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Environmental Impact Assessment
VOLUME 1/4
NON-TECHNICAL EXECUTIVE SUMMARY

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UZB: TAKHIATASH POWER PLANT EFFICIENCY IMPROVEMENT PROJECT

This EIA is prepared by the consultants for the Uzbekenergo of the Republic of Uzbekistan and for the Asian Development Bank (ADB)

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A. INTRODUCTION

A.1. Scope

1. The scope of the present document is to summarize the Environmental Impact Assessment (EIA) for the demolition of the already dismantled units I-II, the decommissioning of the inefficient existing power plants units III and IV and the construction and operation of the two new 255 MW CCGT units in the Takhiatash Thermal Power Plant (TPP), in north-western Uzbekistan, whose owner is Uzbekenergo (UE).

2. This EIA was entrusted to the GAS NATURAL FENOSA ENGINEERING (GNFE) Company on behalf of the Asian Development Bank (ADB).

A.2. Project history and justification

3. Takhiatash TPP was constructed between 1961 and 1990 in six stages, as shown below. In 1980 uneconomic and obsolete equipment of the I-II lines was dismantled. Therefore, the installed capacity of Takhiatash TPP is currently 730 MW.

Table 1. Commissioning of Takhiatash TPP units

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

4. The project "Construction of two 255 MW CCGT units at Takhiatash TPP" is a priority project identified by Uzbekenergo. Takhiatash TPP, with the installed capacity of 730 MW, is the main power supply source for the Karakalpakstan and Khorezm regions with over 3 million people located in the western part of Uzbekistan. The power demand outlook is strong with a number of industrial development projects envisaged for the region, exceeding currently available capacity. Furthermore, operational lifetime of the Takhiatash TPP's equipment is 22-43 years, resulting in its degradation and the increasing in the probability of accidental risk with potential negative consequences for the environment.

5. This project will allow cutting operational expenses, increasing the efficiency of energy transformation and the reliability of supply of energy to the consumers, and improving the environmental situation as a result of the demolition of the already dismantled units I and II and the replacement of the obsolete equipment of III and IV lines by the two new combined cycle gas units (CCGTs) in the Takhiatash Thermal Power Plant (TPP).

A.3. Location and access

6. The existing 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 to the north of TPP industrial site.

Figure 1. Takhiatash TPP location

7. Construction site for CCGTs is planned to require the additional territory of 40 hectares on the south side of Takhiatash TPP. The location of key project components in relation to the wider Project area is shown in the following picture.

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

Figure 3. Location of the existing Takhiatash TPP (blue line) and the future extension area (red line).

B. POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK AND STANDARDS

8. In compliance with the Cabinet Ministers' Decree of the Republic of Uzbekistan (RUz) No. 491, thermal power stations with capacity of 300 MW and more belong to Category 1 and therefore must undertake national EIA procedure.

9. The Environmental Impact Assessment presents the information from the original Russian EIA and includes some additional sections required to meet ADB environmental policy requirements. With reference to ADB's Safeguard Policy Statement SR1 on Environment, this Project is considered to be a 'Category A' project and therefore a complete EIA is requested.

10. Throughout the project (starting from design, construction, demolition, decommissioning and through to unit operation) all requirements in RUz environmental legislation and ADB's safeguards policy statement, including World Bank Group Environmental, Health and Safety guidelines (specific Guides concerning thermal power stations published in December 2008, and general guides published in April 2007) and international conventions were incorporated into the study.

11. It should be pointed out that limit values concerning gas emissions, noise, waste, air quality etc, were based on [whichever was] the more restrictive of the two regulation sources (national or international).

C. PROJECT DESCRIPTION

Existing power plant (units III to VI)

12. 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. Old units I and II were dismantled in 1980. The building, foundations and the 65 m stack are still there. Buildings are used as occasional workshop and warehouse facilities.

13. The main fuel for Takhiatash TPP is natural gas from Bukhara deposit that is supplied to the TPP through two underground pipelines. Mazut, a type of residual black oil, is used as back-up fuel.

14. Already dismantled units I-II are going to be demolished. III and IV units, with a total installed capacity of 310 MW (boilers Nº 1-6), are to be decommissioned whereas V and VI units, each one with a capacity of 210 MW (boilers Nº 7-8), will continue operating as back up units. 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 5-8 are discharged through the 150 m high stack.

15. The water supply source for the existing units of the TPP is Suenly canal, which is fed by Amudarya river. The quality of this water is characterized by a high content of suspended solids, mineralization, chloride ions, sulfates and oil products so that a previous conditioning in the Water Treatment Plant (WTP) is required.

16. 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 being the volume of water intake is almost equal to the water discharge. Apart from the thermal increase, discharge water characteristics are practically the same as the intake.

17. Power generated by the existing units of the TPP is evacuated via 35 kV, 110 kV and 220 kV. The availability of the existing blocks is low and so is the quality of the service being provided to the demand.

18. In order 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, an **Environmental Audit** was carried out in January 2013.

19. As a result, 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 Greenhouse Gases 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.

20. It has been found that the adequacy of the documentation and operation of the Takhiatash TPP Environmental Health and Safety (EHS) management to the requirements of the World Bank Guidelines need to be strengthened. In this regard, a Corrective Action Plan (CAP) has been designed 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. 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.

New Combined Cycle Power Units (CCGT)

21. The purpose of this project is the installation of two combined cycle units with a total power of 255 MW each. It is based on bringing a gas cycle and a steam cycle together, allowing for the thermal energy contained in the gas cycle exhaust gases to be used to generate steam with sufficient energy to be used in the steam cycle. In this way, performance is much higher (in the range of 50-60%) than that obtained by any conventional thermal power plant at present, even far above that of any newly built simple cycle, gas or steam power plant, resulting in environmental improvement, thanks to a more efficient use of the primary energy, and a reduction in generation costs.

22. Natural gas is the main and backup fuel for both CCGT units and it will be supplied from the GDP (Gas distribution plant) to the Gas Processing Facilities (GPF). In accordance with preliminary estimates, the gas will be done through two new underground gas pipelines with a minimum diameter of 300 mm. Gas pipeline to the GDP will have a 2 km length (4.55 ha of temporary land acquisition will be required) and the final tack is still not defined. It could be traced parallel to the

existing pipeline or a new path could be needed. In this last case, specific instructions to design the most environmental friendly path have been included in the EIA. Taking into account the decommissioning of units III and IV, the GDP will be sufficient for the natural gas the CCGT units need with the installation of gas compressors.

