be sludge ponds, oil and chemicals storage tanks, hazardous waste storage by adding one well below each site in the direction of groundwater to surface waterways. Parameters to measure are: • pH • Oil products • Metals: arsenic, cadmium, cobalt, copper, chromium, lead, mercury (inorganic), nickel, zinc • Organochlorine Pesticides • Phenols

MITIGATION MEASURE N° 55	
	The schedule recommended for sampling and analyzing activities will be flexible depending on the environmental expert judgment; however it would be never less often than once a year. If there is no variation in results of metalls organochlorine pesticides observed after one year, the monitoring of these parameters could be discontinued.
ORGANISATION RESPONSIBLE FOR ITS MANAGEMENT	EMT
PERIOD AND DOCUMENT IN WHICH IT IS SPECIFIED	EMP operation
PRECAUTIONS FOR IMPLEMENTATION AND MANAGEMENT	The monitoring equipment will be calibrated and maintained properly and periodically through a plan of calibration and maintenance, compliance with which will be included in a document. The sampling will have to follow the methods of sample collection, preservation and analysis internationally agreed. The samples must be conducted under the supervision of qualified personnel. The analysis will be carried out by organizations with appropriate permissions and certificates.
MAINTENANCE	Check that the global monitoring and recording equipment works properly. Check the state of maintenance and preservation of measuring devices.
COST	Option 1: If own equipment is used, cost is included in mitigation measure nº 42 Option 2: Cost for campaign for 4 wells 900 $US (3600 $US/year)

MITIGATION MEASURE N° 56	
IMPACT CONCERNED	Potential soil and groundwater pollution by accidental spillages or wrong waste management.
DEFINITION OF THE MEASURE	Specific storage of chemical products
OBJECTIVE	Avoid contamination of soil and groundwater due to discharges and mismanagement of chemicals.
DESCRIPTION OF THE MEASURE / ISSUES THAT IT INCLUDES	Chemical products whether received will be labeled and stored in suitable places and registered and recorded by the chemical products department. At the time of each delivery, it must be ascertained that all environmental and safety measures are applied.
ORGANISATION RESPONSIBLE FOR ITS MANAGEMENT	EMT
PERIOD AND DOCUMENT IN WHICH IT IS SPECIFIED	EMP operation

MITIGATION MEASURE N° 56	
PRECAUTIONS FOR IMPLEMENTATION AND MANAGEMENT	It must be ascertained that there are safety and environmental information sheets concerning all products present on the site, and that they are easily accessible and available to all chemical Department operators or any other Power Station personnel.
MAINTENANCE	Maintenance specific to the operational phase.
COST	Good practice. Staff of the TPP

MITIGATION MEASURE N° 57	
IMPACT CONCERNED	Potential health risk for the operation of the cooling towers
DEFINITION OF THE MEASURE	O&M program for the cooling towers in order to prevent legionella.
OBJECTIVE	Legionella prevention by the application of health and safety measures.
DESCRIPTION OF THE MEASURE / ISSUES THAT IT INCLUDES	An O&M program will be undertaken for the legionella prevention. This program will ensure that typical cooling system diseases as a consequence of bacterial outbreaks will not take place in the CCPU cooling system. The program will include: - Drawing of the cooling towers with water sampling points. - Check and inspection of all parts of the installation to ensure proper operation, establishing the critical points, the parameters to be measured and the procedures to follow, as well as the frequency of each activity. - Water treatment plan, to ensure its quality. This program shall include products chemicals, doses and procedures as well as physical, chemical and biological control parameters, their measurement methods and the frequency of testing. - Cleaning and sanitizing program for the whole facility to ensure that it works according to safety conditions, clearly establishing the procedures, the chemicals to be used and their dosage, the prevention measures to be considered, and the frequency of each activity. - Existence of a maintenance record for each facility to collect all incidents, activities, results and dates of technical stops and start-ups of the facilities, including their reasons.
ORGANISATION RESPONSIBLE FOR ITS MANAGEMENT	EMT
PERIOD AND DOCUMENT IN WHICH IT IS SPECIFIED	EMP operation
PRECAUTIONS FOR IMPLEMENTATION AND MANAGEMENT	The following documentation can be used as a guidelines: • LEGIONELLA and the prevention of legionellosis (WHO) • ISO/TS 12869:2012 Water quality -- Detection and

	quantification of Legionella
MAINTENANCE	Recommended by the equipment supplier.
COST	Staff of the TPP

D. Decommissioning of the TPP

MITIGATION MEASURE N° 58	
IMPACT CONCERNED	All the impacts during the decommissioning phase
DEFINITION OF THE MEASURE	Design a Decommissioning Plan at the time of TPP closure.
OBJECTIVE	The Decommissioning Plan will include the best available decommissioning management procedures and technologies at the time when the power plant is closed.
EFFICIENCY	High.
DESCRIPTION OF THE MEASURE / ISSUES THAT IT INCLUDES	The facilities will be decommissioned in accordance with an agreed Decommissioning Plan. The environmental aspects of the decommissioning stage should be also considered, both during initial design and during periodic reviews undertaken as part of the management system. Risk and impacts will be analyzed for the decommissioning or closure phase. The Decommissioning Plan will provide for the protection of the quality of soil and water as well as other natural resources such as fauna and flora, woodlands, forest products and marine resources so as not to pose an unacceptable risk to human health, safety, and the environment due to the presence of pollutants. For the purpose of achieving the aforementioned, the preventive and corrective measures needed to mitigate, eliminate or compensate for any impacts will be proposed once these impacts have been assessed.
ORGANISATION RESPONSIBLE FOR ITS MANAGEMENT	Operation Manager
PERIOD AND DOCUMENT IN WHICH IT IS SPECIFIED	At the end of the power plant life.
PRECAUTIONS FOR IMPLEMENTATION AND MANAGEMENT	None
MAINTENANCE	None.
COST	To be estimated at the end of the life of the plant previously to the decommissioning phase.

Appendix 2: Environmental monitoring plan

<table>
<tr><th>Aspect to be monitored or Mitigation Measure.</th><th>Monitoring Methods</th><th>Parameters to be measured</th><th>Assessment Criteria</th><th>Locations</th><th>Monitoring Frequency</th><th>Responsibility</th><th>Cost</th></tr>
<tr><td colspan="8">CONSTRUCTION AND DECOMMISSIONING PHASES</td></tr>
<tr><td>Air emission and noise</td><td>To keep a record book with the official inspection certification of the vehicles and machineries as evidence to ensure that are serviced and tuned by a competent entity.</td><td>Vehicle and machinery Inspection certification.</td><td>Compliance with the national SNCP and local regulations with regards to emission and noise</td><td>Competent entity
Record book at the safeguard unit of the PMU office</td><td>Every time a new machinery or vehicle is hired</td><td>Safeguard unit of the PMU</td><td>Included in the Environmental Safeguard Expert tasks.</td></tr>
<tr><td>Noise</td><td>Noise monitoring campaign
Monitors should be located approximately 1.5 m above the found and no closer than 3 m to any reflecting surface. A type 1 or 2 sound level meter should be used.</td><td>Ambient noise levels (dBA)</td><td><table>
<tr><th>Name of area</th><th>Sound level, (dBA)</th></tr>
<tr><td>Residential areas (inside) (SanR&N No.0267-09):
Day time
Night time</td><td>

40
30</td></tr>
<tr><td>Residential areas (outside) (SanR&N No.0267-09 and IFC EHS general guidelines (2007)):
Day time
Night time</td><td>

55
45</td></tr>
<tr><td>Industrial areas (IFC EHS general guidelines (2007))</td><td>70</td></tr>
</table></td><td>See Figure 1 at the end of this table
Points 1 to 4: Industrial area
Points 5 to 8: Residential area</td><td>Every 6 months.
If noise perception is high or nuisances from the population are registered, frequency should be increased</td><td>Safeguard unit of the PMU</td><td>See mitigation measure nº 41</td></tr>
<tr><td rowspan="2">Waste management</td><td>To keep:
a) Permits and certifications of the waste management and recycling enterprises
b) Contracts of the authorized waste management and recycling enterprises. In the contract it should be included the management and final disposal of wastes under an environmental sound manner.</td><td>Waste manager's permits and certifications.

Contracts with the waste managers</td><td>Uzbek Law on wastes and IFC EHS general guidelines (2007)</td><td>Waste management and recycling enterprises
Safeguard unit of the PMU office</td><td>Every time a new waste management or recycling enterprise is hired</td><td>Safeguard unit of the PMU</td><td>Included in the Environmental Safeguard Expert tasks.</td></tr>
<tr><td>The documentation concerning the delivery of waste will be stored to serve as evidence of their appropriate treatment.
Produced and managed wastes, as well as its destination shall be addressed and recorded</td><td>Waste delivery notes

Waste receipts</td><td></td><td>Waste management and recycling enterprises
Safeguard unit of the PMU office</td><td>Monthly</td><td>Safeguard unit of the PMU</td><td>Included in the Environmental Safeguard Expert tasks.</td></tr>
<tr><td>Waste water</td><td>A check shall be made to ensure that sanitary effluents from site personnel are appropriately managed.

The documentation concerning the delivery of effluents for their treatment in the Takhiatash municipal waste water treatment plant will be stored to serve as evidence of their appropriate treatment.</td><td>Effluents delivery notes and receipts</td><td>Municipal waste water treatment plant should fulfill SanR&N No 0172-04 Hygiene requirements for the protection of surface waters and table 1.3.1. of the IFC EHS general guidelines (2007)</td><td>Takhiatash municipal waste water treatment plant
Safeguard unit of the PMU office</td><td>Every time the sanitation systems need to be emptied.</td><td>Safeguard unit of the PMU</td><td>Included in the Environmental Safeguard Expert tasks.</td></tr>
</table>

<table>
<tr><th>Aspect to be monitored or Mitigation Measure.</th><th>Monitoring Methods</th><th>Parameters to be measured</th><th>Assessment Criteria</th><th>Locations</th><th>Monitoring Frequency</th><th>Responsibility</th><th></th></tr>
<tr><td colspan="7">CONSTRUCTION AND DECOMMISSIONING PHASES</td><td></td></tr>
<tr><td rowspan="2">Surface water Quality.</td><td>Observation and report of the results of the current water quality monitoring of the TPP done every 15 days to analyze the variation of the suspended solids parameter during the works to be done at the intake and discharge areas</td><td>Suspended solids</td><td>Suspended solids:
Norms for pollutants into the discharging water (for Takhiatash TPP)= 103 mg/l
Table 5 of Thermal Power Plants IFC EHS guidelines = 50 mg/l</td><td>Intake and discharge areas</td><td>Every 15 days during the construction works at the intake and discharge areas</td><td>Safeguard unit of the PMU
TPP EMT</td><td>Analysis already on going on the TPP current management. Assessment included in the Environmental Safeguard Expert tasks.</td></tr>
<tr><td>Extension of the current water quality monitoring of the TPP done every 15 days to include more parameter in order to achieve a broader water quality baseline that includes IFC EHS general guidelines (2007)</td><td>New parameters: Total residual chlorine, Cr, Cu, Zn, Pb, Cd, Hg and As

Current parameters: Suspended solids, mineralization, Cl-, SO4, NO3, NO2, NH4, Fe, BOD-5, Oil products, pH, temperature.</td><td>Norms for pollutants into the discharging water (for Takhiatash TPP) and Table 5 of Thermal Power Plants IFC EHS guidelines
<table>
<tr><th rowspan="2">Parameter</th><th>TPP limits</th><th>WB limits</th></tr>
<tr><th>MAC
mg/dm³</th><th>MAC
mg/dm³</th></tr>
<tr><td>Pb</td><td>0.03</td><td>0.5</td></tr>
<tr><td>Cd</td><td>0.005</td><td>0.1</td></tr>
<tr><td>Cu</td><td>0.001</td><td>0.5</td></tr>
<tr><td>Zn</td><td>0.01</td><td>1</td></tr>
<tr><td>Fe</td><td>0.3</td><td>1</td></tr>
<tr><td>Cr (total)</td><td>-</td><td>0.5</td></tr>
<tr><td>As</td><td>0.05</td><td>0.5</td></tr>
<tr><td>Hg</td><td>-</td><td>0.005</td></tr>
<tr><td>pH</td><td>6.5-8.5</td><td>6-9</td></tr>
<tr><td>Suspended solids</td><td>103</td><td>50</td></tr>
<tr><td>Residual chlorine</td><td>-</td><td>0.2</td></tr>
<tr><td>Oil products</td><td>1.45</td><td>10</td></tr>
<tr><td>Temperature Increase (ºC)</td><td></td><td>3ºC (1)</td></tr>
<tr><td>Mineral content</td><td>785</td><td>-</td></tr>
<tr><td>Cl-</td><td>300</td><td>-</td></tr>
<tr><td>SO_4</td><td>265</td><td>-</td></tr>
<tr><td>NO_3</td><td>9.1</td><td>-</td></tr>
<tr><td>NO_2</td><td>0.026</td><td>-</td></tr>
<tr><td>NH_4^+</td><td>0.5</td><td>-</td></tr>
<tr><td>BOD_5</td><td>3</td><td>30(2)</td></tr>
</table>
(1) In the mixing zone
(2) Table 1.3.1. IFC EHS general guidelines (2007)</td><td>Intake and discharge areas</td><td>Every 15 days.</td><td>Safeguard unit of the PMU
TPP EMT</td><td>See mitigation measure nº 42</td></tr>
</table>

Aspect to be monitored or Mitigation Measure.	Monitoring Methods	Parameters to be measured	Assessment Criteria	Locations	Monitoring Frequency	Responsibility	
CONSTRUCTION AND DECOMMISSIONING PHASES							
Traffic management	Register of vehicles site entry/exit hours and route to control observance of distances between transport vehicles fulfilling schedule planned to avoid nuisances to the population.	Vehicles schedule and route	No complaints of the surrounding population	Site entry/exit	Monthly	Safeguard unit of the PMU	Included in the Environmental Safeguard Expert tasks.
Social management	Register of the local workers and enterprises hired to analyze the percentage of local resources vs external or overseas resources. This will allow to analyze the positive impact on the municipality and region.	Workers and enterprises origin		Human Resources office at the site	Monthly	Human Resources unit	Included in the Environmental Safeguard Expert tasks.
Occupational Health and Safety	Monitoring of: ✓ Safety inspection, testing and calibration ✓ Surveillance of the working environment ✓ Surveillance of workers health ✓ Training Accident and diseases monitoring: Implement accident and diseases reporting of the root cause of individual causes, cause patterns and analysis of weekly and monthly statistics.	Check that parameters indicated in the EHS construction and decommissioning plans are being monitored. For accident and disease monitoring: Number of fatal and non fatal injuries and duration of the incapacity to work.	Uzbek health and safety legislation Point 2.9. (Monitoring) of the IFC EHS general guidelines (2009)	Construction/Decommissioning site.	The indicated in the EHS construction and decommissioning plans. For accident and disease monitoring: Weekly and monthly reports	Safeguard unit of the PMU	Included in the H&S expert tasks
	Periodic audit of the EHS construction and decommissioning plans .	Check that parameters indicated in the EHS construction and decommissioning plans are achieved	Uzbek health and safety legislation Point 2. (Occupational Health and Safety) of the IFC EHS general guidelines (2009)	Constructions/Decommissioning site	Monthly	Safeguard unit of the PMU	Included in the H&S expert tasks
Implementation of mitigation measures	Overall EMP construction and decommissioning and CEAP performance. Audit to ensure performance and adherence.	Check that all the requirements agreed are achieved.	-	Construction/Decommissioning site.	Monthly	Safeguard unit of the PMU	Included in the Environmental Safeguard Expert tasks.

<table>
<tr><th>Aspect to be monitored or Mitigation Measure.</th><th>Monitoring Methods</th><th>Parameters to be measured</th><th>Assessment Criteria</th><th>Locations</th><th>Monitoring Frequency</th><th>Responsibility</th><th></th></tr>
<tr><td colspan="8">OPERATION PHASE</td></tr>
<tr><td rowspan="2">Air emissions</td><td>Greenhouse gases quantification</td><td>Greenhouse gases: Direct emissions and indirect emissions associated with the off-site production of power used by the TPP</td><td>2006 IPCC “Guidelines for National Greenhouse Gas Inventories”:
Volume 1: General Guidance and Reporting
Volume 2: Energy</td><td>TPP and off-site production of power</td><td>Annual</td><td>TPP EMT</td><td>Staff of the TPP (see mitigation measure nº 48)</td></tr>
<tr><td>Monitoring and continuous recording of emissions from the stack with a CEMS (Continuous Emissions Monitoring System)</td><td>Emissions of SO_2, NO, NO2, CO, O_2, temperature, pressure and water vapor
(shall not be necessary, provided that the sampled exhaust gas is dried before the emissions are analyzed).</td><td>Currently, Maximun Allowed Emission (MAE) has not been determined for the new CCPU. Therefore, at the time of writing this EMP, the standardization taken into account is the one shown underneath:
<table><tr><th colspan="3">Table 6-C of the IFC EHS Thermal Power Plants guidelines (2008)</th></tr><tr><th>Combustion technology /fuel</th><th>NO_x concentration level (mg/Nm^3)</th><th>Excess O_2 content, dry basis (%)</th></tr><tr><td>Natural Gas Turbines › 50 MW_{th}</td><td>51 (25 ppm)</td><td>15</td></tr></table>
Future MAD should not be more permissive than the above one.</td><td>Stack of the new CCPU</td><td>Continuous</td><td>TPP EMT</td><td>Included in the project (See mitigation measure nº 10)</td></tr>
</table>

<table>
<tr><th>Aspect to be monitored or Mitigation Measure.</th><th>Monitoring Methods</th><th>Parameters to be measured</th><th>Assessment Criteria</th><th>Locations</th><th>Monitoring Frequency</th><th>Responsibility</th><th></th></tr>
<tr><td colspan="7">OPERATION PHASE</td><td></td></tr>
<tr><td></td><td>Stack emission testing in order to have direct measurements of emission levels to counter check the CEMS</td><td>Emissions of SO_2, NO, NO2, CO, O_2, temperature, pressure and water vapor</td><td>Currently, Maximun Allowed Emission (MAE) has not been determined for the new CCPU. Therefore, at the time of writing this EMP, the standardization taken into account is the one shown underneath:
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<tr><td>Natural Gas Turbines › 50 MW_{th}</td><td>51 (25 ppm)</td><td>15</td></tr>
</table>
Future MAD should not be more permissive than the above one.</td><td>Stack of the new CCPU</td><td>Annual.
If results show constantly (3 consecutive years) a significantly (less than 75%) better than the required levels, frequency can be reduced to every two or three years</td><td>TPP EMT</td><td>See mitigation measure nº 50</td></tr>
</table>

<table>
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<tr><td colspan="7">OPERATION PHASE</td><td></td></tr>
<tr><td rowspan="2">Air quality</td><td>Monitoring and continuous recording of ambient air quality through a fixed air quality monitoring station.</td><td>SO_2, NO2, NO, TSP, PM10, PM2.5, CO.</td><td><table>
<tr><th></th><th></th><th>µg/m^3</th></tr>
<tr><td>SO_2</td><td>10 min.
30 min.
24-hour
1 month
1 year</td><td>500 (2)
500 (1)
200(1); 20 (2)
100 (1)
50 (1)</td></tr>
<tr><td>NO_2</td><td>30 min.
1-hour
24-hour
1 month
1 year</td><td>85
200 (2)
60(1)
50 (1)
40 (1) (2)</td></tr>
<tr><td>NO</td><td>30 min.
24-hour
1 month
1 year</td><td>600 (1)
250 (1)
120 (1)
60 (1)</td></tr>
<tr><td>Dust (TSP)</td><td>30 min.
24-hour
1 month
1 year</td><td>150-500 (1)
100-350 (1)
80-200 (1)
50-150 (1)</td></tr>
<tr><td>PM10</td><td>1 year
24-hour</td><td>20 (2)
50 (2)</td></tr>
<tr><td>PM2.5</td><td>1 year
24-hour</td><td>10 (2)
25 (2)</td></tr>
<tr><td>CO</td><td>30 min.
24-hour
1 month
1 year</td><td>5000 (1)
4000 (1)
3500 (1)
3000 (1)</td></tr>
</table>
(1) National standards (SanR&N No 0293-11 Hygienic requirements, the list of MAC for pollutants in atmosphere in Republic of Uzbekistan")
(2) WHO Ambient Air Quality Guidelines (General IFC Guidelines ,2007)

From (1) and (2) whichever is more stringent.</td><td>Air quality station should be located in the predicted maximum ground level concentration point. To locate this point a specifi study should be carried out takiint into account results of the atmospheric dispersion model, (see Annex III), power supply, location within the national territory.</td><td>Continuous</td><td>TPP EMT</td><td>Included in the project (see mitigation measure nº 11)</td></tr>
<tr><td>Monitoring and continuous recording of meteorological data through a fixed meteorological monitoring station.</td><td>Wind speed and direction, atmospheric pressure, relative humidity and temperature.</td><td>-</td><td>Meteorologica station should be located within the TPP terrains in order to gather information of the meteorological dispersion conditions of the exhaust gas.</td><td>Continuous</td><td>TPP EMT</td><td>Included in the project (see mitigation measure nº 11)</td></tr>
</table>

<table>
<tr><th>Aspect to be monitored or Mitigation Measure.</th><th>Monitoring Methods</th><th>Parameters to be measured</th><th>Assessment Criteria</th><th>Locations</th><th>Monitoring Frequency</th><th>Responsibility</th><th></th></tr>
<tr><td colspan="7">OPERATION PHASE</td><td></td></tr>
<tr><td>Noise</td><td>Noise monitoring campaign
Monitors should be located approximately 1.5 m above the found and no closer than 3 m to any reflecting surface. A type 1 or 2 sound level meter should be used.</td><td>Ambient noise levels (dBA)</td><td><table><tr><th>Name of area</th><th>Level of sound, (dBA)</th></tr><tr><td>Residential areas (inside) (SanR&N No.0267-09):
Day time
Night time</td><td>

40
30</td></tr><tr><td>Residential areas (outside) (SanR&N No.0267-09 and IFC EHS general guidelines (2007)):
Day time
Night time</td><td>

55
45</td></tr><tr><td>Industrial areas (IFC EHS general guidelines (2007))</td><td>70</td></tr></table></td><td>See Figure 1 at the end of this table
Points 1 to 4: Industrial area
Points 5 to 8: Residential area

Two other points should be located at the new CCPU fence once the final layout would be decided</td><td>Annually.</td><td>Safeguard TPP EMT</td><td>See mitigation measure nº 41</td></tr>
<tr><td rowspan="2">Waste management</td><td>To keep:
c) Permits and certifications of the waste management and recycling enterprises
d) Contracts of the authorized waste management and recycling enterprises. In the contract it should be included the management and final disposal of wastes under an environmental sound manner.</td><td>Waste manager's permits and certifications.

Contracts with the waste managers</td><td>Uzbek Law on wastes and IFC EHS general guidelines (2007)</td><td>Waste management and recycling enterprises
TPP EMT office</td><td>Every time a new waste management or recycling enterprise is hired</td><td>TPP EMT</td><td>Staff of the TPP</td></tr>
<tr><td>The documentation concerning the delivery of waste will be stored to serve as evidence of their appropriate treatment.

Produced and managed wastes, as well as its destination shall be addressed and recorded</td><td>Waste delivery notes

Waste receipts</td><td></td><td>Waste management and recycling enterprises
TPP EMT office</td><td>Annual estimation</td><td>TPP EMT</td><td>Staff of the TPP</td></tr>
</table>

<table>
<tr><th>Aspect to be monitored or Mitigation Measure.</th><th>Monitoring Methods</th><th>Parameters to be measured</th><th>Assessment Criteria</th><th>Locations</th><th>Monitoring Frequency</th><th>Responsibility</th><th></th></tr>
<tr><td colspan="7">OPERATION PHASE</td><td></td></tr>
<tr><td>Effluents</td><td>Intake and discharge continuous and automatic monitoring and recording of temperature, pH and conductivity</td><td>Temperature, pH, conductivity</td><td>Currently, Maximun Allowed Concentration (MAC) has not been determined for the new CCPU. Therefore, at the time of writing this EMP, the standardization taken into account is the one shown underneath:
<table><tr><th>Parameter</th><th>Table 5 of the IFC EHS Thermal Power Plants guidelines mg/dm³</th></tr><tr><td>pH</td><td>6-9</td></tr><tr><td>Temperature Increase (ºC)</td><td>3ºC (1)</td></tr></table>(1) In the mixing zone. Considered 100 m from the point of discharge.

These levels should be achieved, without dilution, at least 95% of the time that the plant or unit is operating, to be calculated as a proportion of annual operation hours.

Future MAC should not be more permissive than the above ones and the existing TPP MAC.</td><td>Intake and discharge points from and to Suenly canal
Temperature at 100 meters from the discharge</td><td>Continuous</td><td>Plant engineers</td><td>Included in the project (see mitigation measure nº 18)</td></tr>
</table>

Aspect to be monitored or Mitigation Measure.	Monitoring Methods	Parameters to be measured	Assessment Criteria	Locations	Monitoring Frequency	Responsibility	
OPERATION PHASE							
	Intake and discharge continuous and automatic monitoring and recording of the biocide used for the cooling water treatment (sodium hypoclorite) with an automatic dosage calibration.	Total residual chlorine	Currently, Maximun Allowed Concentration (MAC) has not been determined for the new CCPU. Therefore, at the time of writing this EMP, the standardization taken into account is the one shown underneath: <table><tr><th>Parameter</th><th>Table 5 of the IFC EHS Thermal Power Plants guidelines *mg/dm³*</th></tr><tr><td>Total residual chlorine</td><td>0.2</td></tr></table> These levels should be achieved, without dilution, at least 95% of the time that the plant or unit is operating, to be calculated as a proportion of annual operation hours. Future MAC should not be more permissive than the above ones and the existing TPP MAC.	Discharge point to Suenly canal	Continuous	Plant engineers	Included in the project (see mitigation measure nº 19)

<table>
<tr><th>Aspect to be monitored or Mitigation Measure.</th><th>Monitoring Methods</th><th>Parameters to be measured</th><th>Assessment Criteria</th><th>Locations</th><th>Monitoring Frequency</th><th>Responsibility</th><th></th></tr>
<tr><td colspan="7">OPERATION PHASE</td><td></td></tr>
<tr><td></td><td>Effluent quality monitoring</td><td>Cr, Cu, Zn, Pb, Cd, Hg;, As, Suspended solids, mineralization, Cl-, SO4, NO3, NO2, NH4, Fe, BOD-5, Oil products.</td><td>Currently, Maximun Allowed Concentration (MAC) has not been determined for the new CCPU. Therefore, at the time of writing this EMP, the standardization taken into account is the one shown underneath:
<table>
<tr><th>Parameter</th><th>Table 5 of the IFC EHS Thermal Power Plants guidelines mg/dm³</th></tr>
<tr><td>Pb</td><td>0.5</td></tr>
<tr><td>Cd</td><td>0.1</td></tr>
<tr><td>Cu</td><td>0.5</td></tr>
<tr><td>Zn</td><td>1</td></tr>
<tr><td>Fe</td><td>1</td></tr>
<tr><td>Cr (total)</td><td>0.5</td></tr>
<tr><td>As</td><td>0.5</td></tr>
<tr><td>Hg</td><td>0.005</td></tr>
<tr><td>pH</td><td>6-9</td></tr>
<tr><td>Suspended solids</td><td>50</td></tr>
<tr><td>Mineral content</td><td>-</td></tr>
<tr><td>Cl-</td><td>-</td></tr>
<tr><td>SO_4</td><td>-</td></tr>
<tr><td>NO_3</td><td>-</td></tr>
<tr><td>NO_2</td><td>-</td></tr>
<tr><td>NH_4^+</td><td>-</td></tr>
<tr><td>BOD_5</td><td>30 (1)</td></tr>
</table>
(1) Table 1.3.1. IFC EHS general guidelines (2007)

Future MAC should not be more permissive than the above ones and the existing TPP MAC.</td><td>Intake and discharge point from and to Suenly canal</td><td>Every 15 days. If there is no variation between intake and discharge points observed after one year, the monitoring of heavy metals could be discontinued.</td><td>TPP EMT</td><td>Included in the project (see mitigation measure nº 42)</td></tr>
</table>

Aspect to be monitored or Mitigation Measure.	Monitoring Methods	Parameters to be measured	Assessment Criteria	Locations	Monitoring Frequency	Responsibility	
OPERATION PHASE							
Water Consumption	Continuous flue rate monitoring at the intake and discharge point to calculate water consumption rate	Water intake and discharge flue rate		Intake and discharge point from and to Suenly canal	Continuous.	Plant engineers	Staff of the TPP. Currently on going
Groundwater.	The TPP existing groundwater monitoring plant will be extended and improved. Samples and analysis of the proposed parameters in the proposed frequency will be undertaken. .	New parameters: Ph, oil products, metals (cadmium, cobalt, copper, chromium, lead, nickel, zinc, arsenic, mercury), organochloride pesticides, phenols, Current parameters: pH, C_A^{2+}, Mg^{2+}, N_A^+, Cl, SO_4^{2-}, HCO_3^-, Hardness, Temperature.	Due to the absence of national standards for groundwater quality, surface water quality standards can be used as reference. -	New wells will be located in areas which could mean risks on the quality of groundwater and soils as: sludge ponds, oil and chemicals storage tanks, hazardous waste storage by adding one well below each site in the direction of groundwater to surface waterways. Location of wells should be approved once the final project layout is decided an under the supervision of a specialist. .	Quarterly. If there is no variation observed after one year for heavy metals and organpchloride pesticides, the monitoring of these parameters could be discontinued.	TPP EMT	See mitigation measure nº 55
Soil	Monitoring of soil salination levels	Salt deposited on soil	Value for the potential salination of the ground= 0.01 $g/m^2/h$,	Along the area in which, after the observation of the steam plume, deposition is more likely to occur.	Preferably during spring and summer seasons. This check would be also made after significant changes in the towers, such as changes in components or in the operating system, which may lead to a substantial increase in the salts emission rate finally adopted.	TPP EMT	See mitigation measure nº 52
Fuel Usage	Continuous natural gas flue rate monitoring	Natural gas flue rate		Gas intake station	Continuous	Plant engineers	Staff of the TPP
Power output	Continuous power output monitoring	Power output		Main Control Room	Continuous	Plant engineers	Staff of the TPP

Aspect to be monitored or Mitigation Measure.	Monitoring Methods	Parameters to be measured	Assessment Criteria	Locations	Monitoring Frequency	Responsibility	
OPERATION PHASE							
Occupational Health and Safety	Monitoring of: ✓ Safety inspection, testing and calibration ✓ Surveillance of the working environment ✓ Surveillance of workers health ✓ Training Accident and diseases monitoring: Implement accident and diseases reporting of the root cause of individual causes, cause patterns and analysis of weekly and monthly statistics.	Check that parameters indicated in the EHS operation plan are being monitored. For accident and disease monitoring: Number of fatal and non fatal injuries and duration of the incapacity to work.	Uzbek health and safety legislation Point 2.9. (Monitoring) of the IFC EHS general guidelines (2009)	TPP	The indicated in the EHS operation plan.	TPP EMT	Staff of the TPP
	Periodic audit of the EHS operation plan	Check that parameters indicated in the EHS operation plan are achieved	Uzbek health and safety legislation Point 2. (Occupational Health and Safety) of the IFC EHS general guidelines (2009)	TPP	The indicated in the EHS operation plan	TPP EMT (supervised by qualified and experienced external experts or qualified NGOs)	40000 $US/audit
Implementation of mitigation measures	Overall EMP operation plan. Audit to ensure performance and adherence.	Check that all the requirements agreed are achieved.	-	TPP.	The indicated in the EMP	TPP EMT (supervised by qualified and experienced external experts or qualified NGOs)	30000 $US/audit

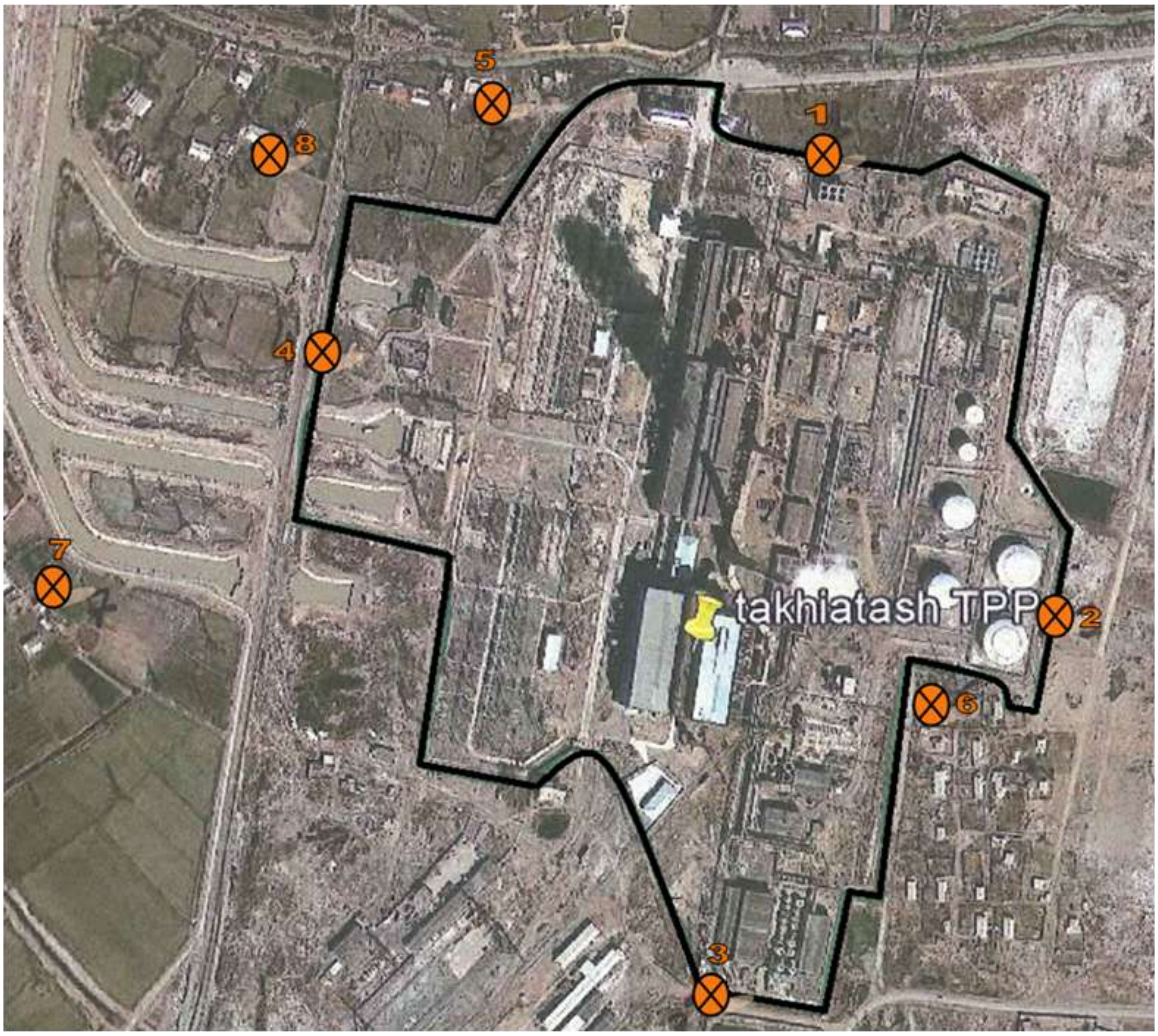

Figure 1: location of noise measuring points

ANNEX VIII. INFORMATION DISCLOSURE AND PUBLIC CONSULTATION. GRIEVANCE MECHANISM

Appendix 1: Information letter from the Takhiatash TPP of th Public Consultations

"O'ZBEKENERGO"
DAVLAT-AKSIYADORLIK
KOMPANIYASI
"TAXIATOSH ISSIQLIK ELEKTR
STANSIYASI"
OCHIQ AKSIYADORLIK JAMIYATI
"TAXIATOSH IES" O.A.J.