23. Amudarya River will be the source of raw water at the new facilities of the CCGT units through the existing intake canal of the existing facilities of Takhiatash TPP. Just a new pump station within the existing intake canal will be needed to be constructed.

24. Circulating water system for the new CCGT units is designed in closed circuit, including the installation of ten mechanical draft cooling towers.

25. It is planned to build a new water treatment plant for total water desalination in order to meet the makeup water requirements of the CCGT units steam cycle.

26. A new heating-water converter plant is designed to provide heating of system water in system water heaters by extraction steam from steam turbine heat extraction, and to supply system water using line pumps in main heating system for consumers heat supply.

27. Power output of the new CCGT units will be evacuated through the existing 110 kV and 220 kV substations and through the existing switchgears and transmission lines with minor upgrades on the switchyard. The current transmission capacity of the existing transmission line is 540 MW (the power consumption in 2011 had a maximum load at 466 MW), which is not enough to evacuate the installed capacity of the remaining units V-VI and the new CCGTs. Nevertheless, according to current electricity demand, units V-VI are planned to operate only as back-up units during maintenance operations of the CCGTs so that this project does not require an extension project of the transmission lines in the short term.

28. Nevertheless, by 2020 the power consumption is expected to reach a maximum load of 620 MW. Uzbekenergo however has a plan to expand the transmission capacity to improve the stability and reliability of the grid in the future. This extension project shall be accompanied by its corresponding EIA project.

C.1. Description of works

Construction phase

29. Due to the fact that the present project is not to build a new Thermal Power Station, but to extend an existing plant, and in view of the fact that the new 2 CCGT units will be located at the same site as the Power Station, it will not be necessary to build new access routes and certain infrastructure, since these are already in place for existing Units (for instance, no new water intake and discharge canal or transmission line are needed). Consequently, the extent and volume of the works will be less than those necessary for a new Power Station being built on a new site.

Decommissioning phase

30. The efficiency improvement project involves the decommissioning of the units III and IV and the demolition of units I and II.

31. During the commissioning of the new combined cycle units, in order to maintain the power plant available capacity, together with the more modern units V and VI, it will be necessary to keep units III and IV in operation, complementing the power generated by the new CCGT units in order to cover the demanded power at all time. In this regard, units III and IV will be disconnected once the Provisional Acceptance of the CCGT-1 and CCGT-2 takes place, respectively. After the Final Acceptance of the CCGT-1 and CCGT-2 the process of dismantling and demolition of units III and IV shall proceed, respectively.

32. According to the schedule, the construction phase of the first CCGT is preliminary planned to finish in April 2018, whereas the construction of the second CCGT is scheduled by July 2018. Construction, commissioning and decommissioning periods are likely to last 24, 6 and 12 months per unit, respectively. Unit III shall be decommissioned by September 2019 since they are the most worn out boilers; for December 2019, unit IV shall be decommissioned. The total duration of the project is approximately 4 years and 9 months.

C.2. The project’s environmental and social aspects

33. The implementation of the project for construction of the new 2 CCGT units to replace obsolete and worn-out boiler units shall help to improve environmental situation in the concerned area.

Emissions

34. The emission of pollutants into the air is caused by the exhaust gas combustion of natural gas. Natural gas is considered a clean fuel as it produces less atmospheric contamination than other liquid or solid fuels.

35. The combustion chamber of the new gas turbines will be equipped with dry type low NO_x burners (Dry low NO_x Hybrid Burner Ring), achieving emissions below 51 mg/Nm^3 at 15% O_2, dry basis (World Bank emission limit). This fact together with the efficiency improvement of the new technology will allow a reduction in emission of NO_x of approximately 30% and a reduction of natural gas consumption of 321.4 million m^3/year also.

36. Regarding CO_2 emissions, Uzbekistan is a country not listed in Appendix I of Kyoto protocol, and is therefore not required to limit its emissions of CO_2. The net reduction of CO_2 emission gather with the project will be of 16% which will contribute to climate change mitigation.

Noise

37. After the commissioning of the CCGT units, new sources of noise will be added to the existing ones. The level of noise must not exceed 80 dB(A) in operational zone one meter apart from equipment on rigid foundation according to Uzbek legislation.

Effluents

38. The effluent treatment system will be design to fulfill discharge national and international standards. The effluent treatment system consists of:

- **Domestic effluents**

Domestic wastewater or sanitary effluents is discharged though a pipe line to the Takhiatash 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 CCGT units 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 effluent channel.

- **Circulation system blowdown**

Cooling tower blowdown water, as it is similar to the intake water, is discharged into the TPP effluent channel without treatment. TPP effluent channel discharges into Suenly canal.

39. The change from the open cooling system of units III and IV towards a closed circuit of the CCGTs, and the operation of units V and VI only as back-up units during maintenance operations of the CCGTs , will lead to:

- 86% reduction of water intake
- 48% reduction of thermal effluent returned to the canal which will allow a better and faster dispersion. This fact would probably improve the environmental condition of the aquatic ecosystem.
- Increase of 514 m^3/h of water consumption to replace evaporated water in the cooling towers. This is a negative impact but the magnitude is insignificant as it would represent less than 0.63% of Suenly canal flow rate.

Waste

40. The list of waste materials expected to be generated in the demolition of units I and II and decommissioning of units III and IV includes basalt extra-thin fiber, wire netting, fire resistant concrete, thermo-isolated concrete, structural steel and structural concrete. For the decommissioning phase a specific plan must be undertaken including an Environmental, Health and Safety Plan with special attention of the asbestos handling. For the construction of the new CCGT units, asbestos will be not permitted as it use is forbidden by good international practices. Therefore, waste asbestos will not be produced in the operation of the new units.

41. The current management of wastes of the TPP can be used but some of the procedures should be corrected to fulfill international good practices. Classification of hazardous or non hazardous wastes will be based on the international Basilea Convention signed by Uzbekistan:

Non-hazardous wastes:

- 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 will not be rendered harmless 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 in the operation of the existing units.

- 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. As an option, the municipal landfill could include the following improvement measurements that are recommended:

- Location of the municipal landfill further than 250 meters to residential areas and following location recommendations of the IFC guidelines.
- Soil cover material, with base and side slopes designed to 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

42. 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).

- Recycle:

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.

- Dispose:

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 located at 35 km of the TPP can be adapted as hazardous wastes storage for the construction, demolition, decommissioning and operation phases if the following recommendations are undertaken:

- Remaining mazut should be completely removed or stabilized 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

43. In any case, direct discharge of wastes will be never allowed on the ground.

Jobs

44. At present, the number of employees of Takhiatash TPP amounts to 1082 people. The project will promote industrial development projects envisaged for the region. Consequently, this will promote socio-economic development in the region and indirectly in whole Uzbekistan.

45. The construction phase will constitute the highest levels of activity with up to 1,000 construction workers concentrated onto the project site. For the demolition of units I and II about 50 workers will be needed and for the decommissioning of units III and IV about 400 workers. During operation phase, about 110 people will be required for long term operation of the plant (81 production workers and 29 administrative-management staff) but they will be covered with current workers from the TPP.

D. ALTERNATIVE SOLUTIONS EXAMINED AND JUSTIFICATION FOR THE SELECTED SOLUTION

46. This section will explain why and how certain decisions were made and analyzed concerning the project under study.

D.1. "No project" alternative

47. The main goals of the Takhiatash TPP's CCGT project are to cut operational expenses, to increase the efficiency and the reliability of the energy supply to consumers, as well as to improve the environmental quality within its area of influence.

48. The "No project" alternative means that Uzbekenergo decides not to construct the CCGT units at Takhiatash TPP and continues operating the technically obsolete and physically worn-out equipment of III and IV units. As a result, the reliability and technical condition of the equipment would decrease and this option would result in even lower technical and economic indicators. Furthermore, accidental risks with potential negative consequences for the environment would increase.

49. On the one hand, the power demand outlook in Karakalpakstan region is strong and, furthermore, Takhiatash TPP not only provides the North-West region of the country with electricity but also heats water for consumers supply in Takhiatash town and for covering its own needs.

50. On the other hand, operational lifetime of Takhiatash TPP's equipment ranges from 22 to 43 years, which is the main reason for the equipment reliability degradation and increases the probability of accidental risks with potential negative consequences for the environment.

51. Not carrying out the project would mean potentially reducing the planned coverage of the energy demand in Uzbekistan in case of failure of the worn-out equipment, with the resulting parallel reduction in both economic development (delay in the development or investment in Takhiatash area and the supplied cities due to a lack of infrastructure, etc.) as well as the quality of life of its inhabitants (limited access to electricity and poor environmental conditions).

52. Given the consequences indicated and the social impact produced if the "no project" alternative is considered, the most appropriate alternative is believed to be going ahead with the construction of the CCGT units at Takhiatash TPP.

D.2. "With project" alternative: location and technology alternatives

53. The implementation of the Takhiatash CCGT units is a priority project within the development program in Uzbekistan. The "with project" alternative will result in a quantitative improvement of the environmental quality in the area of the TPP and an increased economic development in the region and country.

54. Alternatives chosen for the project are the best option on location and technology, both combustion and cooling system. As locate the project in an existing industrial area with part of the existing facilities to be used for the new CCGT units (transmission line, water intake and discharge canals, and gas supply) the environmental potential impacts are going to be minimized. By other hand, combined cycle technology based on natural gas and refrigerated with a closed cooling water systems gather the most environmental friendly power generation among those fuel combustion technologies (normally used to produce base load energy). This technology achieves the highest rate of power generation with the lowest rate of air emission pollutants. The closed refrigeration system has the advantage to decrease the amount of water intake and discharge reducing the temperature increase of the effluent compared to those open systems.

55. Karakalpakstan is an area of ecological disaster. The drying out of Aral Sea and ecological crisis in the region has caused huge economic losses, affected living standards and health of population in the Karakalpakstan and broader Aral Sea area.

D.3. Physical environment

Climate

56. Climate in the Takhiatash TPP region – sharp continental is characterized by wide annual and daily temperature fluctuation range. Annual air temperature is 13.64 ºC. Maximal temperature 45 ºC, minimal -26.80 ºC. Annual precipitation level is 110.6 mm. Winds of north-east, north and east directions prevail. Annual wind speed is 2.26 m/s. On rare occasions the speed of winds reaches 15 m/s and higher, because of the proximity of desert and dryness of underlying terrain which is accompanied by significant dust transfer.

Air quality

57. Air quality in the Takhiatash TPP region is determined by the emissions of industrial centers as Nukus, Urgench and Khodjeyli and depends on the conditions of spread of the dust from the bottom of Aral Sea.

58. In order to determine air quality baseline, data over of approximately 2 years (2011-2012) from two existing air quality stations in Nukus and Kizketken settlement area conducted by the Main Hydrometcenter was analyzed. Results show that neither national nor international standards are exceeded for NO, NO_2 and CO.

Noise

59. 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 4^{th} and 5^{th} March 2013 during the day and at night time.

60. From the eight measuring points, the half of them are located bounding the TPP and the other half are located at residential areas, outside the plot of the power plant, in order to be representative of the noise perceived by the population of the nearby settlements.

61. Measurements show that the background noise levels comply with what requirements of the standards except for two points at night and one of them daytime. This point is a residential settlement of a former army unit and the houses are located in close proximity to the southwest area TPP fence.

Geology and soil

62. The territory of Takhiatash TPP is composed of quaternary sediments, which are sandy loam, clay loam, clay and sand. According to the results of laboratory data and hydrochloric acid extracts, the sands are considered saline. Sandy loam, clay loam and clay are non-saline.

63. 4 samples near the Takhiatash TPP’s fuel tanks are analyzed in a twice-a-year basis. In addition, a comprehensive soil study has been carried out in March 2013 in order to study the potential soil contamination with hazardous substances or petroleum products within the area of the future CCGT units.

64. Soil samples within this study have been analyzed for organochlorine pesticides, heavy metals, dry residue, moisture, phenol, humus, pH and oil products. All pollutant concentrations measured are much below their international reference standards for industrial soil quality class (Soil Quality Regulation of the Netherlands).

<u>Hydrogeology</u>

65. At the TPP site ground water appear at the depth of 0.3-2.2 m. The water is saline and has strong sulfate aggressive to concrete in ordinary cement and high corrosivity to metals.

66. Takhiatash is located in the area of high level phenol contamination of groundwater, which is toxic to humans and biota, and means a high-risk area of adverse impact on human health when using groundwater for human consumption.

<u>Surface hydrology</u>

67. The closest large surface watercourse to the Takhiatash TPP is Amudarya river which feeds Suenly canal in where Takhiatash TPP intake and discharge is located. Chemical composition of the river water is formed to a large degree under the impact of contaminants coming to the river on the territory of Turkmenistan, agricultural flows and waste waters of factories. Water of Amudarya river is characterized by high turbidity.