25. 04 2013 y.
№ 16-29-708

Председателю
Комитета по охране природы
Республики Каракалпакстан
Айтмуратову П.Д.

Уважаемый Парахат Джанабаевич!

В соответствии с Постановлением Президента Республики Узбекистан № ПП-1442 от15.12.2010г. «О приоритетах развития промышленности Республики Узбекистан в 2011-2015 годах» ГАК «Узбекэнерго» реализует инвестиционный проект «Строительство парогазовой установки мощностью 230-250 МВт на Тахиаташской ТЭС» и привлечением инвестиционных средств Азиатского Банка Развития. В рамках подготовки экологического компонента проекта планируется проведение двух раундов общественных слушаний с привлечением всех заинтересованных сторон. На слушаниях будут представлены основные результаты проведенной экологической оценки воздейсвия проекта «Строительство парогазовой установки мощностью 230-250 МВт на Тахиаташской ТЭС» на окружающую среду. Проведение общественных слушаний запланировано на 29 апреля 2013 в 14 часов в здании энергетического колледжа г.Тахиаташ.

В связи с вышеизложенным, приглашаем для участия в общественных слушаниях сотрудников Вашей организации – Бердиева З. – начальника ГП КРХР при СИАК Республики Каракалпакстан и Атажанову С. – начальника отдела по мониторингу атмосферного воздуха, а также всех желающих экспертов.

Директор
ОАО «Тахиаташская ТЭС» **Б.Т.Мадреимов**

"O'ZBEKENERGO"
DAVLAT-AKSIYADORLIK
KOMPANIYASI
"TAXIATOSH ISSIQLIK ELEKTR
STANSIYASI"
OCHIQ AKSIYADORLIK JAMIYATI
"TAKHIATOSH IES" O.A.J.

«09» 04 20 13 yil
№ 16-29-575

Зам.хакима
г. Тахиаташа
Б.Ж.Конакбаеву

Информационное письмо

В соответствии с Постановлением Президента Республики Узбекистан № ПП-1442 от15.12.2010г. «О приоритетах развития промышленности Республики Узбекистан в 2011-2015 годах» ГАК «Узбекэнерго» реализует инвестиционный проект «Строительство парогазовой установки мощностью 230-250 МВт на Тахиаташской ТЭС» и привлечением инвестиционных средств Азиатского Банка Развития.

В рамках подготовки экологического компонента проекта планируется проведение двух раундов общественных слушаний с привлечением всех заинтересованных сторон. На слушаниях будут представлены основные результаты проведенной экологической оценки воздейсвия проекта «Строительство парогазовой установки мощностью 230-250 МВт на Тахиаташской ТЭС» на окружающую среду. Проведение первого раунда слушаний запланировано на 17 апреля 2013 года, второго – на первую декаду мая. Также просим Вашего разрешения на размещение объявлений о планируемых мероприятиях в общественных местах (школы, базар, хокимият).

В связи с вышеизложенного, прошу Вас оказать содействие консультантам АБР в организации общественных слушаний.

Примечание:

Хокимият должен определить место проведения общественных слушаний.
Место должно быть удобным для размещения 30-50 человек, представления презентации участникам в Power Point (с использованием проектора).
Встреча будет длиться около 1-1,5 часа
Приглашения должны быть отосланы от Хокимията.
Нужны следующие группы, (минимум)

1. Представители Хокимията включая, зам. хокима по вопросам женщин, эл.тармоклари и станции
2. Представители природоохранных организаций (Госкомприрода)
3. Представители медицинских учреждений и учебных заведений
4. Представители Водоканала, Министерства Сельского и Водного хозяйства
5. Представители малого среднего бизнеса
6. Местные жители и представители Махаллей
7. Представители неправительственных организаций.

Директор
ОАО «Тахиаташская ТЭС» **Б.Т.Мадреимов**

"O'ZBEKENERGO" DAVLAT-AKSIYADORLIK KOMPANIYASI "TAXIYATOSH ISSIQLIK ELEKTR STANSIYASI" OCHIQ AKSIYADORLIK JAMIYATI "TAXIATOSH IES" O.A.J.
25. 04 2013 yil
№ 26-29-707

Зам.хакима
г. Тахиаташа
Б.Ж.Конакбаеву

Информационное письмо

В соответствии с Постановлением Президента Республики Узбекистан № ПП-1442 от15.12.2010г. «О приоритетах развития промышленности Республики Узбекистан в 2011-2015 годах» ГАК «Узбекэнерго» реализует инвестиционный проект «Строительство парогазовой установки мощностью 230-250 МВт на Тахиаташской ТЭС» и привлечением инвестиционных средств Азиатского Банка Развития.

В рамках подготовки экологического компонента проекта планируется проведение двух раундов общественных слушаний с привлечением всех заинтересованных сторон. На слушаниях будут представлены основные результаты проведенной экологической оценки воздейсвия проекта «Строительство парогазовой установки мощностью 230-250 МВт на Тахиаташской ТЭС» на окружающую среду. Проведение второго раунда слушаний запланировано на 29 апреля 2013 года. Также просим Вашего разрешения на размещение объявлений о планируемых мероприятиях в общественных местах (школы, базар, хокимият).

В связи с вышеизложенным, прошу Вас оказать содействие консультантам АБР в организации общественных слушаний.

Примечание:

Хокимият должен определить место проведения общественных слушаний.
Место должно быть удобным для размещения 50 человек, представления презентации участникам в Power Point (с использованием проектора).
Встреча будет длиться около 1-1,5 часа
Приглашения должны быть отосланы от Хокимията.
Нужны следующие группы, (минимум)

1. Представители Хокимията включая, зам. хокима по вопросам женщин, эл.тармоклари и станции
2. Представители природоохранных организаций (Госкомприрода)
3. Представители медицинских учреждений и учебных заведений
4. Представители Водоканала, Министрества Сельского и Водного хозяйства
5. Представители малого среднего бизнеса
6. Местные жители и представители Махаллей
7. Представители неправительственных организаций.

Директор
ОАО «Тахиаташская ТЭС» **Б.Т.Мадреимов**

Appendix 2. Newspaper announcements

Local newspaper on the 13th of April.

ДАҒАЗА

Өзбекстан Республикасы Президентиниң 15.12.2010-жылдағы №ПП 1442 «2011-2015-жылларда Өзбекстан Республикасы санаатын раўажландырыў үстинлиги» карарына муўапық «Өзбекэнерго» мәмлекетлик акционерлик компаниясы «Тақыятас ЖЭС ында 230-250 МВт қуўатлықтағы пуўгаз үскенелери қурылысы» инвестициялық жойбары ҳәм Азия Раўажланыў Банкиниң инвестицияларын тартыў әмелге асырылмақта. Экологиялық баҳалаў шегинде ҳәмме қызығыўшы тәреплерди тартыўда жәмийетлик тыңлаў еки раундта өткериў жобаластырылмақта. Тыңлаўда «Тақыятас ЖЭС ында 230-250 МВт қуўатлықтағы пуўгаз үскенелери қурылысы» жойбарында өткерилген экологиялық баҳалаўдың қоршаған орталыққа тәсирлерин илажға алыў тийкарғы нәтийжелери таныстырылады.

Жәмийетлик тыңлаў 2013-жыл 18-апрельде саат 10.00 де Тақыятас қалалық энергетика колледжи имаратында өткериледи.

Жәмийетлик тыңлаўға ҳәмме қызығыўшы ағзалар қатнасыўына мирәт етиледи.

«Тақыятас ЖЭС» ААЖ басқармасы.

Announcement of the 1st Public Consultation hold on 18 April 2013

Local newspaper on the 27th of April (Karakalpak language).

9. Қанлыкөл районы ЖИБ судының 11.02.2013-жылғы №22-85/13 орынлаў хатына тийкарланып, Төрткүл районы суд карарларын орынлаўшылар бөлими тәрепинен хатланған:

Төрткүл районы Ш.Рашидов АПЖда жайласкан Джумабаев Оыарға қараслы ... жер майданы 175,0 м/кв болған мешшик имараты. Дәслепки баҳасы 140 453 200 сум.

10. Қанлыкөл районы ЖИБ судының 11.02.2013-жылғы №22-85/13 орынлаў хатына тийкарланып, Төрткүл районы суд карарларын орынлаўшылар бөлими тәрепинен хатланған:

Төрткүл районы А.Пирманов көшесинде жайласкан Кушанов Курамбайға қарасты узыўма жер майданы 24 м/кв болған дукан имараты. Дәслепки баҳасы 30 278 300 сум.

«Ким-зыят» саўдасына катнасыў ушын арзалар шемби ҳәм екшембиден тысқары күнлери саат 9.00 ден 18.00 ге шекем Нөкис қаласы, Әмир Темур көшеси №122 жайдың 2-қабаты, 15-ханасында қабылланады. Арзаларды қабыллаў саўдадан бир күн бурын тоқтатылады. Қарыйдарлардан «Ким-зыят» саўдасына арза берген мүлки ушын дәслепки баҳасының 10 проценти муғдарында кепеў пулы төлем қағазында орынлаў ҳүжжетиниң саны ҳәм сәнеси көрсетилген ҳалда «CAPITAL REALTOR GROUP» ЖШЖ Қарақалпақстан филиалы е/б: 20208000904927571009, МФО: 01038, ИНН: 207126662, ОАКБ Капиталбанк Нөкис қаласы филиалына төленеди.

Мүрәжат ушын телефон: (8-361) 222-83-41. Лицензия: RR-0017.

... жуўапкершилиги шекленген ...стан филиалы тәрепинен:

... имараты. Дәслепки баҳасы 56 421 215 сум.

4. 1992-жыл курылған узыўма майданы 281,82 кв.м болған моншахана имараты. Дәслепки баҳасы 37 999 799 сум.

5. 1980-жыл курылған узыўма майданы 151,04 кв.м болған котельная имараты. Дәслепки баҳасы 29 027 512 сум.

«Ким-зыят» саўдасына катнасыў ушын арзалар шемби ҳәм екшембиден тысқары күнлери саат 9.00 ден 18.00 ге шекем Нөкис қаласы, Әмир Темур көшеси №122 жайдың екинши қабатының 15-ханасында қабылланады. Арзаларды қабыллаў саўдадан бир күн бурын тоқтатылады. Қарыйдарлардан «Ким-зыят» саўдасына арза берген мүлки ушын дәслепки баҳасының 10 проценти муғдарында кепеў ...

Ассистент лаўазымына: тийисли қәнигелик бойынша жоқары мағлыўматқа ийе болған пуқаралар (магистр дипломлы қәниге) катнасыўы мүмкин.

Таңлаўға катнасыўды қәлеўшилер директор атына арза, кадрларды есапқа алыў бойынша жеке иес қағазы, дипломлар, илимий жумыслар дизими ҳәм қәнигелигин жетилистиргенлиги ҳаққындағы гүўалығының көширмеси тапсырылады.

Арзалар газетада дағаза жәрияланған күннен баслап 1 ай мүддет ишинде қабыл етиледи.

Таңлаў шәртлери бойынша қосымша маглыўматларды ТашМАУ Нөкис филиалы илимий кеңесинен билиўиңизге болады.

Мәнзил: Нөкис қаласы, Х.Абдамбетов көшеси, номерсиз жай.

Өзбекстан Республикасы Президентиниң 15.12.2010-жылдағы №ПП 1442 «2011-2015-жылларда Өзбекстан Республикасы санаатын раўажландырыў устинликлери» қарарына муўапық «Өзбекэнерго» мәмлекетлик акционерлик компаниясы «Тақыятас ЖЭС ында 230-250 МВт қуўатлықтағы пуў-газ үскенелери курылысы» инвестициялық жойбары ҳәм Азия Раўажланыў Банкиниң инвестицияларын тартыў әмелге асырылмақта.

Экологиялық баҳалаў шегинде ҳәмме қызығыўшы тәреплерди тартыўда жәмийетлик тыңлаў еки раундта өткериўди жобаластырмақта. Тыңлаўда «Тақыятас ЖЭС ында 230-250 МВт қуўатлықтағы пуў-газ үскенелери курылысы» жойбарында өткерилген экологиялық баҳалаўдың қоршаған орталыққа тәсирин анлаўға алыў тийкарғы нәтийжелери ҳәм де жәмийетлик тыңлаўдың биринши раундтағы талқылаў нәтийжелери таныстырылады.

Жәмийетлик тыңлаў 2013-жыл 29-апрельде саат 14.00 де Тақыятас қалалық энергетика колледжи имаратында өткериледи.

Жәмийетлик тыңлаўға ҳәмме қызығыўшы ағзалардың катнасыўына мирәт етиледи.

«Тақыятас ЖЭС» ААЖ басқармасы.

БИЙКАР ЕТИЛЕДИ

Тақыятас экономика колледжин 2007-2008-оқыў жылында питкерген Рустембай Дурдиевке берилген К №601915 дипломы жойтылыўына байланыслы бийкар етиледи.

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3-санлы Нөкис медицина колледжин 2010-2011-оқыў жылында питкерген Улмекен Ибрайымоваға берилген К №1890793 дипломы жойтылыўына байланыслы бийкар етиледи.

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Нөкис агро-экономика колледжин 2000-2001-оқыў жылында питкерген Лаззат Сулайманова берилген №493939 дипломы жойтылыўына байланыслы бийкар етиледи.

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Нөкис қаласы кадастр хызмети тәрепинен Нөкис қаласы, А.Досназаров көшеси 9-жай 2-ханасында жасаўшы ... берилген ТА №0517173 санлы гүўалықнамасы жойтылыўына байланыслы бийкар етиледи.

Announcement on Karakalpak language

Local newspaper on the 27th of April (Russian language).

ОБЪЯВЛЕНИЕ

В соответствии с Постановлением Президента Республики Узбекистан № ПП-1442 от15.12.2010 г. "О приоритетах развития промышленности Республики Узбекистан в 2011-2015 годах" ГАК "Узбекэнерго" реализует инвестиционный проект "Строительство парогазовой установки мощностью 230-250 МВт на Тахиаташской ТЭС" и привлечением инвестиционных средств Азиатского банка развития.

В рамках проведения экологической оценки планируется проведение двух раундов общественных слушаний с привлечением всех заинтересованных сторон. На слушаниях будут представлены основные результаты проведенной экологической оценки воздействия проекта "Строительство парогазовой установки мощностью 230-250 МВт на Тахиаташской ТЭС" на окружающую среду и результаты обсуждений 1-го раунда общественных слушаний.

Общественные слушания будут проводиться 29 апреля 2013 г. в здании энергетического колледжа г.Тахиаташа в 14.00.

Для участия в общественных слушаниях приглашаются все заинтересованные лица.

АДМИНИСТРАЦИЯ ОАО "ТАХИАТАШСКОЙ ТЭС"

Announcement on Russian language

Appendix 3. List of participants

СПИСОК УЧАСТНИКОВ

1-го РАУНДА ОБЩЕСТВЕННЫХ СЛУШАНИЙ ПО ПРОЕКТУ

«СТРОИТЕЛЬСТВА ПАРОГАЗОВОЙ УСТАНОВКИ (ПГУ) НА ТАХИАТАШСКОЙ ТЭС»

г.ТАХАТАШ, 18 АПРЕЛЯ 2013 ГОДА

№	Ф.И.О.	Должность	Подпись
1	Юсупов Мурат	Экос.	
2	Сапарова. Зулфия	Экос.	
3	Бабаджанова. Г	М.П.Ж. 4.	
4	Аманжанова. С	Табиғат қорғау	
5	Якупов Ж	М.П.Ж. 5.	
6	Куншымуратов. Т	Тах-ш мес.	
7	Матганов У.	Тах-ш ТЭС	
8	Жумамуратова М	Т-таш хэк соғалық	
9	Тавекелова. А.	Махалла фонд.	
10	Данаев А.	М.П.Ж. №2.	
11	Ширбаев. Д	М.П.Ж. №7.	
12	Мадреимова. Г	№6 М.П.Ж. [illegible]	
13	Мамбеталиева. Г	№10 Хаткер [illegible]	
14	Аяпзимбетова. Х.	Хакимият.	
15	Танжиев Азамат	«Камолот» ЖИХ	
16	Жандуллаева. М.	№3 М.П.Ж.	
17	Турсымбаев А.	№1 М.П.Ж. [illegible]	
18	Усманов. М.	№8 М.П.Ж.	
19	Шаримбетов Ю.	МННО "Интеллект"	
20	Ажиниязова Р	КРРО ННО	
21	Жапакова Г.	Ресурс-центр ННО	

№	Ф.И.О.	Должность	Подпись
22	Тлегенниязов Ж.	Суў ағабо.	
23	Хожаназаров А.	[illegible]	
24	Сапаров Ж.	Т-таш. И.Е.С.	
25	Дуйсалиев Б.	Электросети.	
26	Бердиев З.	Госком природа.	
27	Ешмуратова Н.	ЭКОК	
28	Хожамуратова З	ЭКОК	
29	Жасинова Г.	ЭКОК	
30	Даулетмуратова	ЕКОК.	
31	Хожакова Б.	Мектеп №9 [illegible]	
32	Бегжанов Р.	ЭКОК	
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List of participants of 1st round of Public Consultation
Of the Project "Takhiatash Power Plant Energy Efficiency Improvement Project"
Takhiatash, 18 April 2013

№	Name	Position	Signture
1	Yusupov Murat	Energy college, Takhiatash city	
2	Saparova Zulfiya	Energy college, Takhiatash city	
3	Babajanova G.	Makhalla #4	
4	Atajanova S.	Nature Protection Committee	
5	Yakupov J.	Makhalla #5	
6	Qutlimuratov P.	Takhiatash TPP	
7	Matchanov U.	Takhiatash TPP	
8	Jumamuratova M.	Takhiatash city medical foundation	
9	Tavekelova A.	Association of makhallas foundation	
10	Danaev A.	Makhalla #2	
11	Shirbaev D.	Makhalla #7	
12	Madreymova G.	Makhalla #6	
13	Mambetalieva G.	Makhalla #10	
14	Auozimbetova Q.	Local government authority	
15	Tajekiv Azamat	"Kamolot" Young generation Union, chairman	
16	Jandullaeva M.	Makhalla #3	
17	Tursimbaev A.	Makhalla #1, representative	
18	Usmanov M.	Head of Makhalla #8	
19	Sharimbetov Yu.	NGO "Intellekt"	
20	Ajinshuova R.	NGO "Nimfogo"	
21	Japakova G.	NGO "Resources Center"	

22	Toleuniyazov J.	“Vodocanal” of Tkhiatash city	
23	Hojanazarov A.	“Aqmagat” newspaper, editor	
24	Saparov J.	Takhitash TPP	
25	Duysaliev B.	Electrical network	
26	Berdiev Z.	Nature Protection Committee	
27	Eshmuratova N.	Energy college, teacher	
28	Hojamuratova Z.	Energy college, teacher	
29	Jakipova G.	Energy college, teacher	
30	Dauletmuratova	Energy college, teacher	
31	Hojakova B.	Secondary school teacher	
32	Begjanov R.	Energy college, student	

СПИСОК УЧАСТНИКОВ

2-го РАУНДА ОБЩЕСТВЕННЫХ СЛУШАНИЙ ПО ПРОЕКТУ

«СТРОИТЕЛЬСТВА ПАРОГАЗОВОЙ УСТАНОВКИ (ПГУ) НА ТАХИАТАШСКОЙ ТЭС»

г.ТАХАТАШ, 29 АПРЕЛЯ 2013 ГОДА

№	Ф.И.О.	Должность	Подпись
1	Kalilyeva Mexriban	Psixolog 12-mktb	[illegible]
2	Matniyazov Maxet	TES master	[illegible]
3	Лукманова Р	д/с № 9	[illegible]
4	Бабажанова Г	д/с № 5	[illegible]
5	Даубов Д.	Санэпидстанция	[illegible]
6	Алтбердинов	—//—	[illegible]
7	Ниязов	—//—	[illegible]
8	Бердиев З.	Госкомприроды	[illegible]
9	Сейтмуратова	поликл-ка	[illegible]
10	Атамуратова	пол-ка 2	[illegible]
11	Бекмуратова	—//—	[illegible]
12	Фронова А	Гл.тех.цент.	[illegible]
13	Матчанов М	Тах-ш ТЭС	[illegible]
14	Юлдашева Н	4-мактаб	[illegible]
15	Ембаева Н	4-мактаб	[illegible]
16	Урынбаева М	1-поли-ка терапевт	[illegible]
17	Учепов Т	Энергетика КОК	[illegible]
18	Нурмуратова	хакимият	[illegible]
19	Нуржанбетова	хакимият	[illegible]
20	Нурмамбетов К	энергетика	[illegible]
21	Джапабаев А	Энергетика КОК	[illegible]

№	Ф.И.О.	Должность	Подпись
22	Пемуратова М	Энергетика кҚк	
23	Худайбергенова М	— " —	
24	Турсынбаев А	1-дом ком	
25	Хожанов Э	Энергетика кок	
26	Утеенова Г	Қызыл ярым ай	
27	Абдуллаев А	6-мактаб	
28	Мадреимова Н	6-дом ком	
29	Курбанмуратов П	Тахиаташ ТЭС	
30	Досымбетов М	Тахиаташ ТЭС	
31	Сабурбаева Г	энергетика ККК	
32	Жанискеев А	„Камолот" жқх	
33	Қутлимуратова Г	3-мактаб	
34	Сапарова З	— " —	
35	Сапарбаева Т	Тахиаташ ТЭС	
36	Матниязова Г	— " —	
37	Халмуратова Г	— " —	
38	Худайбергенова Б	— " —	
39	Жанкабаева Ж	7-бақша	
40	Атажанов Р	Энергетика ККК	
41	Қадиров М	— " —	
42	Худайбергенова Г	8-балалар бақшасы	
43	Сапаиева Д	— " —	
44	Данаев А	2-дом ком.	
45	Нурымбетова Н.	Энергетика	
46	Даулетмуратов Н	— " —	
47	Шамедова Н	ПРЭС	
48	Сапарова З	Энергетика ККК	

СПИСОК УЧАСТНИКОВ

2-го РАУНДА ОБЩЕСТВЕННЫХ СЛУШАНИЙ ПО ПРОЕКТУ «СТРОИТЕЛЬСТВА ПАРОГАЗОВОЙ УСТАНОВКИ (ПГУ) НА ТАХИАТАШСКОЙ ТЭС»

г.ТАХАТАШ, 29 АПРЕЛЯ 2013 ГОДА

№	Ф.И.О.	Должность	Подпись
1	Юлдашева М	13-балалар бақшасы	
2	Жиенкулова С	— // —	
3	Ерназарова Г	4-бала бақша	
4	Есимбетова Н	10-бала бақша	
5	Бухалинова М	11-бала бақшасы	
6	Абдурасулов Ф	10-дом.ком	
7	Якупов Ш.	5-дом. ком.	
8	Юлдашева Н	2-мактаб	
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LIST OF PARTICIPANT

OF SECOND ROUND OF PUBLIC CONSULTATION ON THE TAKHIATASH POWER PLANT EFFICIENCY IMPROVEMENT PROJECT

TAKHIATASH CITY, APRIL 29, 2013

№	NAME	POSITION	SIGNATURE
1	Kaliyeva Mexriban	# 12 Secondary school	
2	Matniyazov Maxset	Takhiatash TPP	
3	Lukmanova R.	Worker of Kindergarten #9, citizen of Takhiatash city	
4	Babajanova G.	Worker of Kindergarten #9, citizen of Takhiatash city	
5	Yakubov E.	Sanitarian Epidemiological service of Takhiatash city	
6	Ambergenov	Sanitarian Epidemiological service of Takhiatash city	
7	Niyazov	Sanitarian Epidemiological service of Takhiatash city	
8	Berdiev Z.	State Nature Protection Committee	
9	Sedimbetova	Doctor from Takhiatash city polyclinic #1	
10	Atashuradova	Doctor from Takhiatash city polyclinic #1	
11	Bekmuratova	Nurse from Takhiatash city polyclinic #1	
12	Froiova A.	Takhiatash TPP, engineer of environmental laboratory	
13	Matchanov U.	Takhiatash TPP	
14	Yuldashova N.	Secondary school #4	
15	Eshbaeva N.	Secondary school #4	
16	Urinbaeva G.	Doctor from Takhiatash city polyclinic #1	
17	Utepov T.	Energy college of Takhiatash city	
18	Jumamuratova	Khokimiyat of Takhiatash city	
19	Auezimbetova	Khokimiyat of Takhiatash city	
20	Jumaniyazov K.	Energy college of Takhiatash city	
21	Djangabaev A.	Energy college of Takhiatash city	

22	Utemuratova M.	Energy college of Takhiatash city	
23	Khudaybergenova M.	Energy college of Takhiatash city	
24	Tursinbaev A.	Representative of makhalla # 1	
25	Hojonov E.	Energy college of Takhiatash city	
26	Utegenova G.	Representative od Red Cross	
27	Abdullaev A.	Secondary school # 6, teacher	
28	Modreymova G.	Secondary school # 6, teacher	
29	Kutlymuratova P.	Takhiatash TPP, PMU engineer	
30	Dosymbetov M.	Takhiatash TPP, environmental engineer	
31	Saburbaeva G.	Energy college of Takhiatash city	
32	Tajekiv A.	Representative of NGO “Kamolot” (young generation movement)	
33	Kutlimuratova T.	Secondary school #3	
34	Saparova Z.	Takhiatash TPP, water treatment department	
35	Saparbayova T.	Takhiatash TPP, water treatment department	
36	Matniyazova G.	Takhiatash TPP, water treatment department	
37	Halmuratova G.	Takhiatash TPP, water treatment department	
38	Khudaybergenova B.	Takhiatash TPP, water treatment department	
39	Jangabaeva J.	Kindergarten #7	
40	Atajanov R.	Energy college of Takhiatash city	
41	Kadyrov M.	Energy college of Takhiatash city	
42	Khudaybergenova G.	Kindergarten #8	
43	Sapasheva D.	Kindergarten #8	
44	Danaev A.	Representative of makhalla # 2	
45	Nurimbetova N.	Energy college of Takhiatash city	

46	Dauletmuratov P.	Energy college of Takhiatash city	
47	Ishmedova G.	Takhiatash TPP	
48	Saparova Z.	Energy college of Takhiatash city	
49	Yuldashova M.	Kindergarten # 13	
50	Tinekeshova C.	Kindergarten # 13	
51	Ernazarova C.	Kindergarten # 4	
52	Eshimbetova N.	Kindergarten # 10	
53	Abdukhalikov M.	Kindergarten # 11	
54	Абдурасулов Ф.	Representatives of makhalla #10	
55	Yakupov Sh.	Representatives of makhalla #5	
56	Yuldashev N.	Secondary school #2	

Appendix 4. Presentation given during the Public Consultation

Takhiatash Power Plant Efficiency Improvement Project

ADB TA # 8142

Environmental Impact Assessment

"Uzbekenergo"

PPTA Consultants:
GAS NATURAL FENOSA ENGINEERING (GNFE) (Spain) and IKS (Uzbekistan)

Takhiatash 29 April, 2013

Legal Requirements

The most relevant standards taken into consideration for this assessment (the list is not exhaustive):

NATIONAL FRAMEWORK

•**Uzbek Legislation**

Law No.754-XII, 1992 on Nature Protection (states legal, economic, and organizational bases for the conservation of the environment and the rational use of natural resources).
Law No 2000 On Environmental Expertise
Laws of RUz related with environm
Sanitarian Norms and Rules of RU
Sector related guidelinenes

Key environmental legisla
following areas:

- **Air qualit**
- **Water use**
- **Waste management**
- **Soil, subsoil and groundwater**
- **Biodiversity**

INTERNATIONAL FRAMEWORK

•**World Bank, International Finance Corporation**

April 2007 Environmental, Health, and Safety General Guidelines (air emissions and ambient air, quality, energy conservation, wastewater and water quality, water conservation, harzadous materials management, waste management, noise, construction and closing,

ealth, and Safety Guidelines for

2009)

THE MOST STRINGENT REQUIREMENTS HAVE BEEN CONSIDERED FOR THE PROJECT

Legislation Base

Official endorsement from State Nature Protection has been obtained in November 2012 for the Construction of new CCGT.

In accordance with the national Law on "Environmental expertise", a Statement about Environmental Consequences will be prepared during construction phase before commissioning of the new units.

The Project's Benefits

Project implementation will allow:

- cutting operational expenses;
- increasing the efficiency and the reliability of the energy supply to consumers;
- improving the environmental quality in its area of influence

Takhiatash TPP

- Takhiatash TPP is the main power supply source for the Karakalpakstan and Khorezm regions with over **3 million** people
- The power demand outlook is a strong with number of industrial development projects envisaged for the region exceeding currently available capacity
- Takhiatash TPP heats water to supply the consumers in Takhiatash town and for its own needs

Existing situation

Water use ***from***:

- Suenly canal
- Takhiatash water supply system

Water discharged ***into*** the Suenly canal.

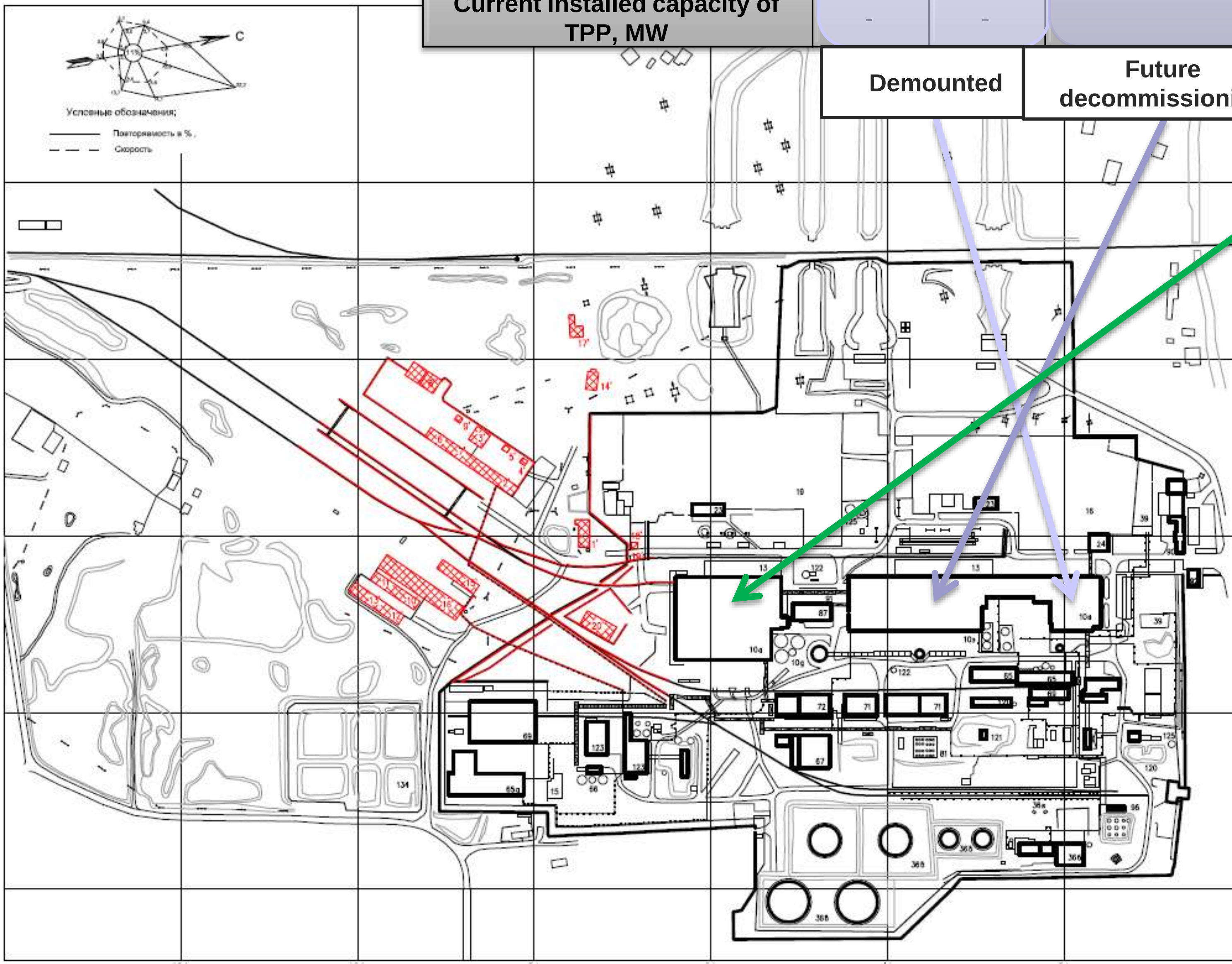
Open cooling water system

Gas supply from ***Bukhara gas deposit***

Current Units

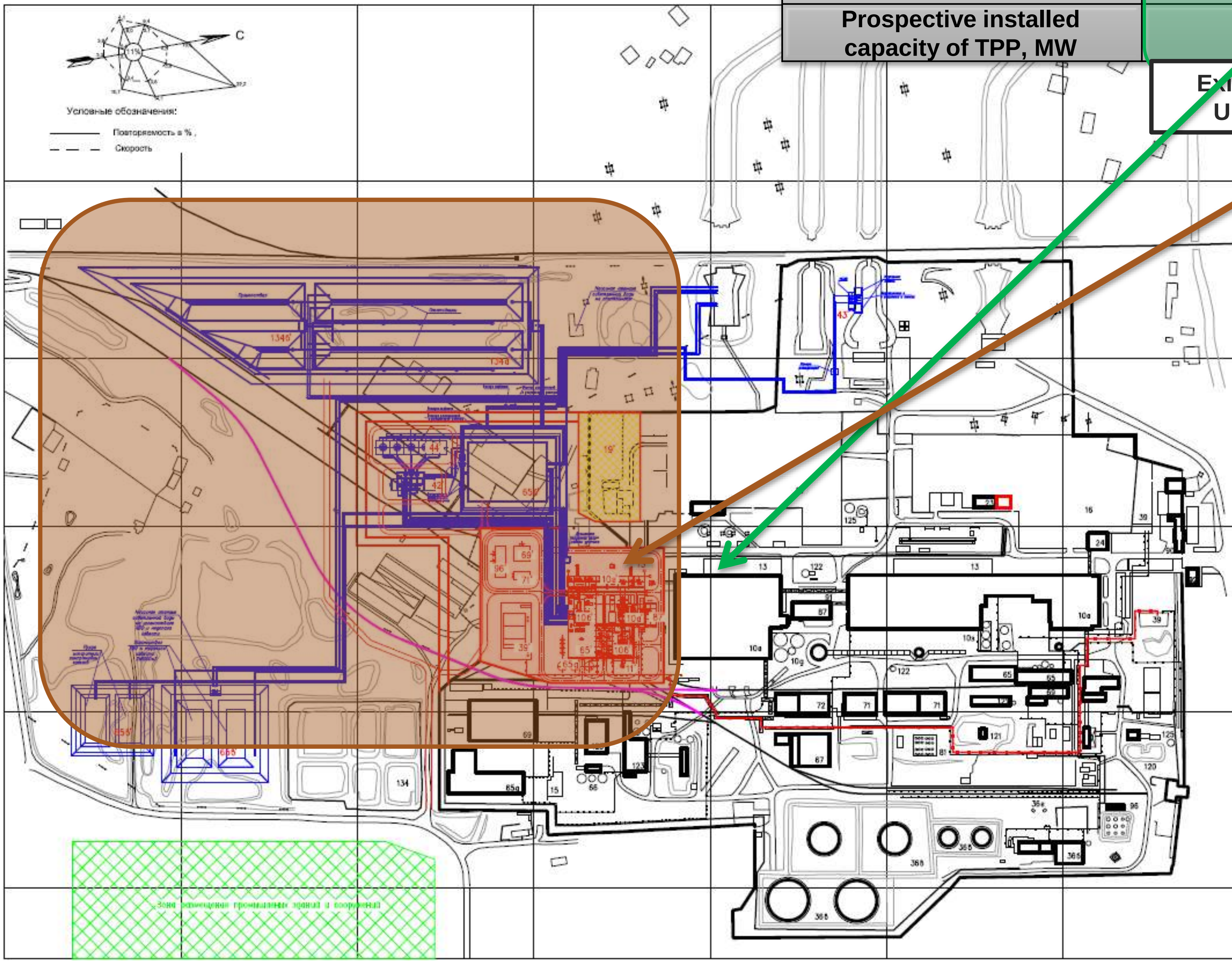
Unit	I	II	III	IV	V	VI
Year of installation	1961	1964	1969	1974	1987	1990
Installed capacity of the line, MW	24	28	200	110	210	210
Current installed capacity of TPP, MW	-	-	730			

Demounted	Future decommissioning	Remaining units



New Takhiatash TPP

Unit	V	VI	CCGTU
Year of installation	1987	1990	2016
Installed capacity of the line, MW	210	210	244.4
Prospective installed capacity of TPP, MW		664.4	
	Existing Units		New Unit



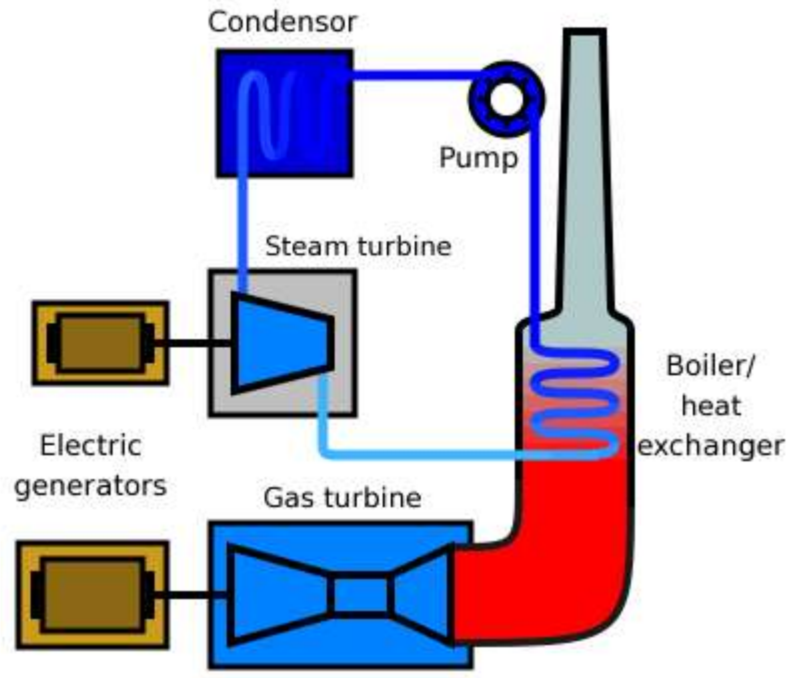
WHAT IS PLANNING TO DO?

At the moment, power and heat production at Takhiatash TPP is based on a conventional steam power technology

It is planning:

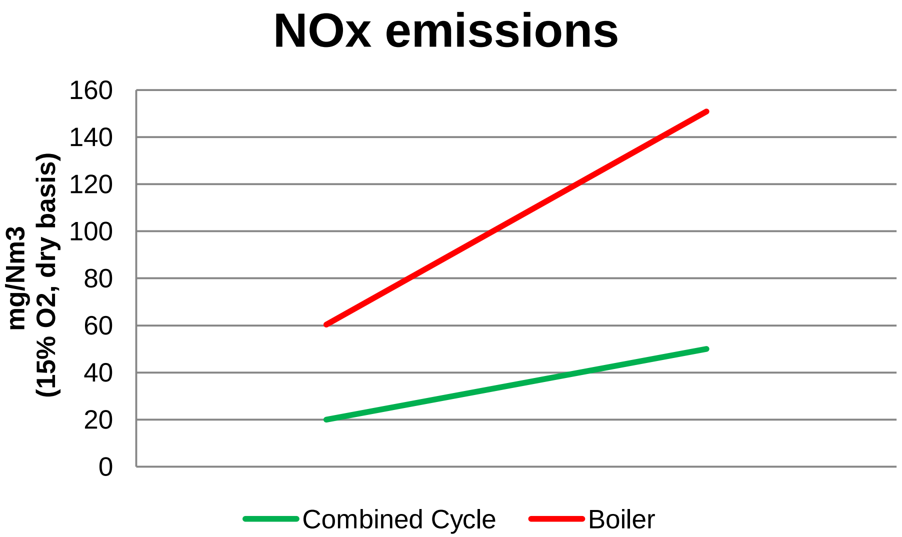
- **to construct** in Takhiatash TPP a CCPU with capacity of **230 - 250 MW** consisting of one gas turbine, one HRSG (heat recovery steam generator) and one steam turbine;
- **to dismantle III and IV units**, with a total installed capacity of **310 MW.**

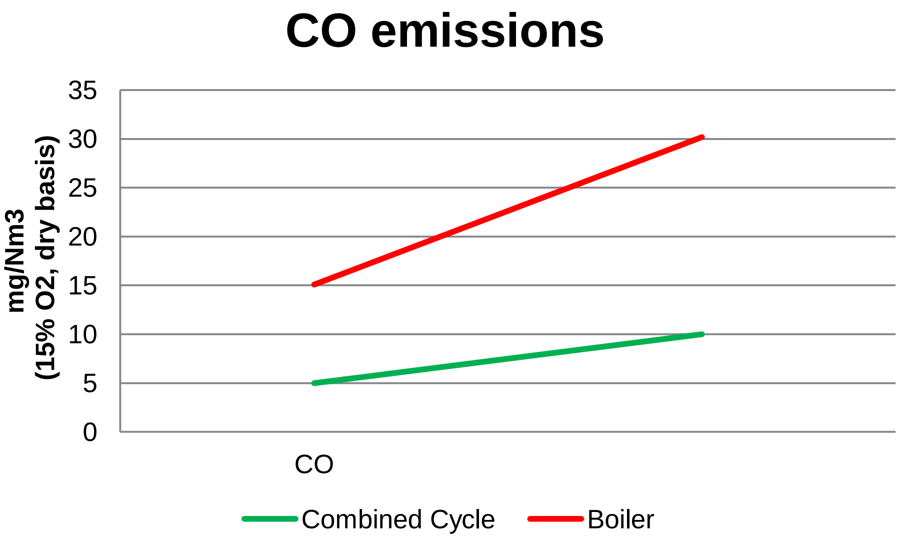
Increasing energy efficiency from **20-30%** to **50-60% (2700 GWh/year to 3600 GWh/year)**

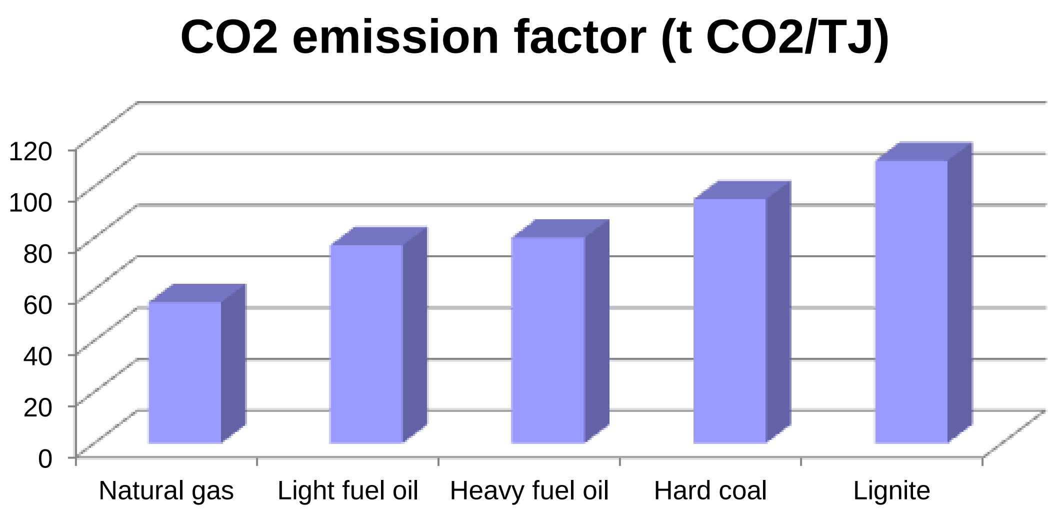


CCPU

- New equipment is the best technology within the fuel combustion power generation technologies (needed to provide base load energy which should not depend on solar or wind resources)

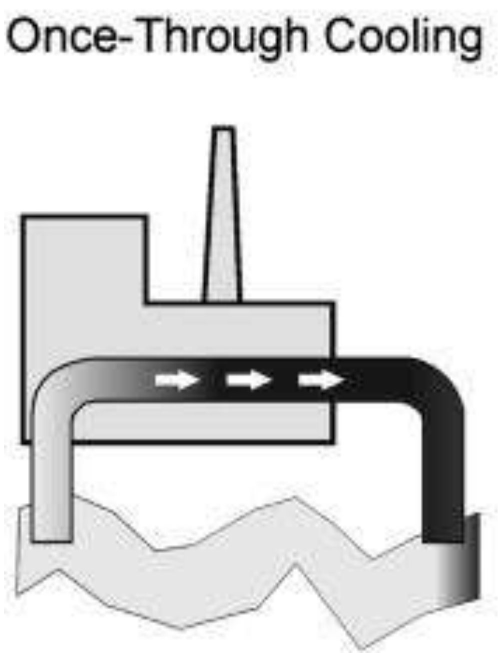




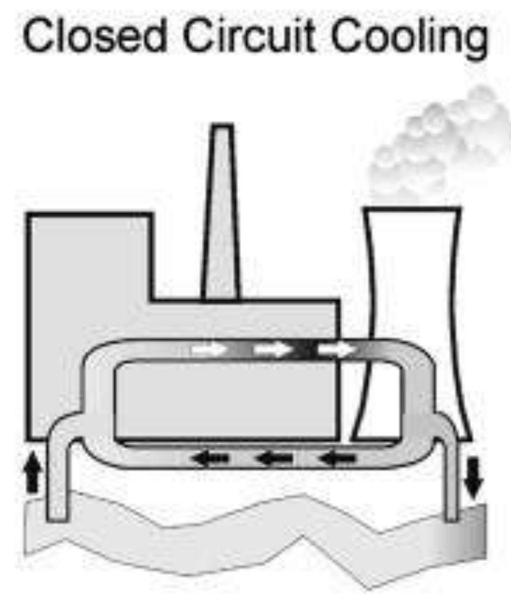


Change from open to closed cooling water system

- Reduction of water intake and discharge to Suenly canal
- Reduction of the thermal discharge



Old units III and IV



New CCPU

PLANNING DESIGN OF NEW FACILITIES LOCATION

Impact on environment

- Construction phase
- Operation phase
- Decommissioning phase

IMPACT IDENTIFICATION MATRIX – WORKS PHASE

PROJECT ACTIVITIES		ENVIRONMENTAL FACTORS														
		NATURAL PHYSICAL SUBSYSTEM								POPULATION AND ACTIVITIES SUBSYSTEM						
		PHYSICAL ENVIRONMENT					BIOTIC ENVIRONMENT		PERCEPTUAL ENVIRONMENT	LAND USE			CULTURE HERITAGE	POPULATION		INFRAST.
		Atmosphere	Geomorphology	Soil	Hydrology / Hydrogeology	Processes	Flora	Fauna	Landscape	Rural	Productive	Nature	Resources	Occupation	Welfare	Infracts.
COMBINED CYCLE CONSTRUCTION	Land and vegetation clearing															
	Earthmoving															
	Trench digging															
	Occupation of land															
	Construction															
	Presence of equipment and stocks															
	Equipment operation															
	Hiring personnel its activity															
	Waste generation															
EXISTING FACILITIES AND DECOMMISSIONING	Earthmoving															
	Decommissioning															
	Presence of equipment and stocks															
	Equipment operation															
	Hiring personnel and its activity															
	Waste generation															

IMPACT IDENTIFICATION MATRIX - OPERATION PHASE

		ENVIRONMENTAL FACTORS																					
PROJECT ACTIVITIES		NATURAL PHYSICAL SUBSYSTEM														POPULATION AND ACTIVITIES SUBSYSTEM							
		PHYSICAL ENVIRONMENT							BIOTIC ENVIRONMENT				PERCEPTUAL ENVIRONMENT		LAND USE			POPULATION					COMM. / INFRASTR.
		Atmosphere			Soil	Hydrology			Flora		Fauna		Landscape		Rural	Product.	Nature Cons.	Occup.		Welfare			Infrast.
		Climate	Noise	Air quality	Soil	Resource	Water quality	Groundwater quality	Natural Vegetation	Anthropic	Fauna	Behavior patterns	Landscape	Visual Intrusion	Agriculture	Industrial Use	Protected land	Employment	Health & Safety	Population welfare	Development of local		Energy infrastructure
CYCLE COMBINED	Flue gas emissions to the atmosphere																						
	Noise emissions																						
	Water consumption																						
	Effluent discharge																						
	Waste generation, transportation & management.																						
	Steam plume from the cooling towers																						
	Physical presence of the Power Plant																						
	Hiring personnel and its activity																						
	Maintenance activities																						

IMPACT DURING CONSTRUCTION/DECOMMISSIONING PHASES

Construction and Decommissioning phases impact assessment summary

IMPACT ASSESSMENT SUMMARY - CONSTRUCTION/DECOMMISSIONING PHASES				
IMPACT	SIGN	NORMALIZED INCIDENCE (BETWEEN 0 AND 1)	MAGNITUDE	FINAL IMPACT VALUE
Potential discrete and local increase in particulate matter suspended in air.	-	INSIGNIFICANT		
Potential degradation of air quality due to exhaust emissions from construction and decommissioning equipment.	-	INSIGNIFICANT		
Potential increase in the noise level of the construction and decommissioning sites	-	0.43	Medium	COMPATIBLE
Potential degradation of the local geomorphology	-	INSIGNIFICANT		
Potential soil compaction	-	INSIGNIFICANT		
Potential increase of suspended solids in water, as a result of construction work	-	INSIGNIFICANT		
Potential soil and water contamination due to improper storage or manipulation of the work materials and/or waste	-	0.57	Medium	MODERATE
Potential contamination of surface water by sanitary water from workers	-	INSIGNIFICANT		
Potential increase of erosion risk due to construction work	-	INSIGNIFICANT		
Potential modification of natural drainage in the work area	-	INSIGNIFICANT		
Potential elimination of vegetation	-	INSIGNIFICANT		
Potential reduction in the total area of fauna habitats in the work area	-	INSIGNIFICANT		
Impact on and potential discomfort to terrestrial fauna	-	INSIGNIFICANT		
Potential modification of landscape during the construction and decommissioning	-	INSIGNIFICANT		
Potential impact on natural areas	-	INSIGNIFICANT		
Potential impacts on agriculture, livestock, etc, which take place in the work area due to changes in land use	-	INSIGNIFICANT		
Potential impact on the historical and archaeological heritage	-	INSIGNIFICANT		
Hiring of personnel and reactivation of the local economy during the construction and decommissioning phase	+	0.50	Medium	---
Potential hazards for the health of the personnel and the population	-	INSIGNIFICANT		
Increase in traffic	-	0.43	Medium	MODERATE
Potential damage to road infrastructure owing to heavy duty construction and decommissioning traffic	-	INSIGNIFICANT		

Construction and decommissioning phases

Point	QUALITATIVE ASSESSMENT	
	Day	Night
P1	Without increase	Without increase
P2	Without increase	Without increase
P3	Without increase	Without increase
P4	Perceptible increase	Two times noisier
P5	Without increase	Without increase
P6	Without increase	Without increase
P7	Perceptible increase	Two times noisier
P8	50% noisier	50% noisier

- <u>Potential increase in the noise level</u>

A noise monitoring campaign was undertaking at 8 points close to TPP

Mitigation measure: heavy equipment during day period

Construction and decommissioning phases

➢Potential soil and water contamination due to improper storage or manipulation of the work materials and/or waste.

Adequate waste management

Safety measures to prevent spillage

MODERATE

➢Increase in traffic.

A management traffic plan will be implemented:

❖**Traffic control: observance of distances between transport vehicles.**

❖**Heavy traffic will be driven through the least sesitive access roads.**

❖**No transport or opertaion of heavy equipment at night.**

❖**Proper registration for the vehicles and heavy equipments, driving licenses, required skills and experience of direvers.**

❖**Speed and load controls.**

❖**Safety awareness campaigns.**

❖**Traffic regulation measures: traffic signals.**

MODERATE

Main existing roads which connect surrounding areas to Takhiatash TPP

OPERATING STAGE

OPERATION PHASE IMPACT ASSESSMENT SUMMARY

IMPACT ASSESSMENT SUMMARY - OPERATION PHASE				
IMPACT	SIGN	NORMALIZED INCIDENCE (BETWEEN 0 AND 1)	MAGNITUDE	FINAL IMPACT VALUE
Greenhouse gases emission reduction by the replacement of an obsolete with an energy efficient technology.	+	1	Low	---
Outdoor air quality improvement due to the emission reduction by the replacement of an obsolete with an energy efficient technology.	+	0.71	Medium	---
Potential increase in noise levels.	-	INSIGNIFICANT		
Potential increase of soil salinity due to the cooling towers steam plume deposition	-	INSIGNIFICANT		
Potential soil and groundwater pollution by accidental spillages or improper waste management.	-	INSIGNIFICANT		
Water resources intake reduction	+	0.5	High	---
Potential effects on water resources due to the increase of water consumed for the new Unit.	-	INSIGNIFICANT		
Potential alteration of the water quality as a consequence of effluent discharge.	-	INSIGNIFICANT		
Potential improvement of the aquatic ecosystems as a consequence of partial replacement of an open cooling water system to a closed one.	+	0.5	Medium	---
Potential impact on the landscape due to the physical presence of the new unit	-	INSIGNIFICANT		
Potential impact on the landscape caused by the cooling water steam plume.	-	0.36	Medium	COMPATIBLE
Potential impact on natural areas.	-	INSIGNIFICANT		
Potential hiring of personnel for operation of the new unit	+	INSIGNIFICANT		
Development of the local and regional economy.	+	0.5	Medium	---
Potential health risk for the operation of the cooling towers	-	INSIGNIFICANT		
Potential hygienic risks for the health and safety of personnel and the surrounding population	-	INSIGNIFICANT		
Increase in installed electrical power	+	0.5	Medium	---

Operating phase

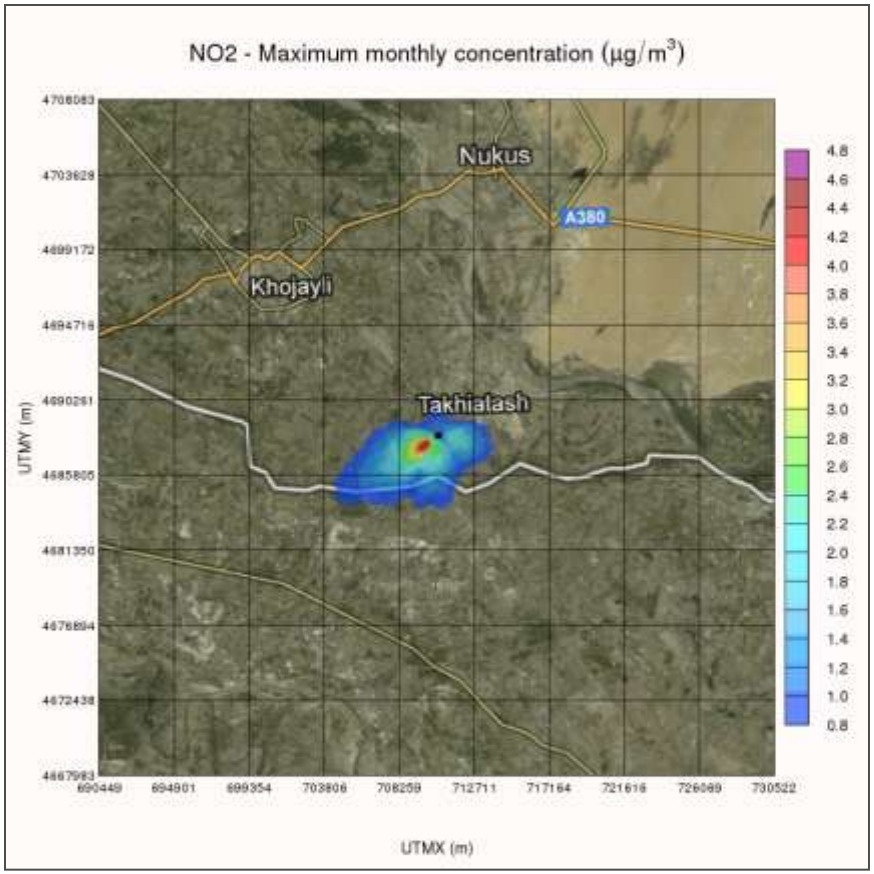
- Ambient air quality improvement
- A special atmospheric dispersion model has been used to analyze air quality impact of the project;
- 2 scenarios have been simulated
  - 1. Current situation
  - 2. Future situation

It was found that all air quality comply with national standards.