68. In order to reflect the water quality conditions of Suenly canal, a number of parameters are measured in both Takhiatash TPP intake and discharge points in a bimonthly basis. These analyses reflect that, except for temperature for what the operation of the TPP clearly causes an important increase, the parameters that exceed standards are being already exceeded by the water quality in the Suenly canal previously to the intake for the TPP.

D.4. Biological environment

Flora

69. The natural conditions of the area under study have defined the development of arid vegetation communities. The presence of halophytic species is and indicator. High soil and water salinity, high insolation, dust storms as well as insufficient irrigation system cause to the paucity of vegetation. Thus, the region has scanty vegetation.

Fauna

70. Fauna of the territory is varied. The most notable of the mass of desert animals are the many and various reptiles, rodents and small insects crawling on the ground. There is an exceptional diversity of species of rodents and an abundance of a group of original prancing animals, the jerboas. There are more than 50 types of fish in Aral Sea basin, 10 of them included into Uzbekistan book as a rare species. There are some fishes into the Suenly as well. However, in most of the cases these fishes flow in Suenly canal from the closest lakes over the high water level in Amudarya river

Natural protected areas

71. The closest protected area to the project is Low Amudarya biosphere reserve which locates on the territory of Amudarya, Beruniy district of Republics Karakalpakstan around 75 km on the east-south from Takhiatash city.

D.5. Socio-economic environment

Socio-economic conditions

72. Takhiatash TPP is located in Takhiatash city, in Khodjeyliy region of the Republic of Karakalpakstan. The total population in Khodjeyli district is 134,400 people, and 47,500 people in Takhiatash city. From them 49% are males and 51% are females. From total population around 25% is under 16 years old. Average monthly income per family at Takhiatash city is 507 USD.

Infrastructure facilities and transportation

73. 99.8% of total population of Takhiatash city is connected to centralized water supply system, 19.5% of houses are connected to municipal sewage network and 99.9% of them are connected to centralized gas supply system.

74. Takhiatash city has a municipal waste water treatment plant with a biological treatment. Communal wastes and most part of the industrial wastes are disposed at the municipal landfill, located 2 km away from the south from Takhiatash city. The landfill is not sited, designed and operated to isolate the wastes from the surrounding as wastes are dumped directly into the soil surface.

75. There is the Nukus-Khodjeyli highway at 4km to the north of TPP. The closest airport is at Nukus, around 20 km away from the TPP.

Power sources of transmission

76. The only power supply source in the area is the Takhiatash TPP, which supplies with energy to all Karakalpakstan, Khorezm province and some districts in Central part of Uzbekistan. Some pilot projects founded through various national and international organizations are being implemented in Karakalpakstan region such as a pilot solar PV station (100 W).

Planned development activities

77. There are several development activities currently taken place in the Karakalpakstan: chemical, gas-refining and construction materials industries are been developed, a number of big gas production and treatment companies are operating and there is an increasing production in textile goods. There is also a special investment program for the development of rural area supported with credit from ADB

Public Health

78. Statistical data analysis showed that the level of overall sickness rate and the majority of clinical entities in the Republic of Karakalpakstan is higher than the average rate for Uzbekistan.

79. The main health problems include decreased kidney and liver function, arthritis, chronic bronchitis, typhoid, hepatitis, genetic disorders and acute respiratory infections, especially among children. There is a high rate of maternal and infant mortality and children's diseases, typhoid, tetanus, intestinal diseases caused by the lack of purified water and poor sewage treatment in many settlements. Takhiatash city has one hospital for 200 beds and two more clinics designed for 500 patients.

Education

80. There are 4 Universities on the territory of Karakalpakstan and in Takhiatash city there are 2 colleges and 645 pupils enrolled in 9 secondary schools.

Vulnerable groups and gender issues

81. There are no vulnerable groups or ethnic minorities defined on the project area and gender issues are not objet of special investigation either as inequality has not been observed.

Cultural properties & cultural heritage

82. The closest historical monuments to the Takhiatash TPP are remains of Mizdakhan city and the Mausoleum Mazlumhon Suluv. Mizdakhan remains as a major medieval town, located 8 km west of the city Khodjeyli.

E. IDENTIFICATION AND ASSESSMENT OF POTENTIAL ENVIRONMENTAL IMPACTS

83. In order to identify the impact of the construction and operation of the new CCGT units as well as the decommissioning of the existing III and IV units and the demolition of the units I and II, a cross-reference was made between the project activities that might have an effect on the environment and the environmental factors that might be affected by those activities. A two-dimensional matrix

(see next table) was used for this purpose, where the potential impacts were presented in a synthetic and visual form.

84. The assessment was performed separately for the construction, demolition, decommissioning and operation phases, to clearly distinguish the impacts generated by each phase and to be able to efficiently devise a series of preventive and corrective actions specific to each phase (see below a table with the potential impacts identified in the matrix).

85. After the identification of the potential impacts, assessment is carried out. Methodology for this assessment gathers the following parameters: incidence (between 0 and 1), magnitude (assigning high, medium, and low values) and final value and assessment (compatible, moderate, severe, critical). See the two tables below (1: construction and decommissioning; 2: operation) in which the summary of the evaluation of those impacts are shown.

Table 2. Impact identification matrix – Works phase

IMPACT IDENTIFICATION MATRIX – WORKS PHASE																										
ENVIRONMENTAL FACTORS																										
PROJECT ACTIVITIES		NATURAL PHYSICAL SUBSYSTEM															POPULATION AND ACTIVITIES SUBSYSTEM									
		PHYSICAL ENVIRONMENT									BIOTIC ENVIRONMENT				PERCEPTUAL ENVIRONMENT		LAND USE			CULTURE HERITAGE		POPULATION				INFRA ST.
		Atmosphere		Geomorphology	Soil		Hydrology / Hydrogeology		Process		Flora		Fauna		Landscape		Rural	Productive	Nature Conservation	Resources		Occupation		Welfare		Infrastr.
		Noise comfort	Air quality	Relief	Soil and subsoil quality	Structure	Water quality	Groundwater quality	Erosion	Superficial drainage	Natural Vegetation	Anthropic Vegetation	Fauna habitats	Behaviour patterns	Landscape quality	Visual intrusion	Agriculture and livestock use	Industrial use	Protected land	Archaeological vestiges	Indigenous People	Employment	Health & Safety	Population welfare	Development of local economy	Road network
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				■			■															■			