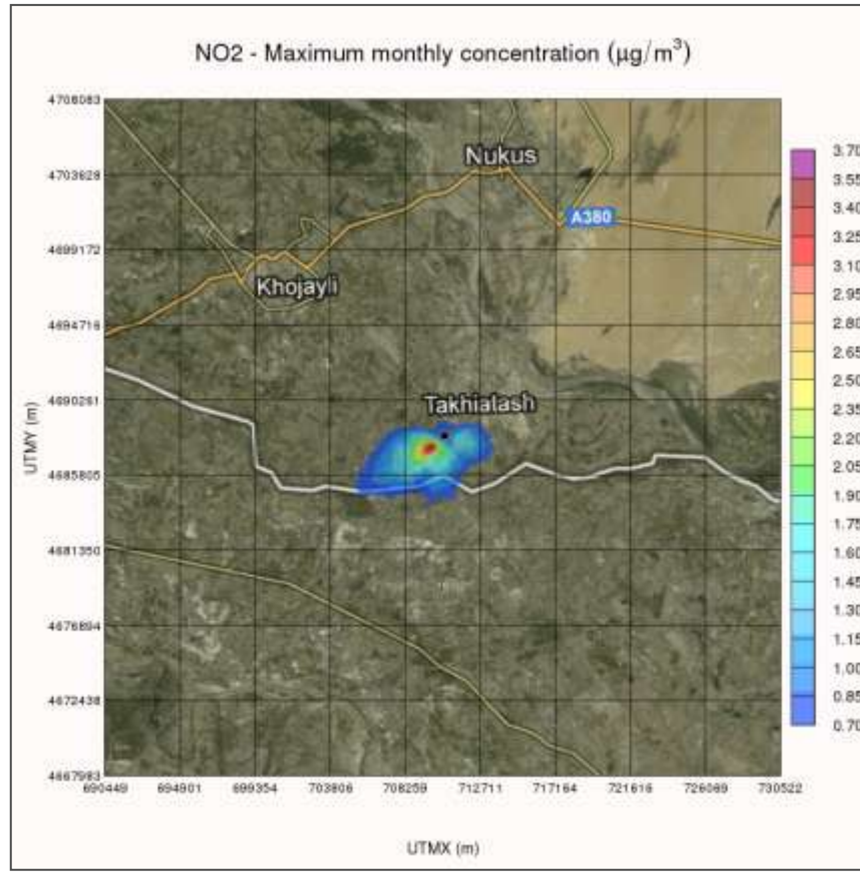
Values for NO_2 ambient air quality are reduced around 40%

Operating phase

➢ <u>Greenhouse gases emission reduction and outdoor air quality improvement.</u>



Current situation



Future situation

Environmental and social benefits from the Project implementation

- reduction of natural gas consumption on 321.4 mln.m^3/year
- 40% reduction of water intake for the cooling water system due to change the type of water use – from open to close water cooling system.
- As a consequence the thermal water discharge into the Suenly canal will also be reduce;
- Improving condition of aquatic ecosystem;
- 30% reduction of CO_2 (greenhouse gas) to the atmosphere, which will contributes to climate change mitigation
- 30% reduction of NOx emitted to the atmosphere
- As a consequence 40% reduction of NO_2 an ambient air quality
- Expected decreasing of noise level
- Decrease of accidental risk by means of using Automatic Control System;
- Promote industrial development projects envisaged for the region; Consequently this will promote socio-economic development
- Increasing workforce demand during the construction phase

ENVIRONMENTAL MANAGEMENT PLAN

PMU'S ORGANIZATIONAL STRUCTURE

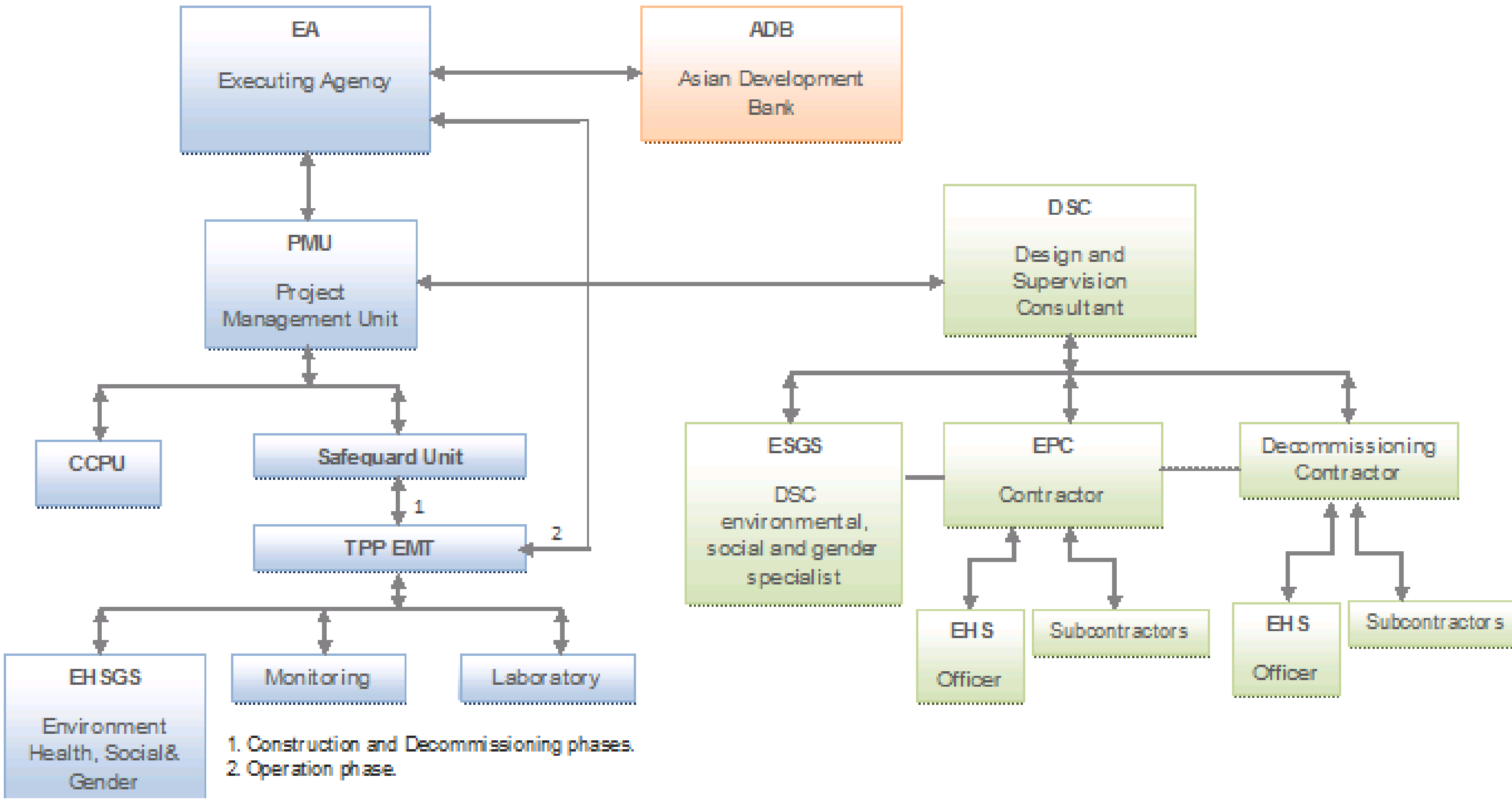


Figure 7.2. Organization of the PMU.

MITIGATION MEASURES

- The required preventive and corrective measures are intended to prevent, reduce or compensate as far as possible, adverse effects.

- The measures were developed during the design, construction, operation phases of the new CCPU and decommissioning phase of the old units III and IV according to the time of their application. In the Environonmental Management Plan (delivered in this public consultation) 58 mitigation measures have been included.

MONITORING AND REPORTING PROGRAM

Takhiatash TPP ***current*** monitoring program

- Annual amount of emissions discharged into the atmosphere;
- Water use and effluents - flow rates and water quality at the intake and discharge point;
- Groundwater quality;
- Annual amount of disposed hazardous and non hazardous wastes;
- Annual financial report on environmental taxes.

Goskompriroda conducts monitoring of:

- Monthly air emissions samples of exhausted gases from TPP and analysis;
- Soil analysis two times per year at the places, which have been defined as a potentially polluted.

EXISTING REPORTING SYSTEM

Takhiatash TPP provides two types of report:

- Emissions reports:
  - State Nature Committee of Republic of Karakalpakstan;
  - State Statistical Committee of Republic of Karakalpakstan;
- Water us and water discharge:
  - Low Amudarya Irrigation System Authority (responsible for surface water management under the Ministry of agriculture and water resources management).
  - State Nature Protection Committee of Republic of Karakalpakstan
  - “Vodocanal” of Takhiatash city– responsible for drinking water suply and communal sewage water collection and treatment).
  - Environemntal department of the SJC “Uzbekenergo”

PLANNING REPORTING

- In addition to existing reporting system reports will be prepared on the following aspects:
  - Significant impacts on environment.
  - Monitoring of greenhouse gases emission
  - Monitoring of air quality: complying with established requirements
  - Monitoring of water quality : discharges
  - Monitoring of ground water
  - Management of wastes collecting and disposal
  - Monitoring of noise level
  - Monitoring of health and work safety issues

Conclusion

1. Combine cycle technology using natural gas is the cleanest of the fuel combustion power technology
2. The project will decrease consumption and emissions improving the environmental quality in its area of influents
3. Increase the efficiency and the realibility of the energy supply to consumers and industrial development projects of the area.

1st public consultation (18 april 2013)

- Questions and answers included in the EIA

Main issues:

- 1.- Will the new unit impact on the quality of water into the Suenly canal?:

  The replacement of the old units with the new CCPU will not change water quality of Suenly canal. In any case, thermal effluent will be reduced.

- 2.- Which is the impact on the TPP as source of employment for our graduated students?:

  Uzbekenergo employment policy regarding graduated students will not change with the new project. Takhiatash TPP has an agreement with the energy college to provide practice training to students during the summer season and this policy will continue on going.

- 3.- What is going to be done with the staff working on old Units after decommissioning?:

  There is a special training program within the project to update these people in order them to work at the new CCPU. Dismissal of current workers is not expected as they will be moved from the old to the new units.

INFORMATION DISCLOSURE

- EIS will be available:

1.-Hardcopy Russian version at the TPP medical service (200 meters outside the TPP entrance)

2.- Electronic copy Russian version at the Uzbekenergo webpage.

3.- Electronic copy English version at the ADB webpage

GRIEVANCE REDRESS MECHANISM

- The following facilities will be provided for the lodging of complaints:
  - Complaint receptacle at the TPP medical service (200 meters outside of the entrance).
  - Public consultation events.

- Complaints received will be logged and forwarded as soon as possible.

- Complaints will be reviewed, investigated, recorded and responded with the actions arising .

- The complainant can ask for reconsideration by a higher authority if not happy with the outcome or not answered back

The organizational structure for the grievance resolution is as follows:

- 1st level: Takhiatash TPP

  Responsible person: Kutlimuradov Pulat,engineer of PIU:

  - Address: Republic of Karakalpakstan, Takhiatash, Takhiatash TPP, post office № 1 TPP
  - Telephone: +998982796871
  - Email: piu_tps@mail.ru

- 2nd level: Uzbekenergo

  Responsible person: Abdullaev Nurulla, PIU manager:

  - Address: 6, Istiqlol str. Tashkent, PIU “Takhiatash TPP”,
  - Telephone: 83712363452
  - Email: piu_tps@mail.ru

- 3rd level: ADB

  www.adb.org

REPORTING TO THE POPULLATION

- Environmental reports will be available for public during the life of the project.
- The procedure will be implement in the same way as grievance mechanism

  (at the TPP medical service, 200 meters outside of the TPP gate)

CONTACT DETAILS

1. Republic of Karakalpakstan, Takhiatash, Takhiatash TPP, post office № 1 TPP ***Kutlimuradov Pulat,***engineer of PIU

Telephone: +998982796871

Email: piu_tps@mail.ru

2. 6, Istiqlol str. Tashkent, PIU “Takhiatash TPP”, ***Abdullaev Nurulla***, PIU manager:

Telephone: 83712363452

Email: piu_tps@mail.ru

THANK YOU FOR ATTENTION!!

Appendix 5. Public Consultations photographic report

1st PUBLIC CONSULTATION:

General view of the public

Representative of local makhalla

TPP's worker

Representative of NGO

2nd PUBLIC CONSULTATION:

 General view of the public	 Representative of the State Protection Committee of the Republic Karakalpakstan
 Student	 Representative of local makhalla

	
Secondary school teacher	TPP worker and resident of a community close to the TPP

Appendix 6. Grievance Mechanism Register Logbook

<table>
<tr><td colspan="2"># Register:</td></tr>
<tr><td>Name:</td><td>Surname:</td></tr>
<tr><td>Organization:</td><td>Address:</td></tr>
<tr><td>Tel:</td><td>Fax:</td></tr>
<tr><td colspan="2">Email:</td></tr>
<tr><td colspan="2">Comment / Complaint:</td></tr>
<tr><td colspan="2">Takhiatash person in charge:</td></tr>
<tr><td>Date:</td><td>Stamp:</td></tr>
</table>

<table>
<tr><td colspan="2"># Register:</td></tr>
<tr><td>Name:</td><td>Surname:</td></tr>
<tr><td colspan="2">Responsible persons:

Kutlimuradov Pulat, engineer of PIU:
☐ Address: Republic of Karakalpakstan, Takhiatash, Takhiatash TPP, post office № 1 TPP
☐ Telephone: +998982796871
☐ Email: piu_tps@mail.ru

Responsible person: Abdullaev Nurulla, PIU manager:
☐ Address: 6, Istiqlol str. Tashkent, PIU “Takhiatash TPP”,
☐ Telephone: 83712363452
☐ Email: piu_tps@mail.ru</td></tr>
<tr><td colspan="2">Takhiatash person in charge:</td></tr>
<tr><td>Date:</td><td>Stamp:</td></tr>
</table>

ANNEX X: ENVIRONMENTAL AUDIT REPORT

Table of contents

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1. Executive Summary

The aim of this environmental audit report is to determine the degree to which the existing units of Takhiatash TPP currently in operation are meeting the stipulated national environmental requirements as well as the ADB's Safeguard and World Bank Group Environmental, Health and Safety Guidelines. The aim is to determine the nature and extent of all environmental areas of concern.

The audit visit took place between 17th and 18th January 2013 at the Takhiatash Thermal Power Plant (Uzbekistan).

This report has been developed according to the standards on format described in "Appendix 1 Safeguards Requirements 1: Environment" of the ADB's Safeguard Policy Statement (June 2009) and Annex A "Background on accepted international practice in conducting and compiling environmental audit reports, references and links to examples" of IFC Guidance note 1 "Assessment and management of environmental and social risks and impacts" (January 2012).

As a result of the audit carried out, it is concluded that the operation of the existing units of Takhiatash TPP exceeds some international standards (World Bank Group EHS guidelines) regarding emissions, thermal discharge of effluents, noise levels and waste management. This is a logical conclusion, given the worn out and old existing equipment currently operating at the TPP. In this case, suitable mitigation measures such as the implementation of cleaner and more efficient technologies is highly advisable. According to this strategy, the replacement of old and inefficient units by new and more efficient ones will reduce the emission of pollutants and GHG to the air improving air quality of the area and globally, will reduce the intake and discharge flue rate improving thermal effluent dispersion in the water body, will reduce the consumption of natural gas, etc. A global decrease in noise level would be also expected.

It has been found that the adequacy of the documentation and operation of the Takhiatash TPP EHS management to the requirements of the World Bank Guidelines need to be strengthened. Certain aspects of the procedures should be modified and new ones need to be developed, as indicated in the tables included in Chapter 6 (Corrective Action Plan), in order to improve the compliance with international requirements.

The corrective action plan must be taken into account as a set of recommendations to improve environmental performance of the Takhiatash TPP in order to achieve, step by step, an EHS management system at the level required by international institutions and good practices. It should be pointed out that this Corrective Action Plan should be agreed and budgeted by the TPP management unit if decided to be implemented. Actions that just imply a management improvement could be put in place as soon as possible taking advantage of the good disposition of the TakhiatashTPP staff.

2. Facilities description

The site of existing Takhiatash TPP is located in the city of Takhiatash, 3 km to the south-west of the city centre, on the left bank of Amudarya river. It occupies the central part of the Republic of Karakalpakstan (Khodjeyliy region), located in north-western Uzbekistan. The capital city of the Republic, Nukus, is located 20 km from the north of TPP industrial site

Figure 1. Location of the surrounding inhabited areas

Figure 2. Location of the TPP, Takhiatash city, Amudarya River and the intake and discharge points at Suenly canal

Figure 3. Aerial photograph of the existing Takhiatash TPP

The structure of the Takhiatash TPP's working team is shown in the following organizational chart.

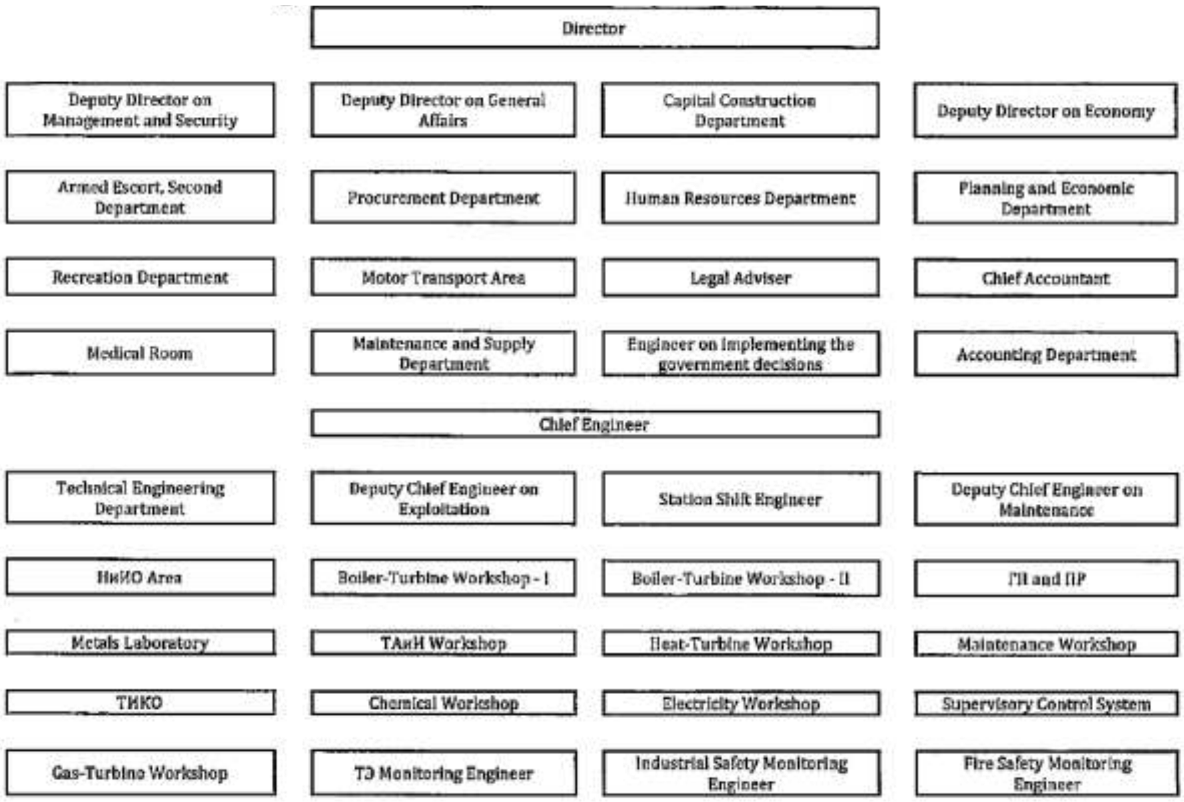


Figure 4. Takhiatash TPP organizational chart

At present, the number of employees of Takhiatash TPP amounts to 1082 people. This figure is broken down in the following table:

Table 1. Number of employees at Takhiatash TPP on 07.01.2012

No	Name	Number or employees
1	Total	1082
	Out of this:	
2	Administrative and managerial staff	39
3	Industrial and production personnel, including	935
3.1.	Managers	110

No	Name	Number or employees
3.2.	Specialist	65
3.3.	Employees	6
3.4.	Workers	754
4	Non-industry personnel, including	108
4.1.	Managers	6
4.2.	Specialist	6
4.3.	Employees	0
4.4.	Workers	83
4.5	Home-based work	13

The existing plant currently consists of four power generation units (III-IV-V-VI) with a total installed capacity of 730 MW. It also comprises a heating water converter plant to supply not only the TPP's own hot water requirements but also Takhiatash city.

III and IV units include six drum boilers of two different types (No. 1-4 are TGM-151 model and No. 5-6 are TGM-151-B). The steam pipeline scheme provides parallel operation for the boilers No.1-6. all of the boilers are designed to burn both natural gas and mazut.

Exhaust gases from boilers No. 1-4 are discharged into the atmosphere through the 80 m high stack whereas gases from boilers No. 5-6 are discharged through the 150 m high stack.

Unit III includes two steam turbines with capacity of 100 MW each and Unit IV includes one steam turbine with capacity of 110 MW.

V and VI units include two drum boilers with natural circulation, designed to burn both natural gas and mazut.

Exhaust gases from boilers No. 7-8 are discharged into the atmosphere through the 150 m high stack.

V and VI units include two steam turbines (K-215-130) with a capacity of 210 MW.

Table 2. Table. Main equipment of the TPP's power island

<table>
<tr><th>Units</th><th colspan="6">III & IV</th><th colspan="2">V & VI</th></tr>
<tr><td>Capacity</td><td colspan="6">(100 + 100 + 110) = 310 MW</td><td colspan="2">(210 + 210) = 420 MW</td></tr>
<tr><td rowspan="2">Boilers</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td></tr>
<tr><td colspan="4">TGM-151
220 t/h; 110 kgf/cm2; 540°C
12 gas and oil burners frontal located</td><td colspan="2">TGM-151-B
220 t/h; 110 kgf/cm2; 540°C
4 gas and oil burners frontal located</td><td colspan="2">TGME-206
670 t/h; 140 kgf/cm2; 545°C
12 gas and oil burners located into the 2 tiers at the back panel</td></tr>
<tr><td>Stack</td><td colspan="4">80 m</td><td colspan="4">150 m</td></tr>
<tr><td>Turbines</td><td colspan="6">3 steam turbines
(K-100-90)
- Condensing type
- Single-shaft
- HP and LP
90 kgf/cm2; 535°C</td><td colspan="2">2 steam turbines
(K-215-130)
- Condensing type
- Single-shaft
- HP, IP and LP
130 kgf/cm2; 540°C</td></tr>
</table>

The different facilities of the plant are explained in detail below.

2.1. Fuel system facilities

The main fuel for Takhiatash TPP is natural gas from Bukhara deposit. Natural gas from the GDP (Gas distribution plant) comes to two GDS (Gas distribution stations) through two aerial pipelines. The GDP is located 2 km away from the TPP.

Mazut, a type of residual black oil (type M-40), from Fergana and Bukhara oil refineries is used as back-up fuel. Mazut is stored for a power generation capacity of 15 days as there is a power supply guaranty to fulfill. Nevertheless, Mazut has not been used since 2004.

Fuel oil facilities consist of a mazut pumping station and a mazut storage with an overall capacity of 250,000 m^3: This storage comprises 6 metal tanks within the TPP terrains, with a capacity of 50,000 m^3 ((2 x 3,000 m^3) + (2 x 10,000 m^3) + (2 x 12,000 m^3)), which have a compacted soil/concrete secondary containment wall in order to prevent any fuel oil spreading. There is also a mazut storage 35 km away from the TPP whose capacity amounts to 200,000 m^3 (20 x 10,000 m^3). The location of this storage is shown in **Error! Reference source not found.**.

Fuel oil transportation from receiver tanks to reservoirs and from there to the boiler units is carried out in a closed circuit to prevent overflowing.

Figure 5. Location of mazut storage in reference to Takhiatash TPP

This mazut storage has been designed in 4 groups with 5 tanks per group. Every one of the tanks has a capacity of 10,000 m^3 (60m x 40m basement x 5m depth). Tanks and groups are constructed in concrete (walls, basement and roof) over the ground. The layout of the mazut storage can be observed in the following picture.

Figure 6. Layout of mazut storage

Mazut is transported in and out of the storage site in cisterns on the railway (visible at the south of the above picture). Currently, a layer of 20-40 cm of mazut remains in all of the 20 tanks but maintenance operations are being undertaken in order to clean it. This residual mazut is being transported to Taskent.

 View of one of the groups constructed over the ground.	 Top view of one of the groups. As it can be observed, the construction material of the roof (as well as the rest of the cube) is concrete. Steam and mazut distribution pipes are disposed along the ceiling of the groups.
 Interior view of one of the tanks from the top. A layer of residual mazut can be observed.	 Cisterns on the railway are being filled with residual mazut to be transported to Taskent by train.

2.2. Water supply and water treatment systems

The water supply source for the existing units of the TPP is Suenly canal, which is fed by Amudarya river.

Raw water from Suenly canal is used for production needs of the TPP. The raw water quality is characterized by a high content of suspended solids, mineralization, chloride ions, sulphates and oil products. Water is treated in the Water Treatment Plant (WTP) for conditioning, previously to its use in the process. Water treatment process consists of the following stages:

- **Clarification**

Raw water enters the clarification tanks and is treated with lime milk, coagulant and polyacrylamide by partial decarbonization and coagulation for the removal of suspended solids. Clarified water is then sent to mechanical filtration.

- **Mechanical filtration**

Clarified water is driven to the mechanical filters where a complete removal of suspended solids takes place. Mechanical filters are divided into two units, four filters in each block.

- **Decarbonization**

After mechanical filters, water is led to the calcinators, where the removal of dissolved carbon dioxide takes place. Decarbonized water is collected into tanks.

- **Na-cation filtration**

Decarbonized water is treated in Na-cation filters, where a complete softening takes place, and from there it is conducted to the chemically treated water tanks.

The poor quality of the raw water, reflected in its high indicators of turbidity and its high content of suspended matter, mineral salts and hardness salts, requires the consumption of high volumes of chemicals and a reliable operation of the water make-up filters.

The chemical unit provides the necessary chemical reagents for water treatment, and comprises:

- Salt: 4 working pits of salt and salt solution tanks.
- Liming: Unit for preparation of lime milk.
- Coagulation: Unit for preparation of coagulant.

The result of the water treatment is the reduction of hardness (from 11 to 2) by salt consumption.

The chemically treated water, stored in tanks, is led to the evaporation units. Replenishment of steam losses and condensate of high pressure is made by the distillate product of the evaporation units.

The conservation of the water in the boilers' circuit consists in a correction of the make-up water with hydrazine, ammonium and tri-sodium phosphate. The objective is to prevent problems of corrosion of the components due to scale deposits, impurities, etc.

2.3. Cooling water system

Water from Suenly canal is also used for the cooling water system. The TPP currently operates with an open once-through cooling system. This means that intake water from the canal passes through the condenser and, after the heat exchange, warm water is directly discharged back to the canal. Apart from the thermal increase, discharge water characteristics are practically the same as at the intake point.

2.4. Drinking water system

Drinking water for consumption of the TPP's personnel is supplied from the local pipeline system of Takhiatash city.

Drinking water is fed for consumption of plant personnel and service water is also used for sanitary needs (showers, eye washers, toilets…).

2.5. Heating water system

Heating water converter plant is designed for covering part of the Takhiatash city heating needs, as well as heating administrative, residential and industrial buildings of Takhiastash TPP. The water is heated in boilers as heating system water: 400 t/h in boilers πCB200-7-15 and 250 t/h in boiler πCB125-7-15. The water temperature at inlet/outlet is 70/150ºC.

Water is fed to the atmospheric deaerator in order to remove the oxygen and feed water is chemically softened in the water treatment plant.

2.6. Effluents treatment system

Description of the treatment systems of the effluents generated in the TPP is presented in the following paragraphs. Depending on their nature, the effluents are subjected to various types of processing:

- **Oily and acid effluents**

These effluents are conducted for treatment to the Purification Complex of Industrial waste water. This complex includes 2 facilities to treat industrial waste water: Greasy/oily treatment system and acid waste water neutralization system:

- **Acid waste water neutralization system.** These chemically contaminated effluents contain effluents resulting after washing regenerative air heater and acid washes of boilers. Acid waste water (up to 800 m^3) is directed to the acid waste water neutralization unit. Acid solution is neutralized by lime water and up to pH 9.5-10. The neutralized effluent is discharged into evaporation sludge ponds identified as nº 5 and nº 6. Currently, sludge pond nº 5 is not being used (see picture below).
- **Oily/greasy treatment system.** The oily effluents are water flows from areas that may have been contaminated by oils and greases such as fuel-oil handling system, open oil warehouse, blowdowns from boiler and turbine units, cooling water coolers, cooling of bearings and seals of the rotating machinery, etc. Oily waste water is directed to the oily water treatment system, with capacity of 50 t/h.

  Oily/greasy waste water goes through several stages of the treatment. Firstly, waste water is collected into the receiving tanks, where the largest oil fractions ascend to the surface of water due to the sedimentation process. Initially pre-cleaned water goes to an oil remover for cleaning from emulsified oil and mechanical impurities. Partly-cleaned water is conducted to an intermediate reservoir of pressure flotation. After flotation stage, cleaned water is directed to two filtration processes. In the first stage water is treated on the mechanical filter filled with anthracite. In the second stage water is cleaned in the coal or claydite filters.

Treated effluent is returned to the Water Treatment Plant and oily residue is discharged into the evaporation sludge ponds identified as nº 1 and nº 2. Currently, sludge pond nº 2 is not being used (see picture below).

- **Cooling System discharge**

As previously mentioned, the cooling system is an open circuit type and therefore requires water supply from Suenly canal. After being used for cooling purposes in the condenser, cooling water increases its temperature and is discharged into Suenly canal. Cooling system is once-through therefore the volume of water intake is almost equal to the volume of water discharge.

Raw water from intake canal is characterized by a high content of suspended solids and mineralization, including chloride ions, sulphates and oil products. Quality of discharged water is almost the same as initial water and main pollution is thermal, with an increase in temperature of 8-10 ºC. Effluent from cooling system does not contain neither poisonous nor toxic matters.

- **Sewage effluents**

Sanitary sewage is discharged into the sewage collector, which is connected with the municipal sewage network. Municipal network ends up in the Takhiatash city municipal waste water treatment plant (WWTP). Takhiatash municipal sewage system is based on biological treatment.

- **Water treatment plant (WTP) effluents**

Blown water from clarification tanks and non-used water from the regeneration of the Water Treatment Plant are effluents that contain small amounts of salts. These effluents are discharged into the municipal sewage network because they do not contain neither hazardous nor toxic components. These effluents are sent to the Takhiatash city municipal waste water treatment plant (WWTP).

Sludge from the liming section of the Water Treatment Plant is conducted to the evaporation sludge ponds, identified as nº 3 and nº 4 (see picture below). This sludge is formed by incompletely burned lime.

Figure 7. Evaporation ponds at Takhiatash TPP

All the sludge disposal sites are non-filterable with impervious screens at the bottom and sides in the form of poured asphalt of 20mm width. Tiling construction – concrete lining - 30 mm, poured asphalt –20 mm, reinforced concrete protective lining of 120 mm made of Portland cement concrete. Ground area of the sludge disposal site is treated with herbicides.

The calculated area of evaporation is 3,300 m^2. The total evaporation of flows is ensured. The capacity of the sludge collector is 1,700 m^3. Currently, sludge tanks are 1/3 full.

On a regular base, lime wastes are delivered to the specialized building organizations. According to the TPP's statistical data, the whole amount of accumulated wastes is 84 tons, 0.065 tons of them are of III toxic class of hazard[3] (oil sludge).

2.7. Waste management system

At the present, Takhiatash TPP waste management is organized as follows:

a) Reused:

- Used asbestos and thermo isolation materials are temporary collected at the open site with concrete covering and reused for boilers clothing during 30 days.
- Waste oil:

[3] SanR&N – 0128-02 29.07.02 – Hygienic classifier of industrial hazardous waste and SanR&N – 0127-02 29.07.02 – Sanitary procedures for industrial waste inventory, classification, storage and disposal (see point 3.1.4.2. C of chapter 2 of the EIA)

- Waste engine oil shall be temporarily stored in a metal container with 0.2 m^3 capacity and reused as a lubricant for lifting and rotating mechanisms as needed for no more than 180 days. The remaining volume shall be transported to the oil storage on a quarterly basis.
- Waste transformer oil shall be temporarily stored in a metal container, and within 30 days regenerated and re-used or delivered to the oil storage.
- Waste turbine-oil shall be temporarily stored in metal containers and within 180 days, regenerated and re-used as designated or delivered to the oil storage.

- Waste cationite – part of it shall be used as an additive for other filters
- Electrolyte from batteries shall be reused for other batteries

b) Recycled:

- Iron and metal debris are temporary collected in an open space until 30 days. Stubs are collected into metal pails located next to the each welding equipment. Waste battery cases and lead plates shall be temporarily stored in the charging room without destroying. All the previous wastes are delivered to “Vtorchermet” enterprise.
- Wood debris is collected into bags and sold to inhabitants.
- Waste rubber and tires are stored in metal containers and shall be delivered to “Artur LLC” enterprise.
- Waste paper shall be temporarily stored and within 182 days shall be delivered to “Vtorsyrye” enterprise.
- Blown LB-40 fluorescent lights shall be temporarily stored in a special storage room, in boxes, and within 182 days shall be delivered to a specialized organization on lamp utilization. This procedure fulfills the Cabinet of Ministers’ Decree No 266 from 21.09.2011 “On approval of the collection and disposal of used mercury-containing lamps”.

c) Recover:

- Oily rags, used anthracite and wood debris shall be temporarily stored and burned in boiler furnaces.

d) Treat and dispose:

- Solid sediment and unconsumed lime sludge, black oil and oily effluents and neutralized effluents are sent to evaporation ponds.
- Certain fuel oil residues shall be temporarily stored in metal containers and within 30 days shall be delivered to the oil storage. Once there is enough quantity, all the oily wastes stored in the oil storage are sent to a final oil base storage place.
- Insoluble salt residue, incompletely burned lime, waste cationite (cation exchange resin), used anthracite, waste paronite, oil sludge from the evaporation ponds and domestic waste shall be temporarily stored and then transported to the municipal landfill.

Places for temporary and permanent storage of wastes are presented in the following picture.

Figure 8. Places for temporarily and permanent storage wastes

Legend:

1. Ferrous scrap metal
2. Non-ferrous scrap metal
3. Insoluble residual of salt
4. Luminescent lumps
7. Battery
8. Tires
9. Used engine oil
10. Communal wastes
11. Insoluble residue of lime
12. Thermo-isolated material
13. Oiled sludge
14. Rags

2.8. Health and safety management

Health and safety issues at the TPP are regulated by the official document approved by Uzbek State Agency on monitoring in energy sector “Uzgosenergonadzor” “Order on approval rules of organizing works with personnel at the enterprises of energy sector“. This document is reviewed every 5 years by “Uzgosenergonadzor” and re-approved every year by Takhiatash TPP’s director and the head of department of Emergency Situation of Takhiatash city. The annual approval is needed to include any new regulation that may arise during that period.

This document consists of 13 chapters which provide data and describe the organizing of the following activities:

1. General regulations
2. Organizational requirements
3. Preparation for new positions (New Task Employee)
4. Probation period
5. Checking knowledge
6. Duplication
7. Work permit
8. Orientation on work safety, technical operating and fire safety
9. Anti-damage tests and anti-fire trainings
10. Special trainings
11. Professional development
12. Observation of personnel work places
13. Team working with personnel.

The occupational health and safety structure of the TPP is presented at the following figure:

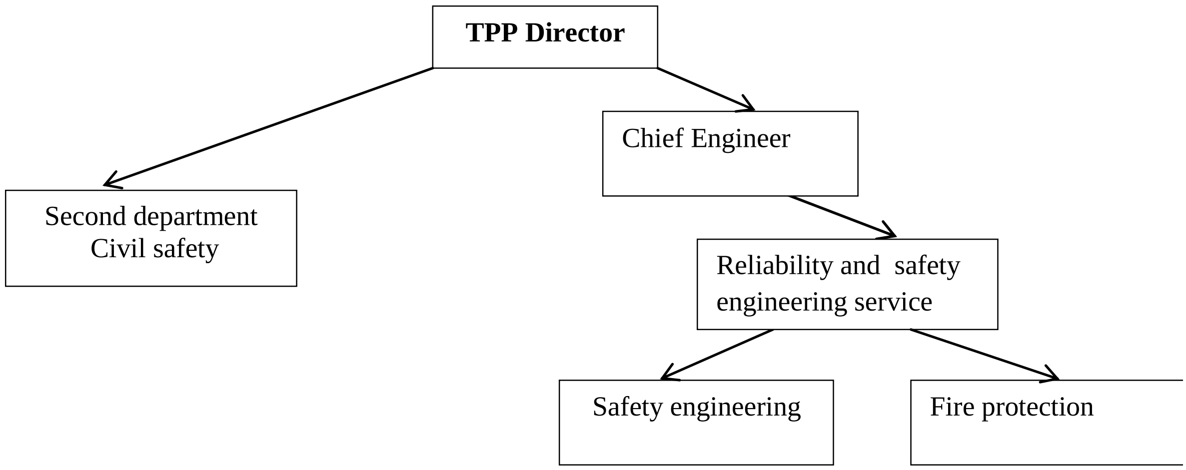


Figure 9. Occupational health and safety structure at the TPP

TPP Director is responsible for the performance of H&S works. There are three main departments working on these issues: safety engineering, fire protection and civil safety. The safety engineering department organizes and implements works on safety activities at the TPP. The fire protection department is responsible for fire protection at the TPP. Civil safety department is responsible for the activities in emergency situations. This department is responsible for personnel activity in case of anthropogenic and natural disasters (earthquakes, hurricanes, flooding). Every department prepares an Action Plan for the whole year. Usually the action plans cover the following topics:

- Number of planned trainings
- Number of people planned to be involved in trainings.

- Other planning activities, such as work safety days and etc.

Safety engineering department submits reports on their activity in a quarterly basis, civil safety department annually and fire protection department every two years.

Reports normally include information on the number of trainings conducted and their number of participants, the results of the observations of work places, the implementation of recommendations provided by external checking organizations or by the main office of Uzbekenergo, number and description of accidents occurred during the reporting period, etc.

3. Summary of national, local and any other applicable environmental laws, regulations and standards

In Uzbekistan, environmental permits given to industrial installations include emission limit values that are developed separately for ambient air, water bodies and waste. Emission limit values are approved by the SCNP on the basis of the SEE.

The terms and procedures for reviewing and approving emission limit values for substances emitted into the ambient air and water bodies, as well as waste disposal limits, are determined in compliance with the requirements of SEE procedures and by the allocation of competences on the approval of emission limit values by the SCNP Department for State Ecological Expertise for the TPP. Waste disposal limits are approved for five years, and the standards of emission limit values and discharge limit values for substances emitted into water bodies are approved for three years.

Emission permits are not based on an integrated approach to pollution prevention and control. Calculations of the standards of emissions discharged into air, water bodies and disposable wastes are based on different approaches. Standards are approved for different environmental areas and two different departments of the SCNP exercise control over their compliance (the Department for Air Protection and the Department for Control over the Protection and Use of Land and Water Resources, as well as specialized inspectorates for analytical control).

The below paragraphs summarize the host country (Uzbekistan) and other applicable environmental standards required by ADB and World Bank Group. The following guidelines have been taken into account:

- IFC General EHS guidelines, April 2007
- IFC EHS guidelines for Thermal Power Plants, December 2008
- IFC EHS guidelines for Waste Management Facilities, December 2007

A very detailed analysis of the applicable legislation has been included in chapter 3 of the EIA.

3.1. Standards on Ambient Air Quality

3.1.1. National standards

In accordance with “SanR&N No 0293-11 Hygienic requirements, the list of MAC for pollutants in the atmosphere in the territory of populated areas in the Republic of Uzbekistan have to comply with following limits:

Table 3. Summary of the relevant Ambient Air Quality Standards for Protection of Human Health (mg/m^3) at Takhiatash TPP

Pollutants	Maximum allowed during 30 minutes	Maximum allowed average day	Maximum allowed average monthly	Maximum allowed average year	Hazard class
	mg/m^3	mg/m^3	mg/m^3	mg/m^3	
NO_2	0.085	0,06	0,05	0,04	2
NO	0.6	0,25	0,12	0,06	3
SO_2	0,5	0,2	0,1	0,05	3
Benzapyerene	100,0E-7	100,0E-7	100,0E-7	100,0E-7	1
CO	5	4	3.5	3	4
Dust	0.15-0.5	0.1-0.35	0.08-0.2	0.05-0.15	3

3.1.2. International Standards

The legal reference limits pertaining to air quality are those corresponding to World Bank reference values in the "Environmental, Health, and Safety General Guidelines" document (April 2007), reference values given by the WHO (Air Quality Guidelines Global Update, 2005), which are shown in **Error! Reference source not found.**.

Table 4. WHO Ambient Air Quality Guidelines (General IFC Guidelines ,2007

Pollutant	Averaging Period	Guideline value in $\mu g/m^3$
SO_2	24-hour 10 minutes	20 500
NO_2	1 year 1-hour	40 200
PM10	1 year 24-hour	20 50
PM2.5	1 year 24-hour	10 25
Ozone	8-Hour daily maximum	100

3.2. Takhiatash TPP's Standards on Air Emissions

3.2.1. National emission standards

For the existing units at the Takhiatash TPP, Maximum Allowed Emissions (MAE) are calculated by unitary enterprises "Uzenergosozlash" and were sent to State Nature Protection Committee for approval in 2009. **Error! Reference source not found.** shows the MAE calculated for the Takhiatash TPP.

Table 5. Pollutants maximum allowed emissions for Takhiatash TPP

Pollutant	Existing situation		MAE		Exceed	
	g/s	t/y	g/s	t/y	g/s	t/y
Nitrogen dioxide	441,8480	3126,2838	441,8480	3126,2838	-	-
Nitrogen oxide	71,80000	508,02715	71,80000	508,02715	-	-
Carbone oxide	9,722000	164,16310	9,722000	164,16310	-	-

As can be observed, national emission standards are based on flue mass rate instead of on concentration units. This could allow diluting the volume of exhaust gas emitted to the atmosphere.

3.2.2. International emission standards

Relevant IFC standards applicable to combustion facilities rated over 50 MWth are presented in the IFC EHS Guidelines for Thermal Power Plants (2008).

Table 6. Pollutant Emissions Limit Values in the "IFC EHS Guidelines for thermal power plants" (December 2008), for boilers (Table 6-C)

	Emission guidelines (mg/Nm^3)			Dry basis, Excess O_2 content (%)
Combustion technology/fuel	NO_x (1)	SO2 (1)	PM (1)	
Natural Gas	240	-	-	3
Liquid fuels (Plant>/=600 MWth)	400	200-850	50	

*(1) Considering a Non Degraded Airshed after analysis of local air quality baseline

3.3. Takhiatash TPP's effluent standards

3.3.1. National effluent standards

There are two types of approved limits for discharging waste water on the TPP. Ones of them are limits for discharging water into the water body (Suenly canal) and the other ones are limits for discharging water into the municipal sewage system.

Limits applicable at the present on the TPP have been prepared in 2012. ***Limits on maximum allowed discharges into the water courses*** have been endorsed by Karakalpakstan Nature Protection Committee, Unitary Enterprise "Uzenergosozlash" under the UE, Takhiatash TPP and they were approved by State Nature Protection Committee (national level). Expiration date of these limits is 3 years (until 2015). Conclusion of State Environmental Expertise from 2012 officially endorses these limits.

According to data provided into the "Permission on maximum allowed discharge of pollutants into the water body (Takhiatash TPP)" water quality in canal "Suenly" (receiver of discharging wastewaters from TPP) is characterized by the pollutants indicated in **Error! Reference source not found.**. Based on national water quality standards and ambient concentration of pollutants into the canal Suenly, State Nature protection Committee defines norms of pollutants (MAC) for Takhiatash TPP.

Volume of water using for turbo-units cooling is 502,331 thousand m^3/year or 57,343.72 m^3/h. This amount is accepted as established and has been used for the calculation of MAD.

Table 7. Water quality in Suenly canal, national norms for pollutants and norms for TPP (Book "Permission on maximum allowed discharge of pollutants into the water body (Takhiatash TPP))

#	Indicator	Unit	Canal Suenly Average 2009	Canal Suenly Average 2010	Canal Suenly Average for 2 years	National Norms for pollutants in water body MAC	Norms for pollutants into the discharging water (for Takhiatash TPP) C_e	Calculated MAD g/hour
1	Suspended solids	mg/dm^3	107	89.3	98.15	Increasing on 0.75 mg/dm^3	103*	5940809
2	Mineral content, including	mg/dm^3	867	764	815.5	1000	785**	45014820,2
3	Chloride	mg/dm^3	294	200	247	300	300	14249914,4
4	Sulphate	mg/dm^3	299	225	262	100	265**	15196085,8
5	Nitrogen nitrate	mg/dm^3	0.199	0.19	0.194	9.1	9.1	57343,72
6	Nitrogen nitrite	mg/dm^3	0.036	0.018	0.027	0.02	0.026	1490,94
7	NH_4^+	mg/dm^3	0.198	0.124	0.161	0.5	0.5	8028,12
8	Fe	mg/dm^3	0.43	0.12	0.275	0.05	0.3**	17203,12

#	Indicator	Unit	Canal Suenly Average 2009	Canal Suenly Average 2010	Canal Suenly Average for 2 years	National Norms for pollutants in water body MAC	Norms for pollutants into the discharging water (for Takhiatash TPP) C_e	Calculated MAD g/hour
9	BOD_5	mg_{O2}/dm^3	0.15	0.06	0.105	3	3	172031,16
10	Oil products	mg/dm^3	1.6	1.4	1.5	0.05	1.45**	83148,394
11	pH	-	8.2	8.2	8.2	6.5-8.5		

* - in accordance with national standards, in case of the mineralization of water course (body) exceeds 30 mg/l during the low water period, it is allowed a 5 % exceed in suspended solids concentration relative to the existing (ambient) concentration in river. Thus, existing (natural) average concentration of suspended solids is 98.15 mg/dm^3 and 5% of this amount is 4.9, and consequently is 103 mg/dm^3.

** - Conclusion of State Environmental Expertise states that "…for Takhiatash TPP MADs should be established in accordance with national MACs, with the exception of the following pollutants: suspended solids, sulphates, iron and oil products. MAD for these pollutants should not exceed ambient pollution of canal Suenly."

Discharge of pollutants not included in **Error! Reference source not found.** is prohibited.

MAD for discharging water into the sewage network is calculated in comply with Resolution of Cabinet Ministries of RUz # 11 from 2010 "On additional measures on improving environmental protection activity in communal services", "Rules on receiving industrial waste water and order of compensations calculation for exceeding MAD into the municipal and other settlements sewage network".

Table 8. MAD for discharging into the municipal sewage network.

#	Pollutants	Actual concentration of pollutants discharged into the WTTP, 2012, mg/m^3	Established concentration C_e mg/dm^3	MAD, g/day
Outlet # 1, actual flow (q_a) – 210.41 m^3/day,(q_p) project flow – 283.37 m^3/day				
1	Suspended solids	77.2	500	141685
2	Dry residual	13.88	2000	566740
3	Chloride	154.3	350	99179.5
4		0.158	45.0	12751.65
5		0.043	3.3	935.121
6		0.255	2.5	708.425
7		0.106	5.0	1416.85
8		Abs	1.0	283.37
9		Abs	22.6	6404.162
10	Phosphates	-	2.5	708.425

#	Pollutants	Actual concentration of pollutants discharged into the WTTP, 2012, mg/m^3	Established concentration C_e mg/dm^3	MAD, g/day
11	pH		6.5-8.5	

#	Pollutants	Actual concentration of pollutants discharged into the WTTP, 2012, mg/m^3	Established concentration C_e mg/dm^3	MAD, g/day
Outlet # 2, actual flow – 166.3 m^3/day, project flow –181.72 m^3/day				
1	Suspended matter	94.35	500	90860.
2	Dry residual	1313	2000	363440
3	Chloride	157	350	63602
4		0.204	45.0	8177.4
5		0.203	3.3	599.676
6		0.068	2.5	454.3
7		0.255	5.0	908.6
8		Abs	1.0	181.72
9		Abs	22.6	4106.87
10	Phosphates	-	2.5	454.3
11	pH		6.5-8.5	

3.3.2. International Standards

EHS IFC effluents standards for thermal power plants are shown in **Error! Reference source not found.**.

Table 9. Effluent guidelines applicable for direct discharges of treated effluents to surface waters for general use (Environmental Health and Safety guidelines for thermal power plants, December 2008, Table 5)

Parameter	Discharge Limit
pH	6 – 9
Total suspended solids (mg/L)	50
Oil and grease (mg/L)	10
Total residual chlorine (mg/L)	0,2
Total chromium, Cr (mg/L)	0,5
Copper, Cu (mg/L)	0,5
Iron, Fe (mg/L)	1
Zinc, Zn (mg/L)	1
Lead, Pb (mg/L)	0,5
Cadmium, Cd (mg/L)	0,1

Parameter	Discharge Limit
Mercury, Hg (mg/L)	0,005
Arsenic, As (mg/L)	0,5
Temperature increase by thermal discharge from cooling system	Waste water temperature shall not cause a temperature increase of more than 3°C at a mixing zone boundary, scientifically determined, taking into account notably, quality of surrounding water, use of the receiving water, potential end receivers, and assimilation capacity. Specific requirements shall be determined by the present environmental assessment depending on sensitive aquatic surroundings at the point of and discharge.

For treated sanitary sewage discharges, IFC EHS general guidelines standards are as follows:

Table 10. Effluent guidelines applicable for treated sanitary sewage discharges (Environmental Health and Safety general guidelines, april 2007, Table 1.3.1.)

Parameter	Discharge Limit
pH	6 – 9
Total suspended solids (mg/L)	50
Oil and grease (mg/L)	10
BOD (mg/L)	30
COD (mg/L)	125
Total nitrogen (mg/L)	10
Total phosphorus (mg/L)	2

3.4. Takhiatash TPP Waste management and standards

3.4.1. National standards

Data on the rate of application of materials used for repairing and O&M of equipment were used to calculate quantity and quality of generated wastes (column 4,**Error! Reference source not found.**). Toxic class of wastes was defined in accordance with SanR&N No 0128-02 “Hygienic classifier of toxic industrial waste in the Republic of Uzbekistan (column 5)”. Places for temporary wastes storage and disposal is defined in accordance with RD Oz RH 84.3.17.2005 “Organizing and order of development of industrial and consumption wastes disposal” and SanR&N No 0127-02 “Sanitarian Rules of inventory, classification, storage and disposal of industrial wastes” (column 6, **Error! Reference source not found.**). Waste characteristics and content were developed in accordance with RD Oz RH 84.3.19.2005 “Terms and definition” (columns 7 and 8, **Error! Reference source not found.**).

In columns 9 and 10 of **Error! Reference source not found.** the Basel Convention category is included. In column 9 the classification included in the Waste Datasheet of the TPP is indicated. In column 10 the category of the wastes that have not been identified in column 9 and the correction of some of them have been included.

- Those wastes which category starts by “A” correspond to Annex VIII and therefore are considered hazardous wastes.
- Those wastes which category starts by “B” correspond to Annex IX and therefore are considered non hazardous wastes.

Table 11. Data on type, quantity, quality, main characteristics of waste and places of their disposal.

#	**Name of wastes**	**Units (per year)**	**Limits (t)**	**Toxic class in accordance with national classification (1)**	**Place for disposal**	**Type/ state of aggregation/Generating source**	**Waste content**	**Waste code in accordance with Basel convention**	
1	2	3	4	5	6	7	8	9	10
1	Iron scrap metal	tn	284.8	4	Scrap to “Vtorcherm et”	Inorganic; solid; rehabilitation of wastes	Steel 50%; Cast iron 50%	B1010	
2	Non-ferrous scrap metal (bronze)	tn	0.187	3	Scarp to “Vtorcvetm et”	Inorganic; solid; Repairing and replacement of energy equipment	Sn – 3-17% Zn – 5-12%, Pb – 3-17%	B1010	
3	Non-ferrous scrap metal (cupper)	tn	0.19321	2	Scarp to “Vtorcvetm et”	Inorganic; solid; Repairing and replacement of energy equipment	Ni 0 16% Cu – 84%	B1010	
4	Non-ferrous scrap metal (babbit)	tn	0.42662	3	Scarp to “Vtorcvetm et”	Inorganic; solid; Repairing and replacement of energy equipment	Zn14-38%; Al- 2,5-6%	B1010	
5	Non-ferrous scrap metal (brass)	tn	0.76208	3	Scarp to “Vtorcvetm et”	Inorganic; solid; Repairing and replacement of energy equipment	Mn – 2% Si- 3,5%, Fe – 3%	B1010	
6	Stub	tn	0.552	4	Scrap to “Vtorcherm et”	Inorganic; solid; welding	C-0.09% S – 0.04%	B1010	

#	Name of wastes	Units (per year)	Limits (t)	Toxic class in accordance with national classification (1)	Place for disposal	Type/ state of aggregation/Generating source	Waste content	Waste code in accordance with Basel convention	
							P – 0.04% Mn- 0.5%		
7	Waste wood	m^3	66.43	4	Reused as raw materials	Organic; Solid; Replacement of wool construction and furniture repair	Wool - 100%		B3050
8	Used fire-resistant and thermo-isolated materials	tn	651.06	4	Reused	Inorganic; solid; Rehabilitation of thermo-isolation of boilers, ponds, pipelines	Chamotte crumbs – 55.7%, power-fire resistant brick – 25,7% Concrete aluminous – 16%, fire resistant clue – 2.6%	A2050	
9	Used asbestos	tn	46.731	3	Reused	Inorganic; solid; Rehabilitation of thermo-isolation of boilers, ponds, pipelines	Asbestos cardboard – 25-35%, asbestos cord – 10-15% Asbestos - vermiculite tile – 50-65%	A2050	
10	Technical rubber	tn	5.65	4	Sent for utilization into LLC “Artur”	Organic; Solid; Energy equipment repairing	S – 2% Rubber – 92-98%	B3040	
11	Waste paper	tn	0.456	4	Sent to salvage	Organic; Solid; Replacement of electrical-isolation cardboard	Paper 85% Cardboard – 15%	B3020	

#	Name of wastes	Units (per year)	Limits (t)	Toxic class in accordance with national classification (1)	Place for disposal	Type/ state of aggregation/Generating source	Waste content	Waste code in accordance with Basel convention	
12	Used paranet	tn	1.2359	3	Removed to landfill	Inorganic; solid; paronit replacement			A2050 (asbestos /rubber)
13	Oiled rags	tn	2.625	3	Burned into the boiler furnace	Organic; Solid; Fitting in of electrical equipment	Cotton – 6-20% Wool – 14-28% Viscose – 13-30% Residual of transformer and diesel oils	B3030	A3020 (As are textile wastes that are mixed with hazardous wastes)
14	Mazut ashes	tn	0.366	2	Stored in evaporation ponds	Inorganic; solid; Mazut burning in boiler furnace			Depending on composition
15	Used turbine oil	tn	12.05	2	Reused	Organic; Liquid; Replacement of turbine oil		A3020	
16	Sludge from oil products	tn	1.89	3	Stored in evaporation ponds	Composite; Discharges from chemical treatment from oil products	Mazut – 2-15% Oil 3-18% Water 5-24% Clue 25-45%		A4060
17	Sludge from water treatment plants	th	1598	4	Stored in evaporation ponds	Inorganic; liquid; During acid washing of boilers			B2120
18	Used anthracite	tn	13.2	4	Burned into the boiler furnace	Organic; Solid Replacement of absorbents in mechanical filters	Coal 100%		B2060
19	Used cationite	tn	23.496	4	Removed to landfill	Inorganic; Solid			A3050

#	Name of wastes	Units (per year)	Limits (t)	Toxic class in accordance with national classification (1)	Place for disposal	Type/ state of aggregation/Generating source	Waste content	Waste code in accordance with Basel convention	
						Replacement of absorbents in filters			
20	Insoluble salt residuals	tn	80	4	Removed to landfill	Inorganic; Composite; Dissolving of salt for filter regeneration	SO_4Ca – 81.45% Other – 18.55%		
21	Not-fuel burning of lime	tn	484.8	4	Removed to landfill	Inorganic; Solid; Dissolving lime	Clue 65-88% Sand – 2-5% Limestone 8-33%		
22	Used oil from transformers	tn	3.9466	2	Reused	Organic; Liquid; Replacement of transformer oil		A3020	
23	Used electrical isolated materials	tn	0.06	3	Removed to landfill	Solid; Composite; Replacement of electrical isolation	Polymers -65-85% Cotton isolation – 12-35%	A3020	
24	Used luminescent lamp	tn	0.23828	1	Removed to demercuriation	Inorganic; Solid; Burned lump replacement	Al – 80.67% Vo-1.437% Cu – 7.05%	A1030	
25	Bottom sediments of mazut	tn	37.652	3	Stored in evaporation ponds	Composite; Solid; Sedimentation and polymerization of heave fractions	Heave hydrocarbons – 12-45% Mechanical admixture – 55-88%		A4060
26	Silt from calcium carbide	tn	0.4046	4	Removed to landfill	Inorganic; Composite; Welding and cutting of metal	$Ca(OH)_2$ H_2O - 12%		
27	Used	tn	1.561	4	Sent to	Organic;	Rubber –	B3040	

#	Name of wastes	Units (per year)	Limits (t)	Toxic class in accordance with national classification (1)	Place for disposal	Type/ state of aggregation/Generating source	Waste content	Waste code in accordance with Basel convention	
	tyres				utilization	Solid; Replacement	70% Viscose cord – 20% Metal cord – 10%		
28	Used engine oil	tn	0.65117	2	Reused	Organic; Solid; Replacement		A3020	
29	Lead plates from battery	tn	0.33525	1	Scarp to “Vtorcvetmet”	Inorganic; Solid; Replacement	Lead – 50-60% PbS- 20%	A1160	
30	Cases of battery	tn	0.08171	4	Scarp to “Vtorcvetmet”	Organic; Solid; Battery replacement	Ebonite	A2010	
31	Used electrolyte	tn	0.12667	2	Reused	Inorganic; liquid; Battery replacement	H_2SO_4 - 28%	A4090	
32	Communal wastes	tn	257.283	Non-toxic	Removed to municipal landfill	Organic; Solid; Workers activity Cleaning of territory		B3060	

The toxic class referred to in **Error! Reference source not found.** is in accordance with the National Uzbek classification as shown in **Error! Reference source not found.**.

Table 12. Toxic class in accordance with national classification is as follows:

Toxic Class	Waste hazardous grade
Class 1	Extremely hazardous waste
Class 2	Highly hazardous waste
Class 3	Moderately hazardous waste
Class 4	Low-hazardous waste

3.5. Takhiatash TPP noise standards

3.5.1. National noise Standards

The "Sanitarian Rules and Norms on providing allowed noise level into the living buildings, public buildings and territory of living area" (SanR&N No.0267-09) establish the maximum admissible noise level into the living areas, both inside and outside buildings, as **Error! Reference source not found.** shows.

Table 13. Admissible noise level into the living areas, both inside and outside the buildings (SanR&N No.0267-09)

Name of area	Level of sound pressure, octave bands with average geometric mean frequencies (dB)								Level of sound, (dBA)
	63	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**	
Living room of flats, bedrooms of resorts (inside)									
Day time	63	52	45	39	35	32	30	28	40
Night time	55	44	35	29	25	22	20	18	30
Territories adjacent to living houses (outside)									
Day time	75	66	59	54	50	47	45	43	55
Night time	67	57	49	44	40	37	35	33	45

3.5.2. International noise standards

The TPP must observe World Bank Directives ("Environmental, Health and Safety General Guidelines, 2007") based on those of the WHO. As for the impact of noise beyond the boundaries, the EHS Guidelines stipulate that such noise shall not exceed the levels given in the table below, nor shall they result in a greater increase of ambient noise than 3 dB at the nearest receiving area outside the site.

Table 14. Maximum Allowable Noise Levels (IFC EHS General Guidelines, 2007)

Receiver	One hour LAeq (dBA)	
	Day time	**Night time**
	7h00 – 22h00	**22h00 – 07h00**
Residential, institutional and educational	55	45
Industrial and commercial	70	70

3.5.3. International Standards

The TPP should comply with the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (1989), ratified in 1996 by Uzbekistan. Hazardous wastes generated by the TPP should be classified under this Convention. The Convention is also intended to minimize the amount and toxicity of wastes generated, to ensure their environmentally sound management as closely as possible to the source of generation.

Waste management of the TPP should be based also on chapter 1.6. of the General EHS IFC Guidelines (April, 2007).

4. Audit and site investigation procedure

The audit procedure has been based on reviewing documents and records, interviews with staff and site reconnaissance observations to generate objective evidence. Environmental monitoring results have been also assessed.

Three types of audit activities were used to assess the level of conformity of the Takhiatash TPP's operational environmental management system:

1. Review of documentation
2. Interviews
3. Site visit

4.1. Document and record review

During the audit, a wide variety of environmental documents and records were reviewed. The documentation review is part of the overall evidence gathering phase.

- Norms for maximum allowed emissions for OJC "Takhiatash TPP", Tashkent 2009
- Permission on maximum allowed discharge of pollutants into the water body. OJC "Takhiatash TPP", State Nature Protection Committee of RUz, Tashkent 2012
- Communal-ecological norms (limits) for waste water discharge into sewage system. OJC "Takhiatash TPP". State Nature Protection Committee of RUz, Tashkent 2012
- Inventory of industrial wastes. OJC "Takhiatash TPP", Tashkent 2007
- Wastes passports. OJC "Takhiatash TPP", Takhiatash 2007
- Limits for waste disposal. OJC "Takhiatash TPP", Tashkent 2008
- Rules on organization of work with personnel in the energy sector, "Uzgosenergonadzor", 2002
- Materials of work places assessment. Minutes of measurements of harmful industrial factors. Map of work conditions at the work places. OJC "Takhiatash TPP". Takhiatash 2010.
- Annual reports on air emissions, generated wastes and their disposal, water use and effluents flows.
- Waste contracts

TPP monitoring records of:

- Monthly air emissions samples from years 2011 and 2012
- Water quality analysis at intake and discharge points every 15 days from years 2011 and 2012
- Groundwater quality analysis every three months from years 2011 and 2012
- Soil analysis every six months from years 2011 and 2012

All documents and existing records were submitted as documental evidence during the audit visit or after it.

Apart from the information provided by the TPP, several environmental surveys and analysis have been undertaken for the EIA and analyzed for the present environmental audit:

- Noise measurement campaign.
- Water intake and discharge quality analysis.
- Soil analysis at the new facility location and existing evaporation ponds.

4.2. Site reconnaissance

The site and areas subject to the report were toured in order to get acquainted with the location and activities and also to gather evidence on actual on-site environmental practices. Annex II of the EIA (photographic report) shows visual evidence of the audit.

4.3. Staff interviews

In addition, interviews were carried out during the audit with plant managers and personnel in order to verify the environmental management system.

Table 15. Staff interviews

#	Name	Position	Location
1	Babajonova Zulfiya	Chief of chemical department	Takhiatash TPP
2	Frolova Aelita	Engineer of eco-analytical laboratory, chemical department	Takhiatash TPP
3	Abdullaev Komol	Environmental Engineer	Takhiatash TPP
4	Esemuratov Satbay	Work safety engineer	Takhiatash TPP
5	Eshanov Alamurat	Chief foremen, Heating isolation and boiler cleaning department	Takhiatash TPP
6	Fayzullaev Abdurahmon	Deputy chief of material procurement department	Takhiatash TPP
7	Atagonova Sanargul	Air pollution monitoring department	Karakalpak State Nature Protection Committee

#	Name	Position	Location
8	Karabaeve Shirin	Soil pollution department	Karakalpak State Nature Protection Committee
9	Mambetov Kengesbay	Air protection department	Karakalpak State Nature Protection Committee
10	Seitniyazov Komol	Soil resources protection department	Karakalpak State Nature Protection Committee
11	Artikboev Nodir	Work safety department	The main office of Uzbekenergo
12	Khomova Tatyana	Environmental Engineer	Design institute “TEP” Uzbekenergo
13	Akromov Bakhodir	Engineer (work safety)	Uzenergosozlash Uzbekenergo
14	Birukov Evgeniy	Engineer (water discharges)	Uzenergosozlash Uzbekenergo
15	Muksimov Akmal	Engineer (solid wastes)	Uzenergosozlash Uzbekenergo
16	Konstantinovskiy Rafael	Chief of environment protection department	Uzenergosozlash Uzbekenergo

What follows is a summary of the actual environmental management and control procedures currently applied at the TPP, concluded after review of documents, staff interviews and site visit.

A. General EHS management, monitoring and report:

There are different tasks (monitoring) undertaken by different areas of the TPP organization structure. Staff (number of people) dedicated to environmental, health and safety issues should be adequate. Analysis and monitoring results are recorded in hardcopy. Monitoring program is based in national methods for sample collection, preservation and analysis. There is no evidence that the national methods comply with quality and strictness of the international methodological standards.

Automated and manual equipment is being calibrated under national regulations. There is not a plan of calibration and maintenance neither sampling nor analysis Quality Assurance/Quality control (QA/QC) plans.

The Takhiatash TPP annually submits two kinds of reports:

1. Air emissions, generated wastes and disposal and financial report on environmental taxes. This information is submitted to the Goskompriroda of Karakalpakstan and Statistical Department of Karakalpakstan:
2. Water use and effluents flues. This information is submitted to the following relevant organizations:
    - Low Amudarya authority of irrigation system (responsible for management of surface water, under the Ministry of Agriculture and Water Resources Management).

- Goskompriroda
- Takhiatash “Vodocanal” – organization responsible for drinking water supply and domestic waste water treatment
- Department of Environmental protection in Uzbekenergo.

B. Air emission and ambient air quality:

Conventional old units of the TPP run with an average thermal efficiency of 31%. This means that, compared with a more efficient technology, current Takhiatash technology emit higher quantities of pollutants and GHG by power unit.

There is not a continuous emission monitoring system at the stacks of the TPP. A monthly emission test is conducted by “Uzenergosozlash” at the boilers. No emission test at the stacks is been carried out in order to have direct measurement of emission levels.

Based on the monthly emission data reported by the TPP, the annual emission rates from each boiler have been calculated by weighting the monthly emissions with the specific operating hours of each boiler and adding the monthly values for the whole year.

Maximum allowed emissions (MAE) were calculated by unitary enterprises “Uzenergosozlash” and have been passed to State Nature Protection Committee for approval in 2009, which are also presented in **Error! Reference source not found.**and **Error! Reference source not found.**.

Table 16. Existing emissions in 2011 and 2012 and emission limits (MAEs) as nominal or design capacity

Pollutant	**Existing emissions (2011)**		**Existing emissions (2012)**		**MAE**	
					Stack 1+Stack 2 = Total	**Stack 1+Stack 2 = Total**
	g/s	*t/y*	*g/s*	*t/y*	*g/s*	*t/y*
NO_2	83.75	2170.25	88.38	2050.82	158.47+283.38 =441.85	358.27+2768.02 =3126.28
NO	13.61	352.67	14.36	333.26	25.75+46.05 =71.80	58.22+449.8 =508.03
CO	0	0	0	0	3.14+6.58 =9.72	23.44+140.70 =164.16

Table 17. Average annual capacity emission limits

Pollutant	**MAE**	
	Stack 1+Stack 2 = Total	**Stack 1+Stack 2 = Total (8000 operating hours/y)**
	g/s	*t/y*
Nitrogen dioxide (NO_2)	35.054+110.76=145.814	4199
Nitrogen oxide (NO)	5.696+17.998=23.694	682
Carbon oxide (CO)	2.29+5.63=7.92	228

Having analyzed emissions in 2011 and 2012 it can be concluded that SO_2 and CO measurements recorded show a 0 value (which could indicate that the measurements were not taken or that there were mistakes in the measurements as it is very estrange to have a 0 value in these parameters). The NO_2 and NO values are shown in the following graphs.