Table 3. Impact identification matrix – Operation phase

IMPACT IDENTIFICATION MATRIX - OPERATION PHASE																						
		ENVIRONMENTAL FACTORS																				
		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.	Occupation		Welfare		Infrast.
PROJECT ACTIVITIES		Climate	Noise comfort	Air quality	Soil and subsoil quality	Resource quantity	Water quality	Groundwater quality	Natural Vegetation	Anthropic Vegetation	Fauna habitats	Behavior patterns	Landscape quality	Visual Intrusion	Agriculture and livestock use	Industrial Use	Protected land	Employment	Health & Safety	Population welfare	Development of local economy	Energy infrastructure
COMBINED CYCLE	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																	■	■		■	
	Electricity generation															■		■	■	■	■	■

Table 4. Impacts identified

IMPACTS IDENTIFIED	
CONSTRUCTION AND DECOMMISSIONING PHASES	**OPERATING PHASE**
- Potential discrete and local increase in particulate matter suspended in air. - Potential degradation of air quality due to exhaust emission from construction and decommissioning equipment. - Potential increase in the noise level of the construction and decommissioning sites. - Potential degradation of the local geomorphology. (*) - Potential soil compaction. - Potential increase of suspended solids in water, as a result of construction work. (*) - Potential soil and water contamination due to improper storage or manipulation of the work materials and/or waste. - Potential contamination of surface water by sanitary water from workers. - Potential increase of erosion risk due to construction work. (*) - Potential modification of natural drainage in the work area. (*) - Potential elimination of vegetation (*) - Potential reduction in the total area of fauna habitats in the work area. (*) - Impact on and potential discomfort to terrestrial fauna. - Potential modification of landscape during the construction, demolition and decommissioning - Potential impact on natural areas. - Potential impact on agriculture, livestock, etc, which take place in the work area due to changes in land use. (*) - Potential impact on historical and archaeological heritage. (*) - Hiring of personnel and reactivation of the local economy during construction, demolition and decommissioning phases. - Potential hazards for the health of the personnel and the population. - Increase in traffic. - Potential damage to road infrastructure owing to heavy duty construction traffic.	- Greenhouse gases emission reduction by the replacement of an obsolete with an energy efficient technology. - Outdoor air quality improvement due to the emission reduction by the replacement of an obsolete with an energy efficient technology. - Potential increase in noise levels. - Potential increase of soil salinity due to the cooling towers steam plume deposition - Potential soil and groundwater pollution by accidental spillages or improper waste management. - Water resources intake reduction - Potential effects on water resources due to the increase of water consumed for the new CCGT. - Potential 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. - Potential impact on the landscape due to the physical presence of the new CCGT. - Potential impact on the landscape caused by the cooling water steam plume. - Potential impact on natural areas. - Potential hiring of personnel for operation of the new CCGT. - Development of the local and regional economy. - Potential health risk for the operation of the cooling towers - Potential hygienic risks for the health and safety of personnel and the surrounding population. - Increase in installed electrical power.

(*) Only in construction phase

Table 5. Impact assessment summary-construction/decommissioning phases

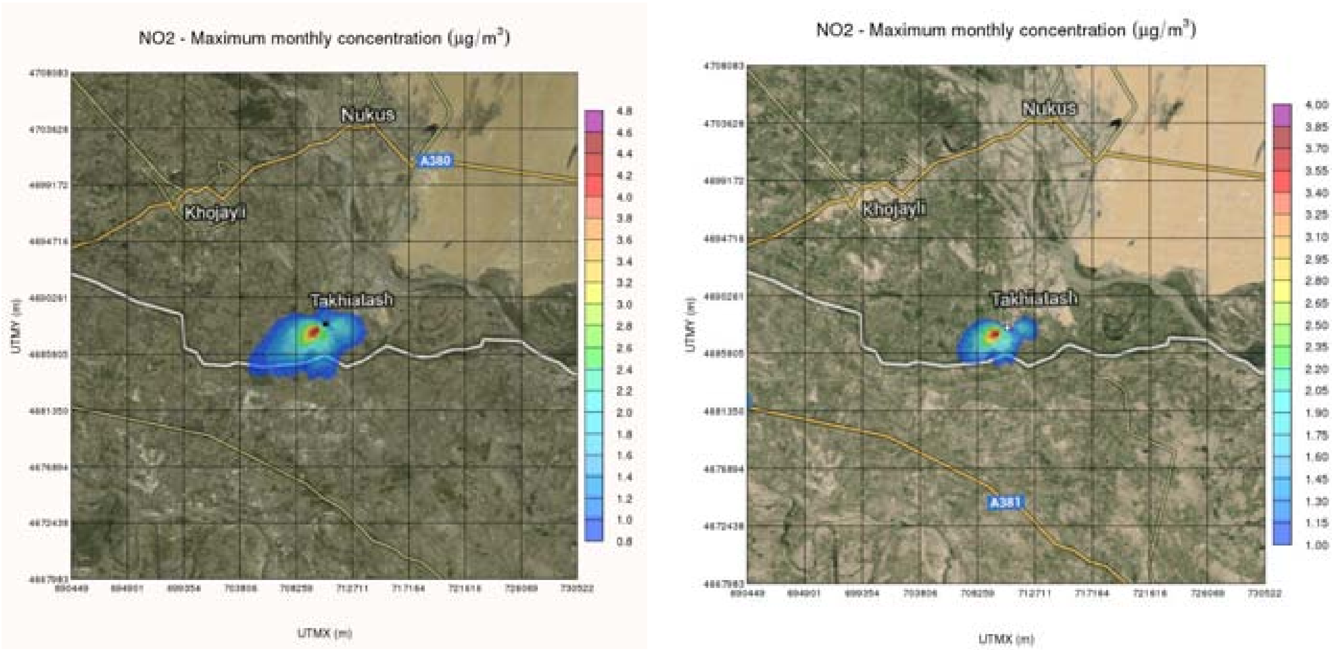
IMPACT ASSESSMENT SUMMARY - CONSTRUCTION/DECOMMISSIONING PHASES				
IMPACT	**SIGN**	**NORMALIZED INCIDENCE (BETWEEN 0 AND 1)**	**MAGNITUDE**	**FINAL IMPACT VALUE**
Potential discrete and local increase in particulate matter suspended in air.	-	INSIGNIFICANT		
Potential degradation of air quality due to exhaust emissions from construction and decommissioning equipment.	-	INSIGNIFICANT		
Potential increase in the noise level of the construction and decommissioning sites	-	0.43	Medium	MODERATE
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, demolition 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, demolition 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, demolition and decommissioning traffic	-	INSIGNIFICANT		

Table 6. Impact Assessment Summary - Operation Phase

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 CCGT.	-	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 CCGT.	-	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 CCGT.	+	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	---

86. It should be pointed out that, for the assessment of specific impacts, specific studies and environmental simulations need to be undertaken. For instance:

87. - For the **assessment of the impact on air quality**, modeling of the dispersion of pollutants by AERMOD model has allowed study the contribution of different emissions of the combustion of natural gas on current and future scenario on levels of air quality in the region. Ultimately, the contribution brought by the operation of the 2 new CCGT units to the background pollution will decrease in around 16% for NO_2, and both national and international air quality standards are fulfilled.



Current scenario Future scenario

Figure 4. Air dispersion model

88. - For the **assessment on impact of the thermal discharge**, a mass balance has been calculated. The influence of the decrease in temperature in the discharge point, due to partial replacement of an open cooling water system to a closed one, will not be appreciated (0.1 ºC) because the huge difference between flow rate of the closed cooling system blowdown (CCGTs) and the opened cooling system effluent (V-VI units). However, the water of the effluent discharge from the open cooling water would be decreased from almost a 50%, so the thermal effluent dispersion would be faster in the Suenly canal and this will have a direct and positive impact on the aquatic ecosystem.

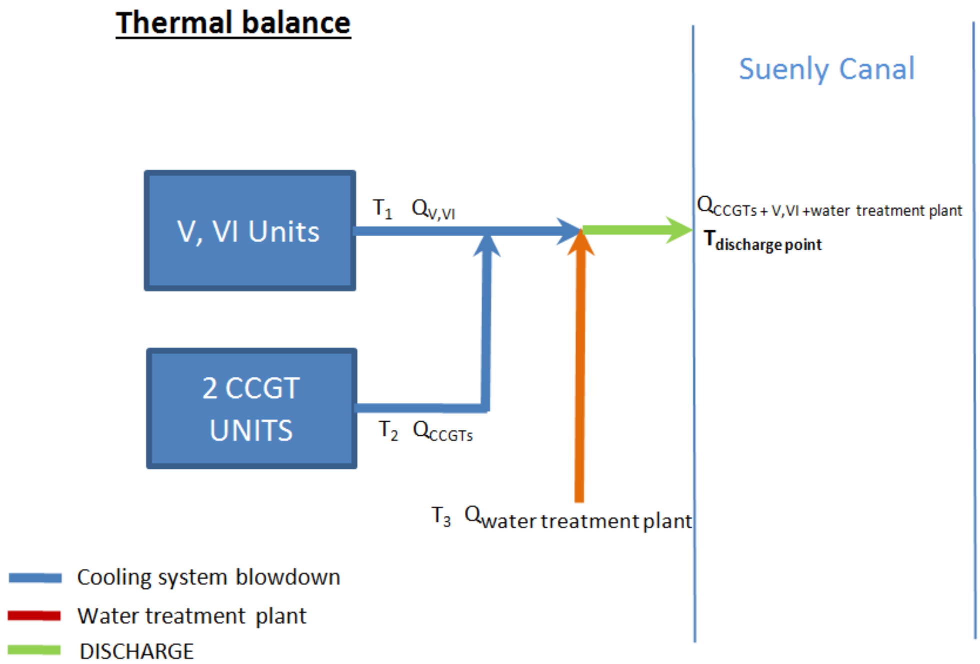


Figure 5. Thermal balance of water discharge to Suenly canal

89. As it can be observed in the above tables and assessments, the fact of replacing and old technology by a most efficient and environmental friendly one result in several positive impacts that indicate a global environmental improvement.

90. After detailed analysis of the project and environmental baseline status of the area of interest, we conclude than the **environmental and social benefits** from the project implementation are:

- Reduction of natural gas consumption in 300 million m^3/year
- 16% emission reduction of CO_2 (greenhouse gas) to the atmosphere, which will contribute to climate change mitigation
- 27% emission reduction of NO_x to the atmosphere
- In accordance with the result obtained from the dispersion model of pollutants in the atmosphere using the EPA's "AERMOD" it can be stated that:
  - A 16% reduction of NO_2 in ambient air quality is achieved
  - Current and future scenarios comply with air quality standards both at national and international level
- The change from the open cooling system of units III and IV towards a closed circuit of the CCGT units and the operation of units V and VI only as back-up units during maintenance operations of the CCGTs will lead to:
  - 86% reduction of water intake
  - Almost a 50% reduction of thermal effluent returned to the canal which will allow a better and faster dispersion. This fact would probably improve the environmental condition of the aquatic ecosystem.

- An increase in 514 m^3/h of water consumption to replace evaporated water in the cooling towers. This is a negative impact but the magnitude is insignificant as it would represent less than 0.63% of Suenly canal flow rate.

➢ Decrease of accidental risk by means of using Automatic Control System;

➢ Increase in power supply will promote industrial development projects envisaged for the region; Consequently this will promote socio-economic development

➢ During the construction phase workforce demand will be highly increased

F. ENVIRONMENTAL MANAGEMENT PLAN

91. The EMP compiles comprehensive information gathering together the actions required to mitigate those impacts in accordance with the laws of Uzbekistan and the ADB safeguard policy, and the monitoring activities that are to be undertaken as part of the project in order to confirm that they have been effective in reaching their objectives.

92. The EMP also details the institutional arrangements and capacities that currently exist, or that will be put in place during project implementation. The project institutional organization is shown in the following chart:

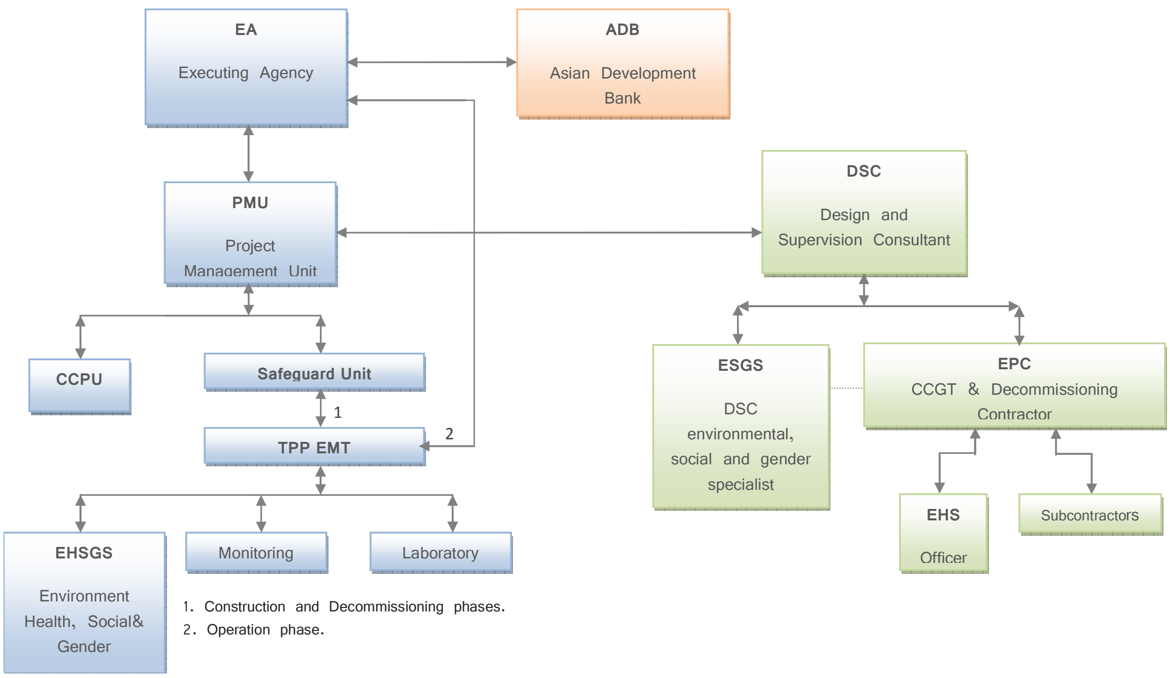


Figure 6. Project institutional organization flowchart

93. 59 mitigation measures have been included in the EMP and a specific monitoring plan to control the implementation and effectiveness of these mitigation measures. A summary of the most representative aspects of the EMP are presented as follows:

94. - For purposes of incorporating all necessary measures so as to stay within emission limits, the following environmental elements have been taken into account for the design of the project:

- Use of low NO_x emission burners so as not to exceed World Bank 51 mg/Nm^3 standard (15% O_2, dry base)
- The project includes the construction of two 112.5 m stacks, in accordance with the result calculated with the Good International Industry Practices (GIIP) formula and in accordance with the Environmental Protection Agency (EPA) atmosphere pollutant dispersion model (AERMOD).
- Installing noise attenuation devices to comply with national and international standards
- Installing an effluent treatment system (a system for separating greases, oils and chemical pollutants from effluents assuring compliance with national and international standards)
- Installing an optimized chemical dosing system for cooling water treatment and control for a minimum requirement of chemical additives, achieving a minimum concentration at discharge with consequent environmental benefits
- Safety tanks for retaining any leaks that may occur from any storage tank for hazardous materials or wastes.

95. - Development of an Environmental, Health and Safety Plan for the construction, decommissioning and operation phases.

96. - As far as possible and depending on availability, work position created by the project will be filled by local personnel.

97. - Implementation of a CEMS (Continuous Emissions Monitoring System) which will guarantee that emissions are always within legal limits, and which will analyze and record pollutants on a continuous and automatic basis: SO_2, NO, NO_2, CO, O_2, temperature, pressure and water vapor.

98. - Yearly quantification and monitoring of Greenhouse Gases emissions in accordance with internationally recognized methodologies (IPCC, etc.)

99. - Implementation of air quality and meteorological monitoring stations on a continuous basis of SO_2, NO_2, NO, TSP, PM_{10}, $PM_{2.5}$, CO; wind speed and direction, atmospheric pressure, relative humidity and temperature, which ensures observance of air quality limit values in force.

100. - Yearly campaign for measuring noise levels using a sound level meter.

101. - Extension of the current monitoring system for water intake and discharge points in order to comply with national and international effluent standards:

- Continuous monitoring of: temperature, pH, conductivity and total residual chlorine.
- By-month basis monitoring of: suspended solids, mineralization, Cl-, SO42-, NO3-, NO2-, NH4+, Fe, BOD5 and Oil products; the project will extend monitoring to heavy metals: cadmium, cobalt, copper, chromium, lead, nickel, zinc, arsenic, mercury (If there is no variation between intake and discharge points observed after one year, the monitoring of these new parameters could be discontinued).

102. - Extension of the current monitoring system for subterranean water: quarterly monitoring of: pH, Ca^{2+}, Mg^{2+}, Na^+, Cl^-, SO_4^{2-}, HCO_3^-, hardness, temperature; the project will extend monitoring to pH, oil products, heavy metals (cadmium, cobalt, copper, chromium, lead,

nickel, zinc, arsenic, mercury), organochloride pesticides and phenols. If there is no variation for heavy metals and organochloride pesticides observed after one year, the monitoring of these new parameters could be discontinued. Wells network will be extended also to include areas which could mean risk on the quality of groundwater and soils as sludge ponds, oil and chemicals storage tanks, hazardous waste storage.

103. - Yearly campaign for measuring soil salination along the area in which deposition of steam plum from the cooling towers is more likely to occur.

104. - Soil monitoring campaign twice per year

105. - Waste management adapted to good international practices and standards: Prevention, reduction, reuse, recovery, recycling, removal and finally disposal; segregation and separate management of hazardous and non-hazardous wastes with the inclusion of a proper final landfill or storage.

106. As a countervailing measure a community social service center will be built to create employment opportunities (with at least 50% for women), and commercial facilities, contributing to improving welfare of the community and gender equality (it will reduce the burden on many women from time consuming household activities).This center will provide the following services to the employees of TPP and residents of Takhiatash City: Prophylactic medical services which include preventive healthcare and regular check-up procedures and supporting healthcare facilities (physical exercise gym); laundry services, dry –cleaning and carpet cleaning.

107. The report monitoring results to internal (project management) and external (authorities, local people, ADB) audiences is required to verify compliance with regulatory and other requirements. For projects which category is A, semiannual reporting is required as a minimum during construction or decommission and annually during operation.

G. Information disclosure, public consultation and participation. Grievance mechanism and reporting to the population

108. As part of the environmental assessment process, Takhiatash TPP organized three rounds of **public consultations** on 18^{th} and 29^{th} of April 2013 and on 8^{th} of July 2013 at the Energy college of Takhiatash. These consultations were an opportunity to associate all of the parties involved and stakeholders concerned to the project: provincial and local authorities, non-central government services, NGOs and civil society, especially representatives of the local population, etc.

109. This consultation was also an opportunity to disseminate pertinent information which helped the general public understand the project risks, impacts and opportunities. In addition, the public consultation organized was a time for: (i) all of the stakeholders involved to express their opinions on the project risks, impacts and mitigation measures and (ii) Takhiatash TPP to study and respond to them.