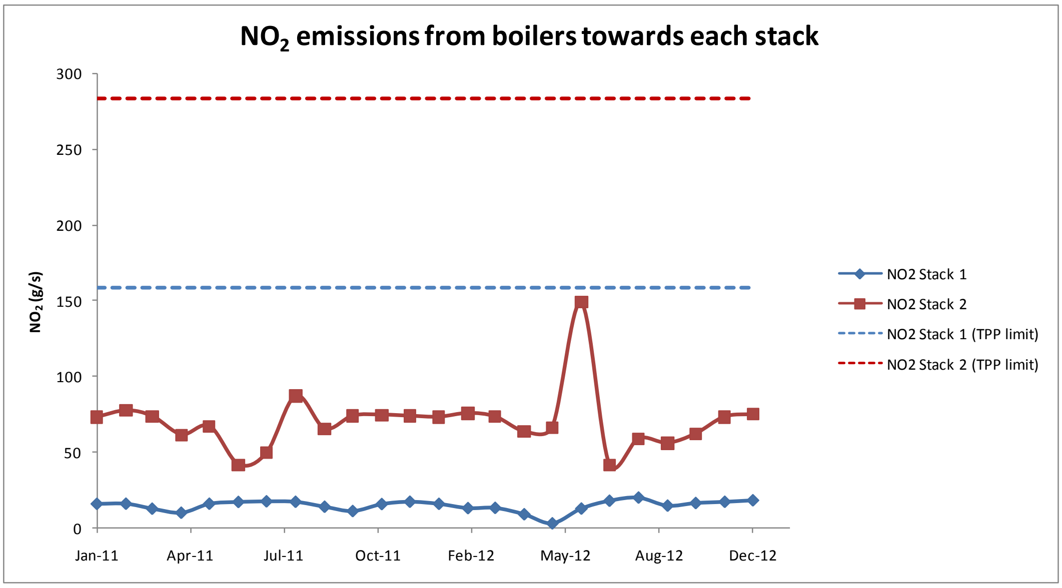


Figure 10. Comparison between NO_2 emissions from boilers towards each stack and the TPP's limits

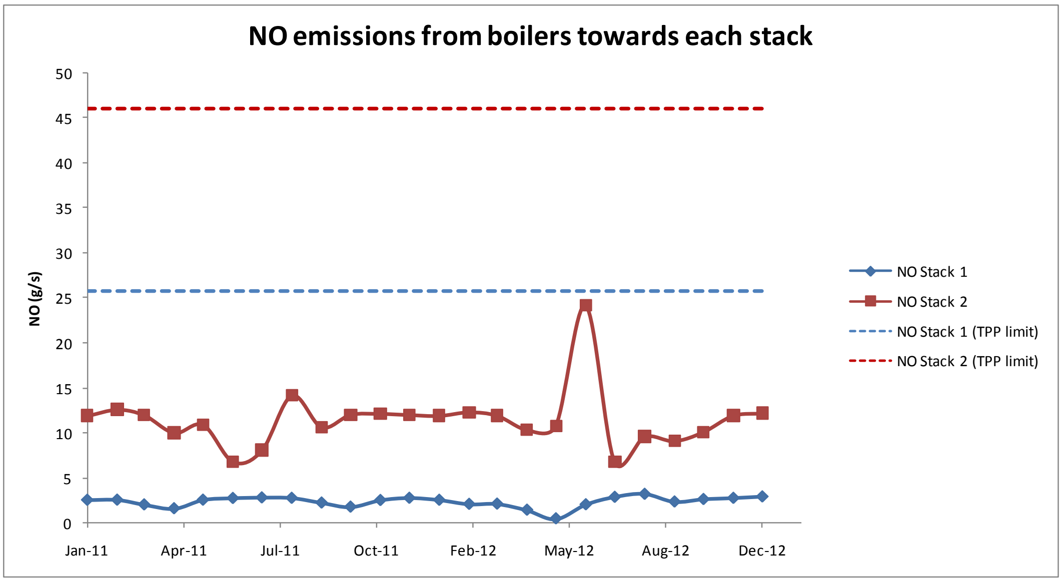


Figure 11. Comparison between NO emissions from boilers towards each stack and the TPP's limits

Regarding international standards, the World Bank standard for boilers (table 6 C of the IFC EHS guidelines for thermal power plants (December 2008)) only refers to NOx emissions when burning natural gas. The WB standard for NOx is 240 mg/Nm^3 (Dry gas, 3% O_2).

In the following figures the comparison between the World Bank standard and the monthly measurements between 2011 and 2012 can be observed.

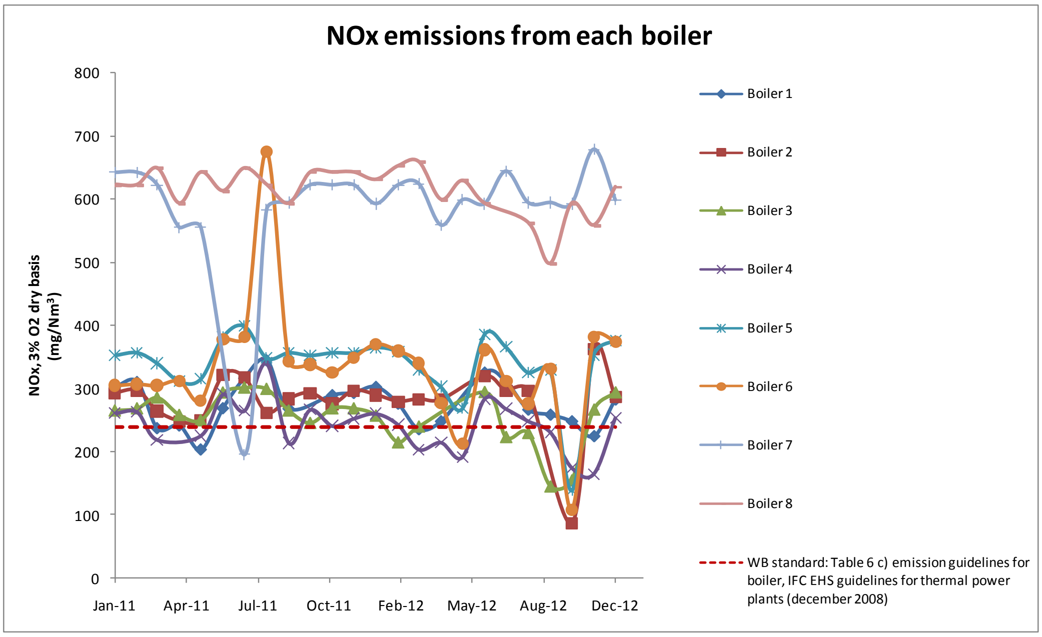


Figure 12. Comparison between total NO_x emissions (mg/Nm^3) from each boiler and the World Bank limits

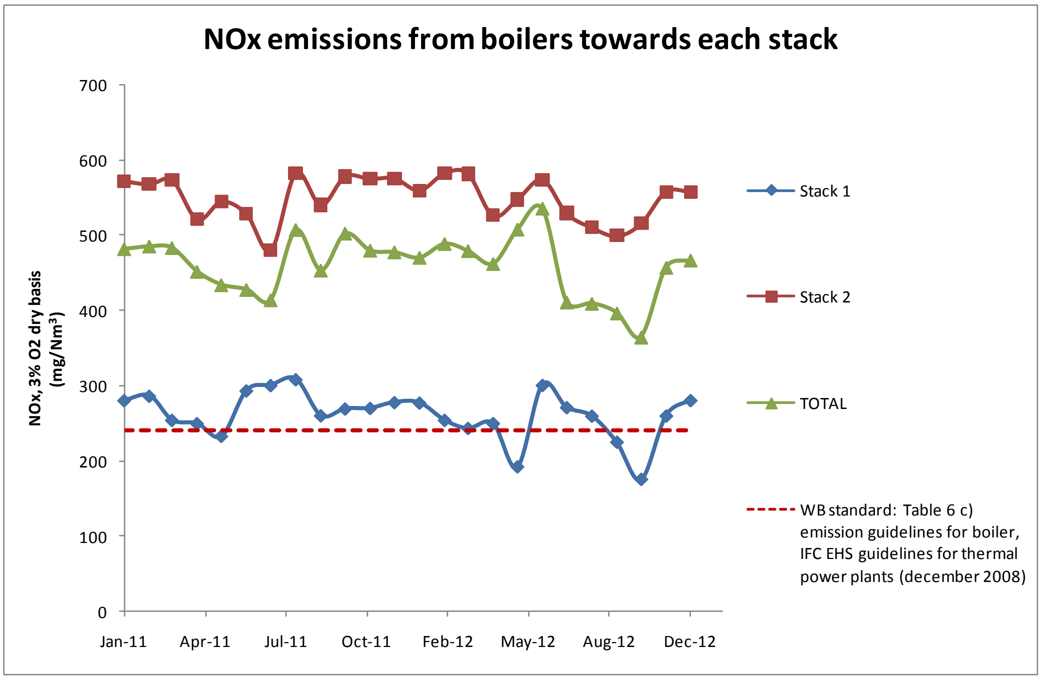


Figure 13. Comparison between total NO_x emissions (mg/Nm^3) from boilers to each stack and the World Bank limits.

Emissions when burning mazut as backup fuel have not been checked as emissions test were not provided. Nevertheless, this fuel has not been used since 2004 as it remains just as a provision of power supply guarantee.

There is no evidence of calculation of GHG emission at the TPP on an annual basis.

Regarding air quality measurements, they are not being undertaken by the TPP.

There are two existing air quality stations in Nukus and Kizketken settlement area which measures are conducted by the Main Hydrometcenter of the Republic of Uzbekistan.

- # 5 monitoring station located in Kizketken near Nukus.
- # 7 monitoring station located in Nukus.

Figure 14. Location of the air quality monitoring stations.

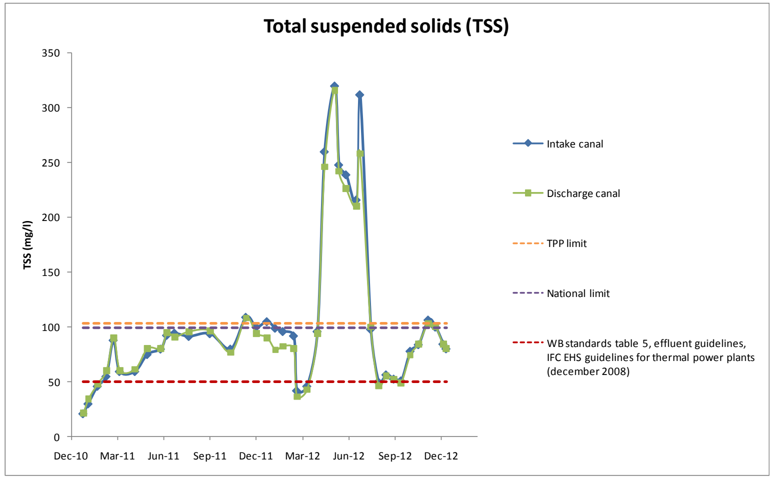
Location of these two air quality stations are far away and not in the wind direction from and of the TPP. Measures recorded by these two air quality stations are not being analyzed and assessed within the environmental annual reports by the TPP either.

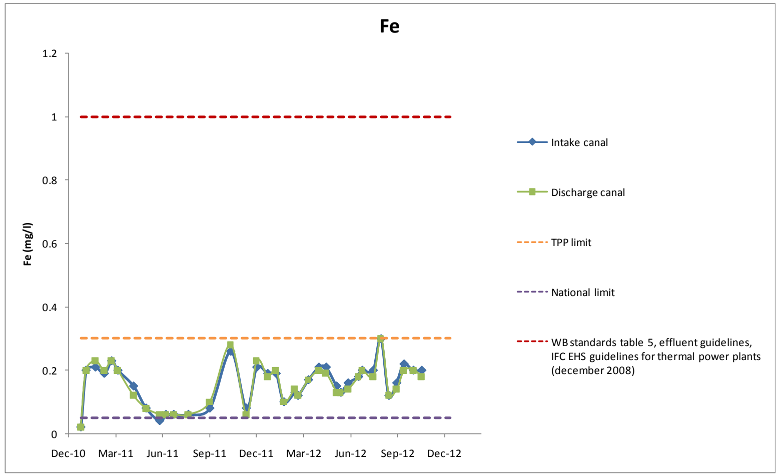
As we dispose of the real air quality and also we have simulated the contribution of the current operation of the TPP to these air quality station (see Annex III of the EIA "Atmospheric dispersion simulation"), we can calculate the percentage of this contribution. This contribution for annual, monthly and daily averages of NO2 is not very significant. Nevertheless, for short periods (hourly results) the contribution can rise up to 69%. For NO the contribution is almost no perceptible and for CO is insignificant.

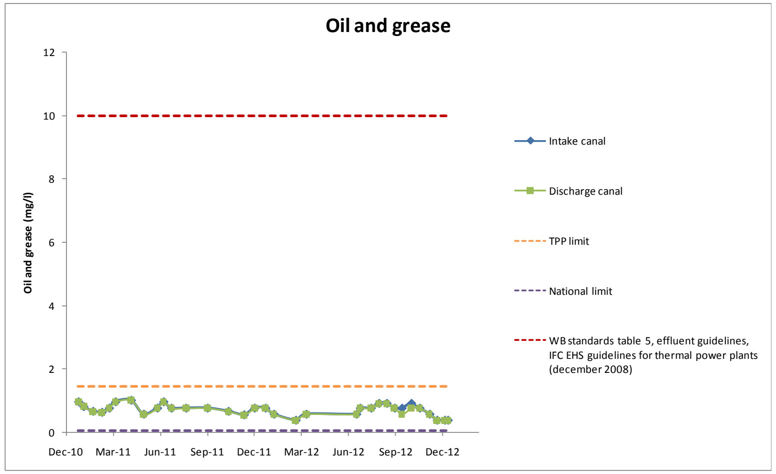
C. Waste water and ambient water quality:

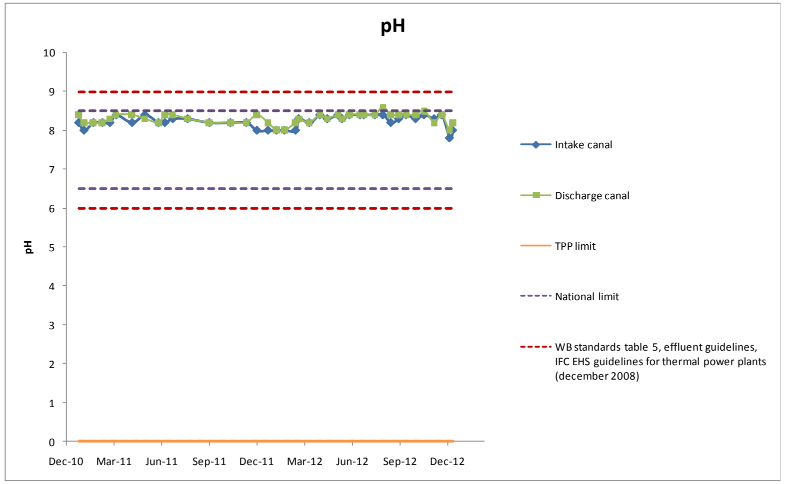
Takhiatash TPP intake and discharge is located in Suenly canal. In order to reflect the water quality conditions of the Suenly channel, a number of parameters are measured in both Takhiatash TPP intake and discharge points to the channel in a bimonthly basis. Just the parameters that have also a limit in the World Bank guidelines have been represented in charts shown below in order to reflect the water quality all over the years 2011 and 2012 and compared with the World Bank standards for effluents and the national and specific TPP limits (Figure 15).

In order to find out the value concentration of the parameters included in the World Bank effluent standards (thermal power plants EHS IFC guidelines, 2007) that are not being currently monitored, an analysis was undertaken on the 6th of march of 2013 which results are shown in **Error! Reference source not found.**.


Total suspended solids (TSS)
TSS (mg/l)
350
300
250
200
150
100
50
0
Dec-10
Mar-11
Jun-11
Sep-11
Dec-11
Mar-12
Jun-12
Sep-12
Dec-12
Intake canal
Discharge canal
TPP limit
National limit
WB standards table 5, effluent guidelines, IFC EHS guidelines for thermal power plants (december 2008)


Fe
Fe (mg/l)
1.2
1
0.8
0.6
0.4
0.2
0
Dec-10
Mar-11
Jun-11
Sep-11
Dec-11
Mar-12
Jun-12
Sep-12
Dec-12
Intake canal
Discharge canal
TPP limit
National limit
WB standards table 5, effluent guidelines, IFC EHS guidelines for thermal power plants (december 2008)


Oil and grease
Oil and grease (mg/l)
12
10
8
6
4
2
0
Dec-10
Mar-11
Jun-11
Sep-11
Dec-11
Mar-12
Jun-12
Sep-12
Dec-12
Intake canal
Discharge canal
TPP limit
National limit
WB standards table 5, effluent guidelines, IFC EHS guidelines for thermal power plants (december 2008)


pH
pH
10
9
8
7
6
5
4
3
2
1
0
Dec-10
Mar-11
Jun-11
Sep-11
Dec-11
Mar-12
Jun-12
Sep-12
Dec-12
Intake canal
Discharge canal
TPP limit
National limit
WB standards table 5, effluent guidelines, IFC EHS guidelines for thermal power plants (december 2008)

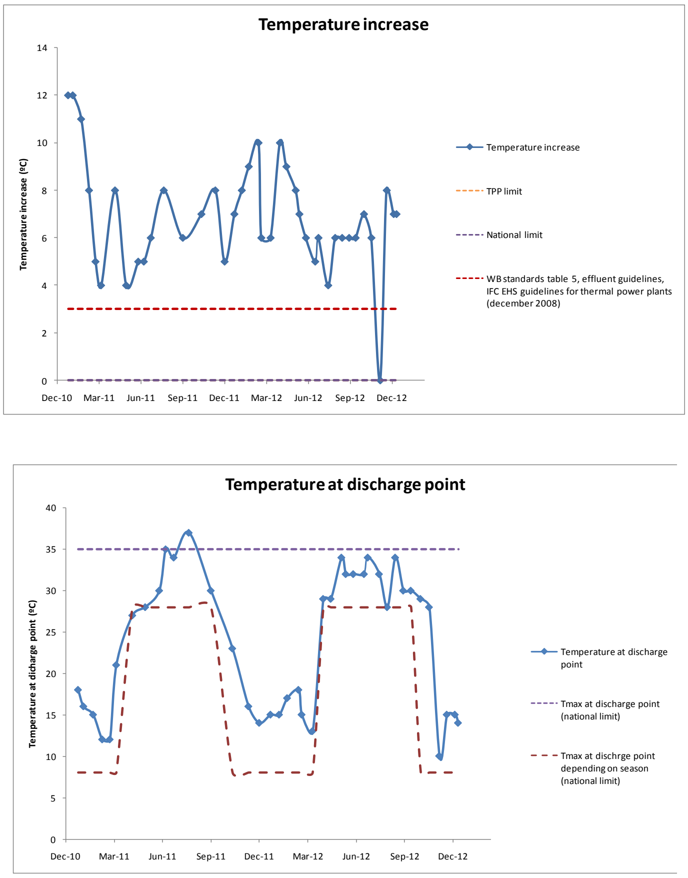


Figure 15. Results of surface water analysis conducted by the TPP.

Table 18. Results of surface water analysis conducted on the 6th of March

Parameter	Water intake canal	Water discharge canal	TPP limits	WB limits
	Measured concentration (mg/dm^3)		MAC (mg/dm^3)	MAC (mg/dm^3)
Pb	0.0001	0.0001	0.03	0.5
Cd	0.00032	0.00035	0.005	0.1
Cu	0.0065	0.0059	0.001	0.5
Zn	0.011	0.0096	0.01	1
Fe	0.6435	0.7155	0.3	1
Cr3+	0.007	0.0065	-	0.5
As	0.022	0.0126	0.05	0.5
Hg	Not detected	Not detected	-	0.005
pH	7.78	7.94	6.5-8.5	6-9
Suspended solids	10	120	103	50
Residual chlorine	Not detected	Not detected	-	0.2
Oil products	0.08	0.22	1.45	10

- **Total suspended solids**

The content of total suspended matter widely varies from one measurement to the next, having reached values above 300 mg/l.

The World Bank's standard is frequently exceeded at discharge point but this is because it is already exceeded at the intake point. The maximum allowable concentration of total suspended solids for the TPP (103 mg/land the national limit (100 mg/l) are less restrictive but they are also exceeded at certain points. It seems that in some periods TSS of the discharge point is lower than in the intake, as if the water process in the TPP operation would reduce this parameter.

Nevertheless, in the water analysis of the 6th of March, suspended solids World Bank standard is exceeded at the discharge and the value at the discharge is 12 times higher than at the intake.

- **Iron**

The concentration of iron in water at intake and discharge points is very similar and it ranges from 0.05 to 0.3 mg/l. These values are below both World Bank´s standard and the TPP's limits. However, the intake water quality exceeds the content of iron established by the national limits.

Nevertheless, in the water analysis of the 6th of March, iron TPP standard is exceeded both at the intake and discharge points being increased of 1.1. times.

- **Oil and grease**

The content of oil and grease is the same for intake and discharge water and it remains mainly constant between 0.4 and 0.9 mg/l, approximately. This value is below both World Bank´s standard and the TPP's limits. However, even the intake water exceeds the national limits which are more restrictive.

In the water analysis of the 6th of March, even if standards are fulfilled, there is an increase at the discharge of 2.75 times.

This increase could be caused by the oily waste water treatment facility being out of order (the audit visit day, 18th January, was out of order; see next picture)

Figure 16. Oil spot at the discharge point to Suenly canal, on January 18th 2013.

In this respect, if oily water is not discharged at Suenly canal, as explained by the TPP documents, this could not be the reason.

- **pH**

The water pH, at both intake and discharge points, hardly varies and is between 8 and 8.5. It meets World Bank's standards as well as the national and the TPP's limits.

- **Temperature increase**

As the cooling system of the TPP is an open circuit, the increase in temperature from intake to discharge points is quite high. The maximum allowable temperature increase defined by World Bank standards is set at 3ºC, value which is greatly exceeded by the TPP discharge.

According to surface water quality criteria in Uzbekistan standards establish a temperature increase limit for fishing purposes (Suenly canal is defined in this category) of 5ºC in comparing average monthly temperature of the hottest month. As in this period of measurements (2011-2012) maximum temperature has been 30ºC, increase allowed should not exceed 35ºC but, a maximum absolute temperature at the discharge point is established in 8 ºC for winter and 28 ºC for summer. Both standards are exceeding even at the intake point.

Regarding analysis of the 6th of March, other parameters are under TPP limits or World Bank standards (Pb, Cd, Cr, As, Hg, residual chlorine) except Cu which exceeds TPP limits at intake and discharge points (where de concentration is decreased); and Zn just at the intake point.

In relation to sewage effluents, as they are discharged to the Municipal Waste Water Treatment plant, this facility is the one that should fulfill World Bank standards. As we have not been provided with analysis of this municipal facility we don't have evidence of standards fulfillment. There is no evidence of a contract with the municipal facility either.

On the other hand, as previously explained, oily and acid waste water effluents are conducted to the evaporation sludge ponds. In the audit visit was observed that the conditions of these evaporation ponds was quite deficient with cracks and corrosion on the concrete layer as shown in the following pictures:

<table>
<tr><td>
Oily waste water evaporation pond</td><td>
Detail of the cracked concrete material of the evaporation ponds</td></tr>
<tr><td>
Detail of the cracked concrete material of the evaporation ponds</td><td>
Acid waste water evaporation pond cracked and corroded concrete</td></tr>
</table>

In order to confirm or rule out potential pollution of soil at the close area of the evaporation ponds, a comprehensive soil study has been carried out. On 2nd March 2013, 13 samples were taken in different places situated within Takhiatash TPP plot. Points 10 to 13 are located close to the existing evaporation ponds. They are marked in the image below.

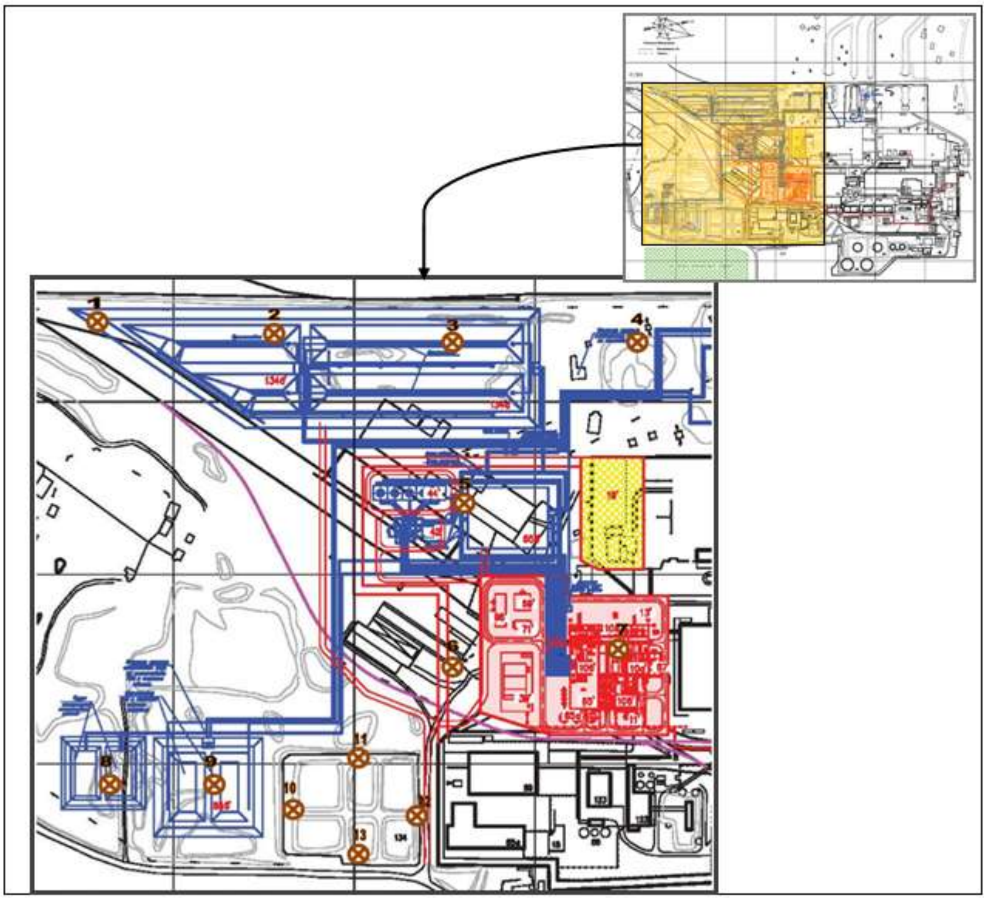


Figure 17. Soil sampling points within Takhiatash TPP plot.

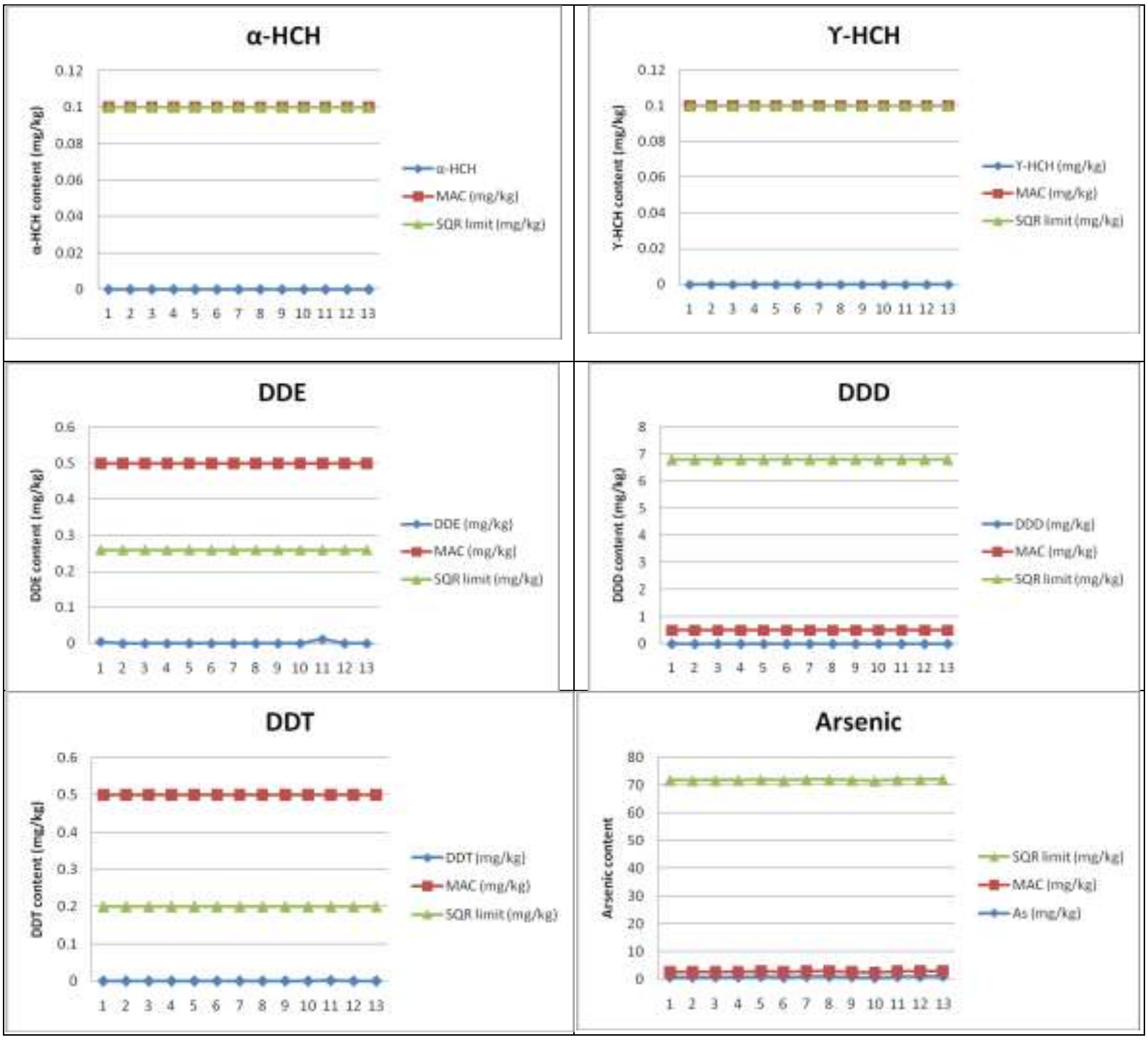
All soil samples have been analysed for the following parameters: Organochlorine Pesticides (α-HCH, ϒ-HCH, DDE, DD, DDT); Heavy Metals (lead, mercury, cadmium copper, zinc, cobalt, nickel, arsenic); Dry residue, moisture, phenol, humus, pH and oil products. In Annex V of the EIA, it can be found all the information related to soil sampling and analysis results and their interpretation and conclusions.

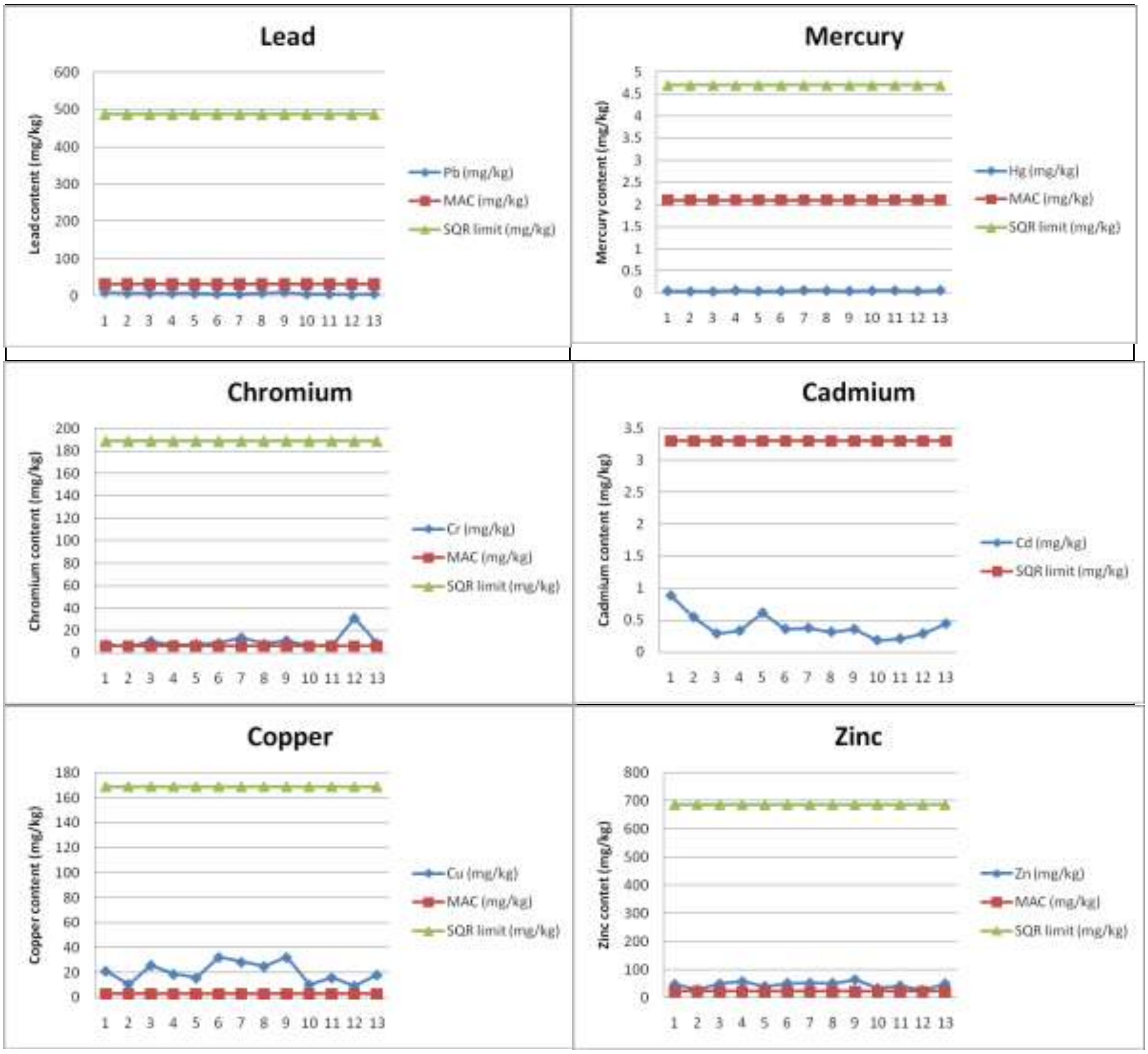
The results have been compared to the Uzbek MACs (Maximum Allowable Concentration) and international standards (maximum values for industrial soil quality class, established in the Soil Quality Regulation[4] (SQR) of The Netherlands)

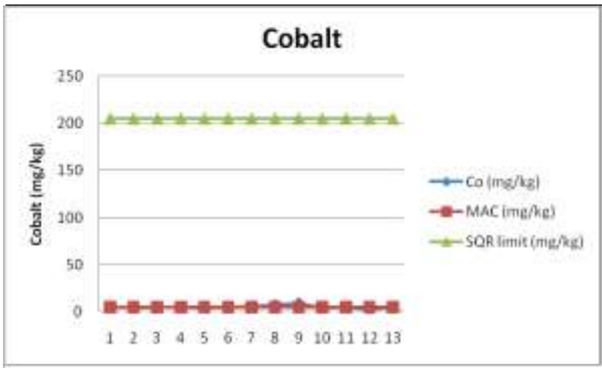
[4] *Soil Quality Regulation*. State Secretary for Housing, Planning and the Environment and State Secretary for Transport, Public Works and Water Management of The Netherlands (2006).

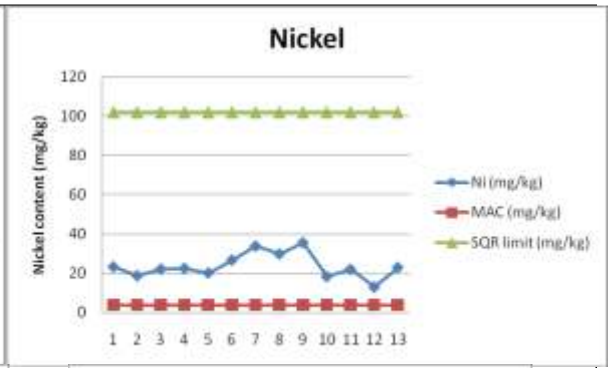
MACs, are based on the principle of a soil that would be fit for all possible functions, ranging from heavy industry to a domestic vegetable garden. Concentrations of contaminants exceeding the MACs do not necessary mean the likelihood of exposure to soil contamination at levels of potential concern to human health if this site is used for human activity. Therefore, the Dutch soil quality criterion is considered worldwide among the leading international approaches to setting soil screening values.

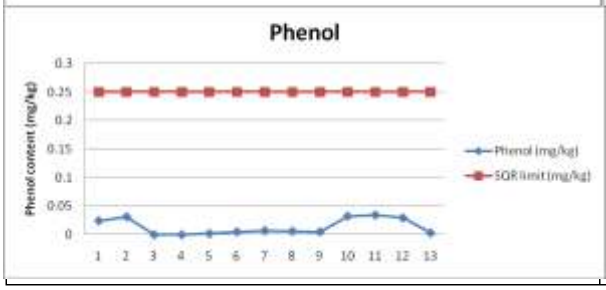
In order to draw conclusions, the results of the analyses carried out are shown in the following graphs.

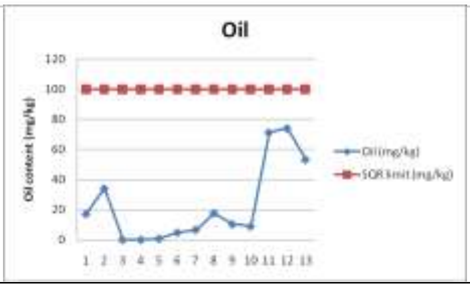



Lead
Lead content (mg/kg)
Pb (mg/kg)
MAC (mg/kg)
SQR limit (mg/kg)
Mercury
Mercury content (mg/kg)
Hg (mg/kg)
MAC (mg/kg)
SQR limit (mg/kg)
Chromium
Chromium content (mg/kg)
Cr (mg/kg)
MAC (mg/kg)
SQR limit (mg/kg)
Cadmium
Cadmium content (mg/kg)
Cd (mg/kg)
SQR limit (mg/kg)
Copper
Copper content (mg/kg)
Cu (mg/kg)
MAC (mg/kg)
SQR limit (mg/kg)
Zinc
Zinc contet (mg/kg)
Zn (mg/kg)
MAC (mg/kg)
SQR limit (mg/kg)









All detected contaminant concentrations in soil are much below their respective corrected maximum value for industrial soil quality class. Nevertheless, It should be pointed out that samples at the evaporation ponds (10 to 13) have a higher content in phenols and oil products that the rest of the points.

D. Hazardous materials management:

Hazardous materials as asbestos that are not allowed in industrialized countries are still been used as repairing materials for the isolation of the equipment. In 2012 131.1 tn (annual average is 94 tn) of asbestos and 2528 kg of paronite were purchased.

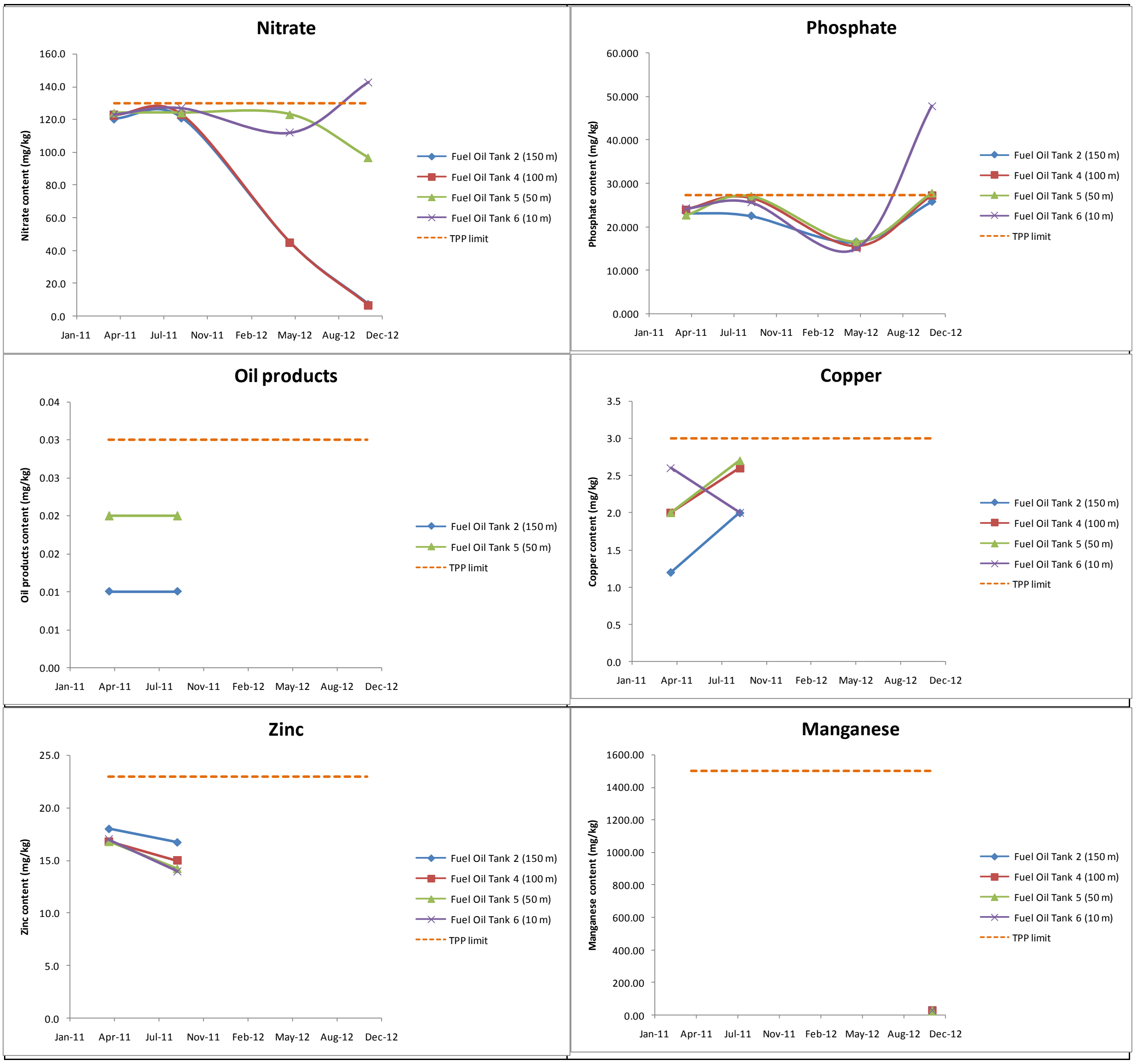
Bad condition of the pipe asbestos isolation that is exposed.

The mazut secondary containments are not made of impervious, chemically resistant material (which is a requirement of the World Bank guidelines) as shown in the following pictures:

Mazut secondary containment material is soil. No impervious material.

Potential mazut spot over the soil basement

At the Takhiatash TPP, samples from four different points are analyzed in a twice-a-year basis. These points are located in the vicinities of the Mazut tanks, at 10, 50, 100 and 150 m of distance. The sampling depth ranges from 0 to 30 m. In the following charts, measurements of years 2011 and 2012 can be observed. Comparison with national soil standards has been also included.



Nitrates and phosphates. The content of phosphates does not vary significantly and is very close to the national limits (27.2 mg/kg). The content of nitrates shows a wide variation and is also below the national MAC (130 mg/kg).

Oil products. Oil products appear in soil samples in a concentration between 0.01 and 0.02 mg/kg, which is below the national limit (0.03 mg/kg) and, logically, it decreases with the distance to the fuel tanks.

Metals. Copper was detected at levels ranging between 1.2 and 2.7 mg/kg, whereas the detected levels of zinc vary between 14 and 18 mg/kg. As it can be observed in the charts, the national MACs are not exceeded.

The above results show that there is not soil pollution outside the secondary containments of mazut tanks for those parameters. Nevertheless, visual inspection of basement of secondary containments shows potential mazut spots.

There is no evidence of the size of the secondary containments fulfilling volume required by the World Bank.

Tanks of chemical products are bounded with impervious and chemical resistant material.

There is a chemical storage consisting in a closed warehouse with a basement of concrete, a ventilation valve and roofed.

There is no evidence of proper labeling of hazardous materials.

There is no evidence of absorption devices that facilitate gathering chemical products in the event of a spill.

E. Waste management

During the audit site visit, the following evidences of solid waste storage and disposal were found:

 Bin for communal wastes	 Wood debris storage
 Bin for oiled rags	 Used oil bin

 Room for storage lamps	 Used batteries storage
 Used rubber storage	 Municipal landfill used by the TPP

No evidence of the following storage as defined by the TPP was found:

- Concrete covered storage for asbestos and thermo isolation materials
- Metal container for paronite

There is not specific hazardous waste storage but there are different storages for some of the hazardous wastes spread at the site. There are not evidences that for liquid wastes stored greater than 220 liters there is a secondary containment that should be at least 110% of the largest storage container or 25% of the total storage capacity (whichever is greater).

Generally speaking, there is not segregation between hazardous and non hazardous wastes at the current TPP waste management. Hazardous (used paronite, oil sludge, used cationite, used electric isolated materials) are mixed with domestic wastes and send to the municipal landfill. As shown in a previous picture, there is not an environmental design of the Municipal landfill which doesn't include features liners, geotextile, drainage, leachate treatment, etc. These mean that hazardous and non hazardous wastes are dumped directly into the soil which probably could cause soil and groundwater pollution and also health risks.

Asbestos, which are not allowed in industrialized countries, are being reused.

Oiled rags, which should be classified as hazardous wastes, are burned in boiler furnace which has not a proper exhaust gases treatment needed for hazardous wastes combustion which could cause introduction of hazardous materials into the atmosphere.

Only “Vtorchermet” waste collection contractor contract/waste records have been checked. There are no evidences of contract or waste records for the rest of the contractors: oil base storage, Artur LLC, Vtorsyrye, fluorescent lamps collection company, municipal landfill, etc.

There is a tracking of waste generation trends by type and amount of waste generated, carried out on an annual basis.

F. Noise:

At the TPP site, there is not background noise data as a noise campaign has never been performed.

With the purpose of knowing the currently background level noise in the surrounding areas of Takhiatash TPP, a background noise level measuring campaign was carried out on 4th and 5th March 2013 in the day and at night time. Noise measurements were conducted twice per day, always in accordance with appropriate national regulation GOST 12-1050-86 «Method of noise measurements at the working places”. Results of the campaign are shown in Annex IV attached to this EIA.

The measuring points were selected in certain places in order to be representative of the levels of noise at Takhiatash TPP site. Half of the points are located along the zone’s perimeter, bounding the current thermal power plant (points 1 to 4, located at industrial area); the other four are outside the plot of the power plant in order to be representative of the noise perceived by the population of the nearby settlements (points 5 to 8, located at residential areas).

These measuring points are included in the image below.

Figure 18. Location of monitoring points for noise measurements.

For sound level measuring a Noise meter -003-M2_No 2431 was used, tested on 9th September 2012 with number of certificate 786/05.

Residential areas noise standards are the same for the national and World Bank standards. Industrial areas noise standards are included just in the World Bank guidelines.

Results of the background campaign are shown in the table below. This is the final summery of all the data gathered by the campaign. They have been processed in order to obtain an average for day and night time, and draw conclusions about currently background level noise at Takhiatash TPP.

Table 19. Results of the pre-operational campaign.

Point	Receiver	Monitoring campaign results (dB(A))		Reference standard, by law (dB(A))	
		Day	Night	Day	Night
P1	Industrial area	55	62	70	
P2	Industrial area	54	60		
P3	Industrial area	55	62		
P4	Industrial area	51	44		
P5	Residential area	53	54	55	45
P6	Residential area	58	64		
P7	Residential area	48	40		
P8	Residential area	45	43		

G. Contaminated land and groundwater

In order to study the groundwater composition, a piezometric network formed by 57 wells-piezometers was deployed at the TPP. The location of the wells where the analysis where performed is shown in the following figure.

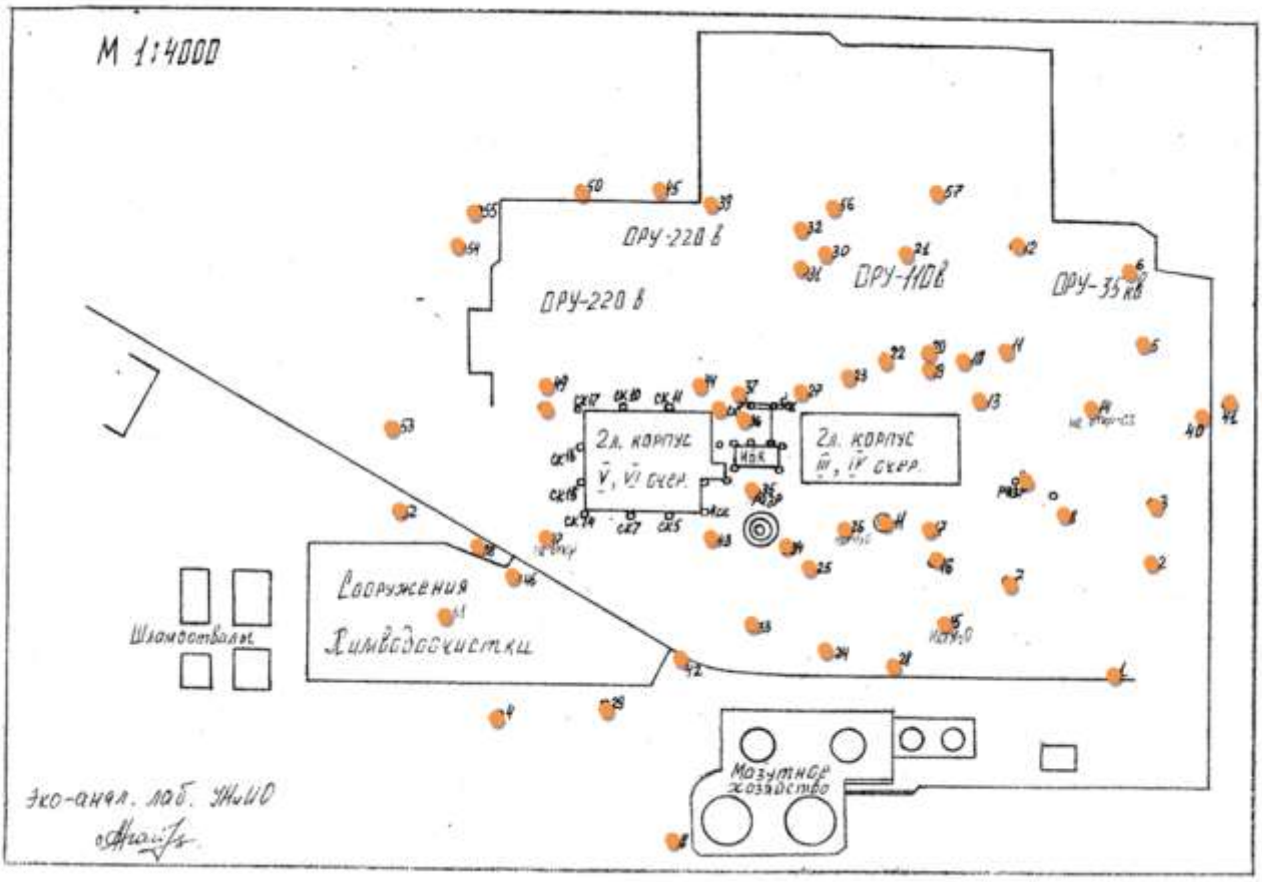


Figure 19. Groundwater sampling site.

Uzbekenergo carries out regular monitoring (every three months) of underground water quality inside the wells.

The parameters measured provided are typical to assess quality of groundwater but not potential contamination.

During the audit visit, a snow layer didn’t allow to proper inspectorate potential soil visible spots or contamination.

There are no evidences of the previous use of the land on the TPP not to be industrial.

H. Health and safety:

Takhiatash TPP has several health and safety procedures which are designed to fulfill national legislation. After reviewing these procedures to compare them with the IFC EHS general guidelines (2007) the following conclusions have been gathered:

a) Occupational health and safety

Regarding "General facility design and operation":

1. Integrity of workplace structures: construction regulations require the design of the facilities in accordance with appropriate national sanitarian norms and standards. The TPP meet these requirements of work safety.
2. Fire precautions: All the departments are equipped with fire detectors and alarm system. A special department (fire protection) is responsible for fire precaution. The fire protection department is located outside of the TPP and it is equipped with necessary facility and staff for firefighting. Worker places defined as appropriate are equipped with fire protection facilities. Every department has a scheme of how to proceed in an evacuation or emergency situation. Trainings on fire safety are conducting by the fire protection department on a quarterly base. Staff from the fire protection department conducts a daily round trip. In addition, the special fire protection team supervises each department on a monthly base.
3. Potable water supply and lavatories and showers: Takhiatash TPP consumes drinking water form municipal water supply organization "Takhiatash vodocanal". This entity is responsible for providing drinking water quality, which meet national standards. There are lavatories in each department at the TPP.
4. Clean eating area: The TPP has its own eating facility – dining room located in the administrative building. The dining room is equipped with all necessary facilities to provide safe food.
5. First Aid: There is a medical center to provide first aid and initial medical treatment for workers on the TPP. Department dealing with chemicals materials has shower facilities and first aid set for accidents. The trainings and tests on providing first air are conducting by the Work safety department on a regular basis.
6. Air supply, Lighting, work environment temperature: Ventilation, work environment temperature and air supply in some work places are not complying with the established national and World Bank requirements.
7. Severe weather and facility Shutdown: There are several refuges on the territory of the Takhiatash TPP. They serve as safety places for emergency situations in cases of natural (earthquakes, hurricanes, flooding) and anthropogenic disasters. Activities undertaken during emergency situation and evacuation plan are provided in the Action Plan in Emergency Situations at the Takhiatash TPP. There are schemes of evacuation on every floor of each TPP's department. Regularly trainings and drills to practice the procedure and plan are undertaken annually. Such drills are conducting annually by a team composed by the engineer on civil safety, representatives of the Ministry on Emergency situations of the Karakalpakstan Republic and local government authority – hokimiyats.
8. Work places and exit: The space provided for each worker is designed in accordance with the appropriate national construction requirements and should be adequate for safe execution of all activities. Nevertheless, some works conducting in temporary manner are executing in uncomfortable positions. This is taking into the account during the work

place assessment and defining the special privileges (additional holydays, earlier retirement) for workers implementing such works. In accordance with TPP fire protection procedure, the passages to emergency exists should be unobstructed at all times. Every exit has a light with sing “Exit” supplied with autonomy energy sources. Special signs indicating direction of movement during emergency situation are placed at the walls.

Regarding “Communication and training”:

Training system at the TPP almost fully comply with World Bank standards on communication and training. Almost all topics are covered. Nevertheless, there is no visitor orientation, as it was checked in the day of the audit visit.

Regarding “Physical hazards”:

Equipment on the TPP has maintenance guideline describing work safety procedures.

Regarding “Chemical hazards”:

There is a procedure on handling hazardous chemicals, their storage and transportation. According to the regulation, special equipment is required to proper organizing this activity. Rooms and departments dealing with hazardous chemicals have a ventilation system and specific PPE. However, in some of the cases chemicals are not storage properly.

Regarding “Personnel Protective Equipment”:

According to procedures adopted at the TPP, workers have to be equipped with PPE such as helmets, eye and face protection, head protection, respiratory protection. Observation conducted at the TPP during the day of the audit visit showed that these requirements are not fully implemented at the TPP. There is no practice to provide PPE for visitors either.

Regarding “Special hazard environments”:

Confined space for electrical equipment at the TPP is designed in accordance with national construction requirements (Electrical Code). There are no places with special hazards environment at the TPP.

Regarding “Monitoring”:

Occupational health and monitoring programs at the TPP includes the following activities:

- Observing the equipment of work places on complying with work safety requirements and its execution by workers;
- Implementation of action plan on the training activities on work safety and fire protection;
- Preparing quarterly reports on the performed activities.

“Uzenergosozlash”’ experts conduct a surveillance of the work environment twice a year. This entity has the certificate on conducting evaluation. All equipment used during the surveillance must have certificates. The same organization conducts an assessment of work places at the TPP every five year. At the Tahkiatash TPP last evaluation of working conditions has been conducted in 2011.

Noise measurements for Takhiatash TPP have been done at 96 working places. Measurements showed exceeding of norms at the most of the reviewed places (around 80%). The biggest exceeding was at the generator - 23 dBA above norm.

Vibration measurements have been also conducted at the places with potential exceeding norms for vibration. 8 working areas have been observed. Vibration level at the most of the reviewed places also exceeds norms. The highest exceeding was observed at the area close to generator – PAN 8 a. Vibration exceeded norm on 8 dB

Microclimate measurements have been conducted for 82 working places. Relative humidity didn't exceed norms, but temperature of most of the work places exceeded norms (around 90% of observed areas).

Air quality has been assessed at 18 work places. Measurements were done for potential pollutants for each place. The maximum exceed has been observed for CO (measured concentration was 36 mg/m3 and allowed 20 mg/m3) at the boilers drum and lime dust (36 mg/m3 and 6 mg/m3 accordingly) at the chemical reagents storage house. Exceeding on asbestos dust have been observed during turbine repairing (14 mg/m3 and 6 mg/m3 accordingly).

Training activities for the employees are conducting at the regular base in accordance with approved work schedule plan. Information on conducted trainings, number of participants and themes of the topics are reported to the main H&S main department in Uzbekenergo on the quarterly and annually basis.

Reporting on occupational accidents and diseases are implementing in accordance with Resolution of Cabinet Ministries of RUz # 286 dated 6 June 1997 "Regulation on consideration and accounting of accidents and other damage of workers health at the production". This regulation almost fully complies with World Bank requirements on this matter.

b) Community health & safety

Regarding "Emergence preparedness and response":

Emergency response procedure has not been provided and therefore has not been possible to check the level of compliance of the World Bank guidelines.

I. Training:

Training system regarding health and safety issues almost fully comply with WB standards. Nevertheless, training in environmental management is not ongoing. There is no evidence of training materials.

J. Social management and communication:

There is not a support or collaboration program with the local communities.

There is not a grievance or complaints mechanism ongoing.

Local communities are not informed of the environmental management plan results and environmental reports are not available to the public.

Emergency plan of the TPP is not communicated to the local population.

5. Findings and areas of concern

The findings may refer to non-compliance with the requirements of the applicable reference standard. Findings and areas of concern arise when there are differences between the requirements and objective evidence.

Once the documentation review, interviews with EHS staff, site reconnaissance, and assessment of the environmental monitoring results have been carried out, the following findings and areas of concern were found:

A. General EHS management, monitoring and report:

There is not a specific environmental, health and safety team with a visible head. There are different tasks (monitoring) undertaken by different areas of the TPP organization structure but without a global perspective and management. An Environmental, Health and Safety Management Team should be appointed within the Takhiatash TPP organization structure with a visible head in order to gather, analyze, solve and report all the related issues from an integrated point of view. Even of number of staff dedicated to environmental, health and safety issues is apparently in correspondence with the TPP, an improvement and updating training program should be provided to the EHS team in order to gather the technical requirements needed. If after training is concluded that an extension of the team would be needed, this should be provided.

An analysis of national methods of the monitoring program should be undertaken in order to check if they comply with quality and strictness of the international methodological standards, such as those published by the International Organization of Standardization (ISO).

The automated and manual equipment should be strictly calibrated in accordance with exactness and requirements of international standards. A plan of calibration and maintenance should be implemented.

Sampling and analysis Quality Assurance/Quality control (QA/QC) plans should be implemented. Analysis and monitoring results should be recorded in automatic and electronic format to improve their assessment.

The annual reports should further summarize the activities undertaken onsite and provide a general idea of the environmental monitoring undertaken onsite in addition to noting compliance with applicable national and international standards. Annual reports include just quantity of emissions, water and waste water flow rates and quantity of waste generated. These annual reports should be completed with other aspects as GHG emissions, air quality and meteorology, noise, water and groundwater quality, soil quality, waste management, health and safety issues and grievance mechanism findings.

It turns out to be advisable the implementation of an Integrated Management System in the existing Takhiatash TPP in a short-term/medium-term period. This would allow the Power Plant to integrate all of organization's processes in to one compete framework, enabling an organization to work as a single unit with unified objectives, promoting a constant improvement in the performance of the entire Power Plant.

In addition, and as the essential point of this recommendation, developing a Management System in accordance with international standards would assure the fulfillment of all *Environmental*, *Health&Safety* and *Quality* requirements established by international legal framework. The implementation could be undertaken in several stages in order to gradually integrate EHS management into the normal operation of the power plant.

Moreover, an effective management system brings many benefits to the organization:

- More efficient resource use

- Improved risk management
- Increase customer satisfaction
- Lower costs

There are three international standards which could be followed:

- ISO 9001 (Quality Management System)
- ISO 14001 (Environmental Management System)
- OHSAS 18001 (Occupational Health and Safety Management System).

B. Air emissions and ambient air quality

In order to improve efficiency of the TPP and therefore to reduce emission of pollutants and GHG, replacement of the old inefficient units by a new and efficient one is highly advisable. Conventional TPPs run with an average thermal efficiency of 31%, compared with 55% of advanced combined cycle gas turbine (CCGT) technology.

As can be observed in the graphs of the previous section, the existing emission values in the TPP do not exceed the approved national MAEs. MAEs are based on flue mass rate units which could allow diluting the exhaust gas emitted to the atmosphere. These MAEs should be based in concentration units. Nevertheless, both stacks exceed World Bank emission standard for NOx. For stack 2, boilers 7 and 8 are the highest contributors. For stack 1 the contribution of the boilers 1 to 4 is quite similar. This conclusion is logical if we take into account age of existing technology at the TPP. In order to improve the emission standards fulfillment, replacement of the old technology by a new and more efficient one should be considered.

As indicated in the World Bank guidelines, "a continuously monitoring of emissions or indicative parameters" should be implemented. An annual emission test at stacks should be undertaken also.

Direct emissions of GHG from the facilities owned or controlled within the physical TPP boundary and indirect emissions associated with the off-site production of power used by Takhiatash TPP should be quantified. Quantification and monitoring of GHG emissions should be conducted annually in accordance with internationally recognized methodologies.

Regarding air quality monitoring, as location of the two existing air quality stations are far away and not in the wind direction from and of the TPP, air quality for parameters consistent with the relevant standards should be monitor either by passive samplers (monthly average) or by seasonal manual sampling (e.g. 1 week/season) at maximum ground level concentration point / sensitive receptors / background point). Measures recorded by the two existing air quality stations and their assessment could be included within the environmental annual reports in order to gather a more complete baseline. All air quality measures could be assessed with the correspondent emissions, speed and wind direction from the TPP in order to conclude the origin source direction that contribute to air pollution.

C. Waste water and ambient water quality

The increase in temperature from intake to discharge points is quite high. The maximum allowable temperature increase defined by World Bank standards is set at 3ºC, value which is greatly exceeded by the TPP discharge. In order to reduce this temperature increase, the conversion of the open cooling water system into a closed one would be highly advisable.

Regarding oil and grease concentration at the discharge point, the origin of the oil spot seen on the audit visit should be find out. In this respect, confirmation of oily effluents not being discharged to Suenly canal should be required to the TPP. Nevertheless, arrangement of the oily waste water treatment facility should be undertaken.

An agreement with the Municipal waste water treatment plant should be put in place to include World Bank indicative values for treated sanitary sewage discharges.

Evaporation sludge ponds should be improved to assure impermeability.

Water quality analysis undertaken by the TPP every 15 days should include World Bank standards for effluents also.

D. Hazardous materials management

Use of asbestos should be avoided or replaced by a non-hazardous material. Asbestos exposure should be not allowed.

Mazut secondary containments should be adapted to assure impervious and chemically resistant characteristics. Basement and walls should be covered by a material gathering these characteristics.

Evidence of the size of the secondary containments fulfilling volume required by the World Bank should be required to the TPP.

Hazardous materials should be correctly labeled and safety sheets visible.

Absorption devices and spill response procedure should be implemented.

E. Waste management

Basel Convention signed by Uzbekistan, general and waste management facilities EHS IFC guidelines (2007) should be fulfilled in the waste management system at the TPP. A waste management hierarchy that consider prevention, reduction, reuse, recovery, recycling, removal and finally disposal of wastes should be considered. This includes an update of the waste management policy every time a new procedure for prevention, reduction, reuse, recovery, recycling and removal can be introduced in the process or operation management. When a new waste stream is generated, this must be fully characterised, periodic characterisation must be documented, and the waste must be properly handled, in particular hazardous waste. Final disposal must be undertaken in an environmentally sound manner.

Minimizing hazardous waste generation must be carried out by implementing stringent waste segregation to prevent the commingling of non-hazardous and hazardous waste to be managed. Hazardous wastes should be classified according to Basel Convention (see column 10 of table 10).

Takhiatash TPP should be equipped with drums and other suitable containers for collecting hazardous and non hazardous wastes. Their location should be conspicuously marked and made known to all site workers.

For hazardous wastes:

- There will be a temporary storage of hazardous wastes. Solid wastes contained asbestos should be storage into places where they will not be destroyed during period of storage as national legislation requires.
- Waste is stored in a manner that prevents the commingling or contact between incompatible wastes, and allows for inspection between containers to monitor leaks or spills. (sufficient space between incompatibles or physical separation such as walls or containment curbs)

- Store in closed containers away from direct sunlight, wind and rain
- Secondary containment is included wherever liquid wastes are stored in volumes greater than 220 liters. The available volume of secondary containment should be at least 110 % of the largest storage container, or 25 % of the total storage capacity (whichever is greater), in that specific location. Should be constructed with materials appropriate for the wastes being contained and adequate to prevent loss to the environment
- Provide adequate ventilation where volatile wastes are stored.

The performance of regular audits on the waste segregation and collection practices shall be undertaken.

Types of wastes generated will be packaged and labeled in homologated containers.

After being collected, waste shall be processed depending on type. Sludge from waste treatment plant and water supply treatment needs to be evaluated on a case-by-case basis to establish whether it constitutes a hazardous or a non-hazardous waste.

The current management of wastes of the TPP can be used but some of the procedures should be corrected to fulfill international good practices:

<u>Non-hazardous wastes:</u>

- Reuse

Solid precipitation of the settling tank and pulp dump will be use in agricultural needs as fertilizer only if analyses of the pulp characteristics conclude that there are not hazardous or toxic compounds that could cause a health risk. Should not be accepted a waste that contains organics that are contaminated by potentially hazardous chemicals and/or pathogenic substances and micro-organisms that will not be rendered harmless by the process or may constitute a health or environmental risk.

- Recycle

Iron, metal debris, stubs, wool debris, waste rubber and tires, waste paper and other recyclable waste fractions can be selling to the enterprises currently being used.

- Recover

Only non-hazardous wastes can be burned in existing boiler furnaces.

- Dispose

Rest of non-hazardous wastes that are not being recycled as household and similar waste should be transported to a properly designed, permitted and operated landfill. Municipal landfill currently being used by the TPP is not design in an environmentally sound manner. As an option, an improvement of the landfill to avoid soil and groundwater pollution is recommended. Following measures could be followed:

- Location of the municipal landfill further than 250 meters to residential areas and follow location recommendations of the IFC guidelines.
- Soil cover material, with base and side slopes designed o minimize infiltration and facilitate collection of leachate.
- Low-permeability landfill liners to prevent migration of leachate.
- Drainage and collection system and landfill cover (daily, intermediate, and final) to minimize infiltration.
- Leachate treatment on site and/or discharge to municipal wastewater treatment.

- Perimeter drains and landfill cell compaction, slopes and daily cover materials to reduce infiltration of rainfall into the deposited waste.
- Prevention system of the run-on precipitation into the active area of the landfill and a collection and control run-off system.
- Quantity and quality of leachate generated measured and recorded.
- Groundwater monitoring wells.

Hazardous wastes:

Hazardous waste storage, transfer, disposal and treatment will be done by an authorized waste management facility. The contractors handling, treating and disposing hazardous waste should be reputable and legitimate enterprises, licensed by the relevant regulatory agencies and following good international industry practice for the waste being handled (ensuring compliance with applicable local and international regulations).

- Recycled:

Fluorescent lights shall be delivered to a specialized organization on lamp utilization as it is being doing up to now.

- Recover:

Hazardous wastes cannot be burned at existing boiler furnaces as they are not provided with exhaust gas treatment. Hazardous wastes can be burned or incinerated just in approved installations with the proper treatment for exhaust gases in order not to introduce hazardous compounds into the atmosphere.

- Disposed:

If there is not a hazardous waste landfill or storage which have the technical capability to manage the waste in a manner that reduces immediate and future impact to the environment neither the permits, certifications, and approvals of applicable government authorities, an specific facility must be constructed or adapted to provide sound long-term storage of wastes on-site or at an alternative appropriate location up until external commercial options become available. In this respect, mazut storage tanks located at 35 km from the TPP can be used as long-term hazardous waste storage considering the following specific adaptation measures:

- Remaining mazut should be completely removed or stabilizated in such a way to avoid potential mixture with the hazardous waste to storage
- Reparation of the potential cracks and fissures that concrete wall, floor and roof could have.
- Divide the tanks into different cells to separate wastes with different properties
- Cement should have low-permeability and be chemically resistant. Otherwise a liner gathering these characteristics should be installed.
- Install a leachate collection and removal system if needed
- Install a groundwater monitoring wells network

Direct discharge will be never allowed on the ground.

The documentation concerning the delivery of waste and contracts/agreements with waste managers should be stored. Records tracking hazardous waste received, stored, or sent out should include: name and identification number, physical condition, quantity, method and date of storage, location of waste at the facility and amount deposited in each area.

F. Noise

As can be noticed in the table included in the previous chapter, where noise measurements of the campaign performed are compared with national and international noise standards, noise levels measurements exceed the limits in two cases. Night measures in points P5 and P6 do not comply with the limits established, as well as day noise levels for P6. This might be due to the proximity of Takhiatash TPP to residential areas which are considered as special sensitive places.

The highest level of noise was measured in point No 6. It is a residential settlement of a former army unit and the houses are located in close proximity to the fence of the plant (see below picture).

Figure 20. Closer houses to the TPP at the southeast area

Apart from the points already mentioned, measurements carried out in all the other points show that the background noise levels comply with the requirements established by the standards.

In order to decrease noise level at the surrounding residential areas, it is highly advisable that old and noisy units are replaced by new and more efficient technology with lower noise emission.

An annual noise campaign should be implemented in order to assess the fulfillment and evolution of noise standards. If complaints about noise arise, a study of noise mitigation measures should be carried out and the best solution implemented.

G. Contamination land and groundwater:

In order to properly assess soil and groundwater potential pollution caused by the operation of the TPP, some of the 57 wells located at the TPP require reconstruction as they are inactive. On top of that, the existing well network should be extended with new wells in areas where soil and groundwater pollution have a higher probability of occurrence by adding one well below each site in the direction of groundwater to surface waterways. These areas are:

- Within the secondary containments of the mazut, oil and chemicals tanks
- Hazardous storage areas
- Evaporation ponds area

Parameters to measure should be extended to include:

- pH
- Oil products
- Metals: arsenic, cadmium, cobalt, copper, chromium, lead, mercury (inorganic), nickel, zinc
- Organochlorine Pesticides
- Phenols

If soil contamination is found (for instance, within the mazut secondary containments) this should be removed and treated as hazardous waste.

H. **Health and Safety management**

Some of the procedures of the TPP are in compliance with international standards (World Bank Guidelines), nevertheless, other procedures are not fulfilling these standards or they even do not exist. Even in the case of the existence of a specific procedure, it doesn't mean that this procedure is ongoing. As an easy example detected in the audit visit, PPE are not used by workers on a regular basis and there is not a supervision to force their use. An update of the Health and Safety Plan and Procedures should be undertaken in order to ensure the World Bank guidelines (IFH EHS general and thermal power plants guidelines) implementation.

Surveillance of the work environment shows clear exceeds on health and safety standards. An improvement on the work environment should be conducted or obligation to use PPE to protect workers should be forced. For instance, management of asbestos at the TPP does not fulfill neither national nor international standards. National standards indicate that "during all process of operation on collecting and temporarily storage of wastes contained asbestos, all workers should wear appropriate wear and respirators"…"works related with wastes loading, transportation, unloading and disposal should be mechanized". Observation of the presence of asbestos at the open air and handling of them by workers shows that these standards are not been followed.

I. Training:

Training system should be improved and completed with a specific environmental management course for all the workers.

J. **Social management and communication:**

A grievance mechanism should be designed, communicated and implanted.

Local communities must be informed of the environmental management plan results by means of having access to the annual environmental reports.

The Emergency Plan of the TPP should be communicated to the local population. Only strategic plans should be confidential. Plans regarding safety of the personnel and population must be communicated and trained.

6. Corrective action plan, costs and schedule (CAP)

The Corrective Action Plan (CAP) must be considered as a set of recommendations to improve environmental performance of the Takhiatash TPP in order to achieve, step by step, an EHS management system at the level required by international institutions and good practices. It should be pointed out that this Corrective Action Plan should be agreed and budgeted by the TPP management unit in order to be implemented. Those corrective actions that only imply a management improvement could be implemented as soon as possible, taking advantage of the willingness of the TPP's staff. Other actions are included in the future project of modernization of the Takhiatash TPP.

The following table outlines the appropriate corrective actions proposed to solve the aforementioned remarks and non conformities along with a schedule for their implementation, the responsible parties and cost.

Table 20. Corrective action plan

(Where EA: Executing Agency Uzbekenergo; TPP EMT: Environmental Management Team of the TPP; EHS staff: Environmental, Health and Safety staff)

CORRECTIVE ACTION PLAN					
No.	**LTA remarks**	**Corrective Actions**	**Target date**	**Responsible Party**	**Estimated Cost**
General EHS management					
1	There is not a specific environmental, health and safety team with a visible head. There are different tasks (e.g. monitoring) undertaken by different areas of the TPP organization structure but without a global perspective and management.	• An Environmental, Health and Safety Management Team should be appointed within the Takhiatash TPP organization structure with a visible head in order to gather, analyze, solve and report all the related issues from an integrated point of view. • A specific training course should be provided to this EMP in order to provide the technical requirements. If after training it is concluded that an increase of the team members is needed, the appropriate experts should be provided to cover the gaps identified.	Before the Commissioning of the new CCPU	TPP director	Staff of the TPP. (see mitigation measure nº 47 of chapter 7 (EMP) of the EIA)
2	There is not an integrated environmental,	• The implementation of an Integrated Management System is highly advisable. This would allow the TPP to integrate all the organization processes into	Short-term/medium-term period. The schedule of	TPP director	Included in the future project of

CORRECTIVE ACTION PLAN					
No.	**LTA remarks**	**Corrective Actions**	**Target date**	**Responsible Party**	**Estimated Cost**
	health and safety management system ongoing.	one single and complete framework, enabling to work as a single unit with unified objectives, promoting a constant improvement in the performance of the entire TPP. The development of a Management System in accordance with international standards (e.g. IFC EHS general and thermal power plants guidelines) would ensure the fulfillment of all Environmental, Health&Safety and Quality requirements established by international legal framework.	implementation must be agreed by the Takhiatash TPP management unit. The implementation could be undertaken in several stages in order to gradually integrate the EHS management into the normal operation of the TPP.		modernization (see mitigation measure nº 1 of chapter 7 (EMP) of the EIA)
Monitoring program					
3	There is no evidence of national methods of the monitoring program complying with international methodological standards.	• A review of national methods of the monitoring program should be undertaken in order to check their compliance with quality and strictness of the international methodological standards, such as those published by the International Organization of Standardization (ISO).	As soon as the mobilization of implementation consultant	TPP EMT	Staff of the TPP. If an specific consultant needs to be hired for the analysis:

CORRECTIVE ACTION PLAN					
No.	**LTA remarks**	**Corrective Actions**	**Target date**	**Responsible Party**	**Estimated Cost**
	Apart from the government requirements in terms of annual air emissions, effluent flow rate and quality and wastes quantities other parameters should be monitored: continuous monitoring of emissions (SO_2, NO, NO_2, CO, O_2, Temperature, pressure and water vapor); air quality (SO_2, NO_2, NO, TSP, PM_{10}, $PM_{2.5}$, CO); meteorological data (wind speed and direction, atmospheric				30000$US

CORRECTIVE ACTION PLAN					
No.	**LTA remarks**	**Corrective Actions**	**Target date**	**Responsible Party**	**Estimated Cost**
	pressure, relative humidity and temperature); noise; effluents (total residual chlorine, Cr, Cu, Zn, Pb, Cd, Hg, As)				
4	There is no evidence of national requirements for calibration for automated and manual equipment being in accordance with exactness and requirements of international standards. There is no Calibration and Maintenance Plan.	• Automated and manual equipment should be strictly calibrated in accordance with exactness and requirements of international standards. • A calibration and maintenance plan should be implemented. Calibration should be normally undertaken annually, but this depends on the specific equipment.	As soon as the mobilization of implementation consultant	TPP EMT	Staff of the TPP. If an specific consultant needs to be hired for the analysis: 30000$US

CORRECTIVE ACTION PLAN					
No.	**LTA remarks**	**Corrective Actions**	**Target date**	**Responsible Party**	**Estimated Cost**
5	There is no evidence of sampling and analysis Quality Assurance / Quality Control Plans. Monitoring results are recorded in hardcopy	• Sampling and analysis Quality Assurance/Quality control (QA/QC) Plans should be implemented. • Analysis and monitoring results should be recorded in automatic and electronic format to facilitate their assessment.	As soon as the mobilization of implementation consultant	TPP EMT	Staff of the TPP. If a specific consultant needs to be hired for the analysis. 30000$US
Report					
6	Annual reports only include data on the quantity of emissions, water and waste water flow rates and quantity of waste generated.	• Annual reports should further summarize the activities undertaken onsite and provide a general idea of the environmental monitoring undertaken onsite in addition to noting compliance with applicable national and international standards. Annual reports should be complemented with other aspects such as GHG emissions, air quality and meteorology, noise, water and groundwater quality, soil quality, waste management, health and safety issues and grievance mechanism findings.	Annually, after commissioning of the new CCPU	TPP EMT	Staff of the TPP
Air emission and ambient air quality					

CORRECTIVE ACTION PLAN					
No.	**LTA remarks**	**Corrective Actions**	**Target date**	**Responsible Party**	**Estimated Cost**
7	The existing emission values in the TPP exceed World Bank emission standard for NOx.	• Replacement of the old technology by a new and more efficient one in order to fulfill with the emission standards and reduce the emission of pollutants and GHG. The project of the replacement of the old units III and IV by a new CCPU satisfies this requirement.	Commissioning of the new CCPU and decommissioning of the old units III and IV	EA	Included in the future project of modernization
8	There is not a continuous emission monitoring system. National MAEs standards are based on flue mass rate units. This could allow the dilution of the exhaust gas emitted to the atmosphere.	• As indicated in the World Bank Guidelines, "a continuously monitoring of emissions or indicative parameters" should be implemented. • Exhaust gas emission pollutants should be measured in a concentration basis, including the percentage of oxygen and indicating if these measurements have been made in dry or wet basis. In the latter case, the percentage of water should be also measured. (see mitigation measure nº 10 in chapter 7 (EMP) of the EIA)	Short-term/medium-term period. The schedule of implementation must be agreed by the Takhiatash TPP management unit.	TPP EMT	720500 $US
9	There is not an annual emission test undertaken at the stacks	• An annual emission test at stacks should be undertaken. (see mitigation measure nº 50 in chapter 7 (EMP) of the EIA)	As soon as the mobilization of implementation consultant.	TPP EMT	(see mitigation measure nº 50 in chapter 7 (EMP) of the EIA)

CORRECTIVE ACTION PLAN					
No.	**LTA remarks**	**Corrective Actions**	**Target date**	**Responsible Party**	**Estimated Cost**
10	Calculation of GHG emission during the operation of the TPP is not being undertaken.	• Direct emissions of GHG from the facilities owned or controlled within the physical TPP boundary and indirect emissions associated with the off-site power production used by Takhiatash TPP should be quantified. Quantification and monitoring of GHG emissions will be conducted annually in accordance with internationally recognized methodologies (2006 IPCC "Guidelines for National Greenhouse Gas Inventories": Volume 1: General Guidance and Reporting and Volume 2: Energy)	As soon as the mobilization of implementation consultant.	TPP EMT	Staff of the TPP- (see mitigation measure nº 49 in chapter 7 (EMP) of the EIA)
11	Neither ambient air quality nor meteorology measurements are being undertaken at the TPP.	• Air quality for parameters consistent with the relevant standards should be monitored either by passive samplers (monthly average) or by seasonal manual sampling (e.g. 1 week/season) at maximum ground level concentration point / sensitive receptors / background point). The project of modernization includes a fixed air quality station and a meteorology station (see mitigation measure nº 11 in chapter 7 (EMP) of the EIA). • Measurements recorded by the two existing air quality stations and their assessment could be included within the environmental annual reports in	Before the commissioning of the new CCPU	TPP EMT	Included in the future project of modernization. (see mitigation measure nº 11 in chapter 7 (EMP) of the EIA).

CORRECTIVE ACTION PLAN					
No.	**LTA remarks**	**Corrective Actions**	**Target date**	**Responsible Party**	**Estimated Cost**
		order to gather a more complete baseline. • All air quality measurements could be assessed with the correspondent data on emissions, wind speed and wind direction from the TPP in order to determine the source direction that contributes to air pollution.			
Wastewater and ambient water quality					
12	The maximum allowable temperature increase defined by World Bank standards is set at 3ºC, value which is greatly exceeded by the TPP's discharge effluent.	• In order to reduce this temperature increase, the conversion of the open cooling water system into a closed one would be highly advisable. The project of the replacement of the old units III and IV by a new CCPU with a closed cooling water system partially satisfy this requirement.	Commissioning of the new CCPU	EA	Included in the future project of modernization

CORRECTIVE ACTION PLAN					
No.	**LTA remarks**	**Corrective Actions**	**Target date**	**Responsible Party**	**Estimated Cost**
13	An oil spot was visible in the discharge area on the audit visit day	• The origin of the oil spot should be found out. In this respect, confirmation of oily effluents not being discharged to Suenly canal is required. • Arrangement of the oily waste water treatment facility should be undertaken	Immediately	TPP direction	65000 $US
14	There is no evidence of fulfillment of the World Bank indicative values for treated sanitary sewage discharges at the Municipal Waste Water Treatment Plant.	• An agreement with the Municipal waste water treatment plant should be made in order to evaluate the fulfillment of World Bank indicative values for treated sanitary sewage discharges (see table 9). In case of Municipal Waste Water Treatment Plant not being fulfilling World Bank standards for sewage effluents, the TPP should implement the adequate treatment to comply with these standards.	Immediately	TPP director	N/A
15	Evaporation ponds are in bad condition (cracked and corroded)	• Evaporation sludge ponds should be improved to ensure impermeability. This can be done by adding another layer of concrete or a liner covering the current one. Concrete/liner should be resistant to extreme changes of temperature (winter-summer),	Short-term/medium-term period. The schedule of implementation must be agreed by	TPP director	74000 $US

CORRECTIVE ACTION PLAN					
No.	**LTA remarks**	**Corrective Actions**	**Target date**	**Responsible Party**	**Estimated Cost**
		impervious and chemically resistant to the sludge to storage. Previously to the arrangements, sludge should be correctly disposed according to their characteristics (see waste management corrective actions).	the Takhiatash TPP management unit.		
16	Water quality analyses at the intake and discharge points do not take into account World Bank effluent standards.	• Water quality analysis undertaken by the TPP every 15 days should include the measurement of all the parameters regulated by the World Bank standards for effluents. (see mitigation measure nº 42 in chapter 7 (EMP) of the EIA).	As soon as the mobilization of implementation consultant. It should de undertaken from the beginning of the construction phase in order to gather a more extended baseline previously to the CCPU operation.	TPP EMT	Included in the future project of modernization. (see mitigation measure nº 42 in chapter 7 (EMP) of the EIA)
Hazardous materials management					
17	Use of asbestos still ongoing at the TPP. These hazardous materials are not	• Use of asbestos should be avoided and replaced by non-hazardous materials. The replacement material recommended is rockwool fiber or vermiculite without asbestos (or similar materials assuring that non hazardous materials are included in the	Immediately	TPP director	Considering: 1.- Asbestos = 1,365 $US/ton 2.- A regular annual

CORRECTIVE ACTION PLAN					
No.	**LTA remarks**	**Corrective Actions**	**Target date**	**Responsible Party**	**Estimated Cost**
	allowed in industrialized developed countries	composition). • Asbestos exposure should not be allowed. • Handling (repair or removal and disposal) of existing Asbestos Containing Materials (ACM) in buildings should: 3. Be only performed by specially trained personnel. Training of specialized personnel and the maintenance and removal methods applied should be equivalent to those required under applicable regulations in the United States and Europe (examples of North American training standards are available at: http://www.osha.gov/SLTC/asbestos/training.html) 4. Follow host country requirements, or in their absence, internationally recognized procedures (Examples include the American Society for Testing and Materials (ASTM) E 1368 - Standard Practice for Visual Inspection of Asbestos Abatement Projects; E 2356 - Standard Practice for Comprehensive Building Asbestos Surveys; and E 2394 - Standard Practice for Maintenance, Renovation and Repair of Installed Asbestos			requirement of isolation material of 94 tons/year: Cost increase due to the isolation material replacement: a) Rockwool 110,000 $US/year (2,535 $US/ton) b) Local vermiculite = 9400 $US/year (1,465 $US/ton)

CORRECTIVE ACTION PLAN					
No.	**LTA remarks**	**Corrective Actions**	**Target date**	**Responsible Party**	**Estimated Cost**
		Cement Products).			
18	The TPP's on-site mazut secondary containments are not impervious.	• Mazut secondary containments should be adapted in order to ensure conditions of imperviousness and chemical resistance. Basement and walls should be covered by a material gathering these characteristics.	Short-term/medium-term period. The schedule of implementation must be agreed by the Takhiatash TPP direction.	TPP director	65000 $US
19	There is no evidence of the actual volume design of mazut secondary containments	• Evidence of the fulfillment of the size of mazut secondary containments with the World Bank standards is required. This volume should be the larger of 110 % of the largest tank or 25% of the combined tank volumes	Immediately	TPP EMT	Staff of the TPP
20	There is no evidence of hazardous materials labels and safety sheets visible on hazardous storage places.	• Hazardous materials should be correctly labeled and safety sheets visible. Example of labeling:	Immediately	TPP EMT	Staff of the TPP

CORRECTIVE ACTION PLAN					
No.	**LTA remarks**	**Corrective Actions**	**Target date**	**Responsible Party**	**Estimated Cost**
					
21	There is no evidence of absorption devices and spill response procedures implemented.	• Absorption devices and spill response procedures should be implemented in order to prevent hazardous materials or wastes spillage. (see mitigation measure nº 51 in chapter 7 (EMP) of the EIA)	Immediately	TPP EMT	Staff of the TPP (see mitigation measure nº 51 in chapter 7 (EMP) of the EIA)
Waste management					
22	Current waste management does not comply with international standards and good practices.	• A new waste management system should be implemented in order to adapt he procedures to international guidelines and good practices. The new waste management system should be based on the recommendations included in chapter 5 of this document.	Before the commissioning of the new CCPU	TPP EMT in close collaboration with local and national authorities	Included in the future project of modernization (see mitigation measure nº 54

CORRECTIVE ACTION PLAN					
No.	**LTA remarks**	**Corrective Actions**	**Target date**	**Responsible Party**	**Estimated Cost**
		(see mitigation measure nº 54 in chapter 7 (EMP) of the EIA)			in chapter 7 (EMP) of the EIA)
Noise					
23	Noise standard in close residential areas is exceeded at some points	• It is highly advisable that old and noisy units are replaced by new and more efficient technology with lower noise levels. The project of replacement the old units (III and IV) by the new CCPU satisfies this requirement.	Commissioning of the new CCPU and decommissioning of the old units III and IV	EA	Included in the future project of modernization
24	There is not noise monitoring campaigns undertaken within the environmental management of the TPP.	• An annual noise campaign should be implemented in order to assess the fulfillment and evolution of noise standards. In case of complaints about noise, a study of noise mitigation measures should be carried out and the best solution should be consequently implemented. (see mitigation measure nº 41 in chapter 7 (EMP) of the EIA)	As soon as the mobilization of implementation consultant. It should be undertaken from the beginning of the construction phase in order to gather a more extended baseline previously to the CCPU operation.	TPP EMT	(see mitigation measure nº 41 in chapter 7 (EMP) of the EIA)
Contamination land and groundwater					
25	Potential soil and	• Some of the 57 wells located at the TPP are inactive	Short-term/medium-	TPP EMT	Option 1: If

CORRECTIVE ACTION PLAN					
No.	**LTA remarks**	**Corrective Actions**	**Target date**	**Responsible Party**	**Estimated Cost**
	groundwater pollution is not well monitored and assessed within environmental management at the TPP.	and require reconstruction. The existing well network should be extended by adding one well below each site in the direction of groundwater to surface waterways at the following areas: - Within the secondary containments of the mazut, oil and chemicals tanks - Hazardous storage areas - Evaporation ponds area The following parameters should be also analyzed: - pH - Oil products - Metals: arsenic, cadmium, cobalt, copper, chromium, lead, mercury (inorganic), nickel, zinc - Organochlorine Pesticides - Phenols If soil contamination is found (for instance, within the mazut secondary containments), this should be removed and treated as hazardous waste.	term period. The schedule of implementation must be agreed by the Takhiatash TPP's direction.		new equipment is purchased for the new CCPU it can be used. Option 2: Cost for campaign for 4 wells 900 $US (3600 $US/yr)

CORRECTIVE ACTION PLAN					
No.	**LTA remarks**	**Corrective Actions**	**Target date**	**Responsible Party**	**Estimated Cost**
26	Bad condition of sludge or evaporation ponds, tanks and pipelines.	• Implementation of an inspection program to maintain the mechanical integrity of pressurized containers, tanks, pipe systems, ventilation and dump valve systems, brace infrastructure, automatic emergency stop systems, controls, pumps and related process equipment. • Periodic monitoring should be carried out to maintain the structural integrity (coatings and retention systems) of sludge ponds, oil, fuel and chemical storages/containers in order to avoid leaks. Where applicable, adequate repairs will be carried out. • Spill response and emergency plans to address accidental spillages should be prepared and implemented (see mitigation measure nº 51 in chapter 7 (EMP) of the EIA)	Immediately	TPP EMT	Staff of the TPP
Health and safety management					
27	Some of the procedures of the TPP do not fulfill	• An update of the Health and Safety Plan and Procedures should be undertaken in order to assure the implementation of World Bank Guidelines (IFH			

CORRECTIVE ACTION PLAN					
No.	**LTA remarks**	**Corrective Actions**	**Target date**	**Responsible Party**	**Estimated Cost**
	international standards (World Bank Guidelines), some other specific procedures are not being implemented and others do not even exist. Surveillance of the work environment shows clear exceeds on health and safety standards.	EHS general and thermal power plants guidelines). (see corrective action nº 2). • Some examples of procedures to de developed are: - Documentation Control - Recording Management - Risk Analysis - Legal Requirements - Internal Audit - Consultation & Communication - Management of Inspections and Control of Safety and Environmental Measures on the Site - Detection of Non-Conformities and AC/AP Monitoring - Sub-Contractor/Supplier Management - Training and Awareness - Accident and Incident Management - Definition of Structures and Responsibilities - PPE - Health and Safety Committee - EHS Performance Surveillance and Measurement - Confined Space			

CORRECTIVE ACTION PLAN					
No.	**LTA remarks**	**Corrective Actions**	**Target date**	**Responsible Party**	**Estimated Cost**
		- Marking - Fire Authorization - Monitoring of Noise Measurements - Management and Use of Sealed Radioactive Sources - Warning Status and Response to an Emergency Situation - Housekeeping - Internal Operation Plan - Monitoring of Measurement Devices. - Near-Miss			
Training					
28	No training on environmental management is ongoing.	• Training system should be improved and completed with a specific environmental management course for all the workers. Training can be provided by the TPP EMT and must include all the procedures that workers should take into account to improve environmental behavior of staff, especially waste management procedures (hazardous and non hazardous segregation, use of containers, etc.). A brief explanation of the TPP's environmental impact and the mitigation and monitoring measures	Immediately	TPP EMT	Staff of the TPP

CORRECTIVE ACTION PLAN					
No.	**LTA remarks**	**Corrective Actions**	**Target date**	**Responsible Party**	**Estimated Cost**
		undertaken regarding emission to the air, air quality, meteorology, noise and effluents should be also included.			
Social management and communication					
29	There is not any grievance mechanism or complaints mechanism ongoing.	• A grievance mechanism should be design, communicated and implanted. (see point 7.4 and chapter 8 of the EIA)	Immediately	TPP EMT	Staff of the TPP
30	Local communities are not informed of the environmental performance of the TPP.	• Local communities must be informed of the Environmental Management Plan results by means of having access to the annual environmental reports.	Immediately	TPP EMT	Staff of the TPP
31	Local communities are not informed of the Emergency Plan of the TPP	• The Emergency Plan of the TPP should be notified to the local population. The mahala to be informed is, at least, the closest one (1 Brigada, Kolhoz “khamza”, Khodjeyli district).	Immediately	TPP EMT	Staff of the TPP

7. Conclusions

First of all, the audit team would like to acknowledge the assistance and good treatment received during the carrying out of this audit.

The audit team notes that this audit has been conducted based on a sample and therefore there might be other non-conformities not identified in the report.

The non-conformities detected are related to non-compliance with regulatory requirements, as set out in the scope of the audit work.

As a result of the audit carried out, it has been concluded that the operation of the existing units of Takhiatash TPP exceeds some international standards (World Bank Group EHS Guidelines) regarding emissions, thermal discharge of effluents, noise and waste management. This is a logical conclusion given the worn out and old existing equipment. In this case, suitable mitigation measures such as the implementation of cleaner and more efficient technologies is highly advisable. According to this strategy, the replacement of old and inefficient units by new and more efficient ones will reduce the emission of pollutants and GHG to the air improving air quality of the area and globally, will reduce the intake and discharge flue rate improving thermal effluent dispersion in the water body, will reduce the consumption of natural gas, etc. A global decrease in noise level would be also expected.

It has been also found that the adequacy of both the documentation and the implementation of the Takhiatash TPP's EHS management to the requirements of the World Bank Guidelines needs to be strengthened. Certain aspects of the procedures should be modified and new ones have to be developed, as indicated in the tables in chapter 6 (Corrective Action Plan), in order to improve the compliance with international requirements.

The corrective action plan must be taken into account as a set of recommendations to improve the environmental performance of the Takhiatash TPP in order to achieve, step by step, an EHS management system at the level required by international institutions and good practices. It must be pointed out that this Corrective Action Plan should be agreed and budgeted by the TPP's management unit, if decided to be implemented. Actions that just imply a management improvement could be put in place as soon as possible taking advantage of the good disposition of the Takhiatash TPP staff.

Given the sampling and punctual nature of this audit, it is necessary to remark to the Organization that the development of the Corrective Action Plan should be based on an investigation to determine the deviation extent. The actions taken should focus on solving the deviations detected instead of correctly the findings after having considered the degree of extension of the deviation.