110. The public consultations meeting were mainly based on:

- prior communication of useful and pertinent information (concise, well-developed environmental assessment documents prepared up to that date) via dissemination of the EMP and EIA,

- a focus on the social and environmental risks and impacts and on the measures and actions planned to reduce and mitigate them,
- **public continued consultation and information** period throughout the duration of the project via a grievance log and via public access to the annual and the environmental monitoring report (which includes result of the Grievance Mechanism put in place) made permanently available to Takhiatash TPP at the medical services, 200 meters outside of the TPP gate.

H. FINDINGS

111. In conclusion: In view of the Environmental Impact Assessment concerning construction of two 255 MW Combine Cycle Power Units (CCGT), the demolition of the already dismantled units I and II and the decommissioning of the 310 MW existing units III and IV at Takhiatash TPP, and after having analyzed all the types of impact that may be generated by the project, we find that **the project will produce an overall positive environmental and social impact** that will be compatible with, controllable by, and that fits perfectly into, the sustainable development policy framework maintained by the Uzbek authorities and the ADB environmental requirements policy.

112. The entire project can therefore be considered to be **viable on condition that the Environmental Management Plan is observed** as laid out in the EIA.

engineering

gasNatural fenosa

Environmental Impact Assessment
VOLUME 2/4
ENVIRONMENTAL AUDIT

July 2013
Version: 2

UZB: TAKHIATASH POWER PLANT EFFICIENCY IMPROVEMENT PROJECT

This EIA is prepared by the consultants for the Uzbekenergo of the Republic of Uzbekistan and for the Asian Development Bank (ADB)

Volumes

Volume I:	Non-Technical Executive Summary
Volume II:	Environmental Audit
Volume III:	Environmental Impact Assessment
Volume IV:	Annexes

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A. EXECUTIVE SUMMARY

1. 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.

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

3. 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).

4. 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.

5. 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 F (Corrective Action Plan), in order to improve the compliance with international requirements.

6. 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 Takhiatash TPP staff.

B. FACILITIES DESCRIPTION

7. 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

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

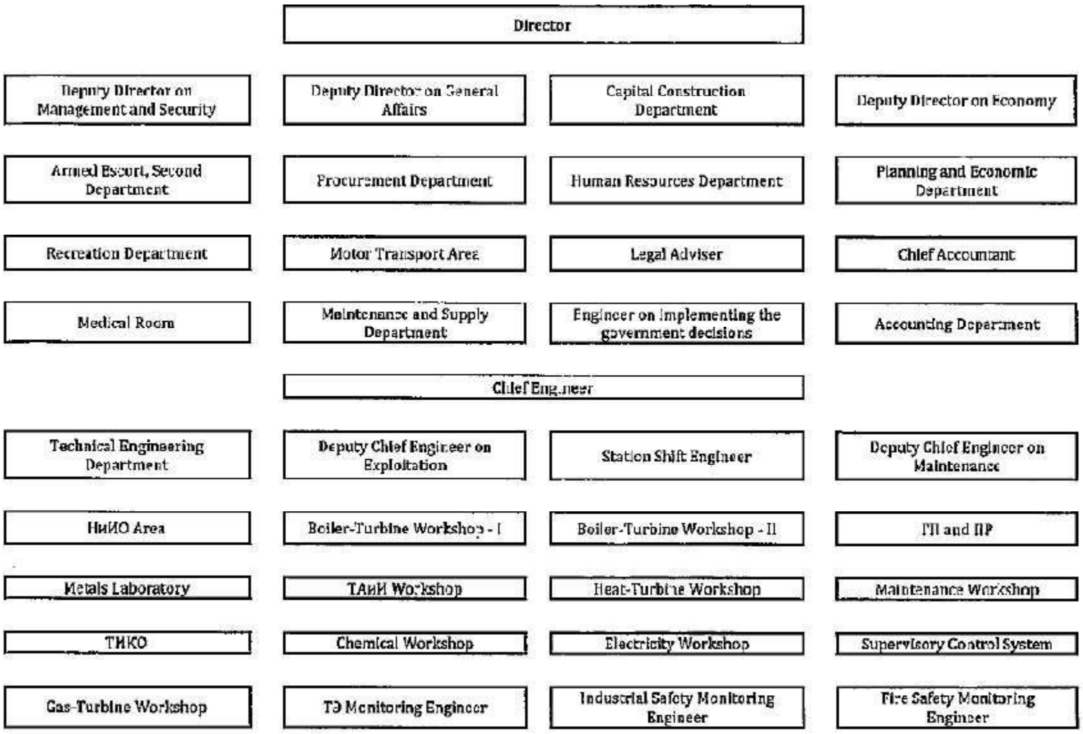


Figure 4. Takhiatash TPP organizational chart

9. At present, the number of employees of Takhiatash TPP amounts to 1,082 people. This figure is broken down in the following table:

Table 1. Number of employees at Takhiatash TPP on January 7th 2012

Name	Number of employees
Administrative and managerial staff	
Subtotal	**39**
Industrial and production personnel	
Managers	110
Specialist	65
Employees	6
Workers	754
Subtotal	**935**
Non-industry personnel	
Managers	6
Specialist	6
Employees	0
Workers	83
Home-based work	13
Subtotal	**108**
TOTAL	**1082**

10. 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.

11. Old units I and II were dismantled in 1980. The building, foundations and the 65 m stack are still there. Buildings are used as occasional workshop and warehouse facilities.

12. III and IV Units

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.

13. V and VI Units

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 used as well for boilers Nº 5-6.

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

Table 2. 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>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></td><td colspan="4">TGM-151
220 t/h; 110 kgf/cm^2; 540°C
12 gas and oil burners frontal located</td><td colspan="2">TGM-151-B
220 t/h; 110 kgf/cm^2; 540°C
4 gas and oil burners frontal located</td><td colspan="2">TGME-206
670 t/h; 140 kgf/cm^2; 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/cm^2; 535°C</td><td colspan="2">2 steam turbines
(K-215-130)
- Condensing type
- Single-shaft
- HP, IP and LP
- 130 kgf/cm^2; 540°C</td></tr>
</table>

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

B.1. FUEL SYSTEM FACILITIES

15. 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 underground pipelines. The GDP is located 2 km away from the TPP.

16. 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.

17. 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 is 200,000 m^3 (20 x 10,000 m^3). The location of this storage is shown in Figure 5.

18. 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

19. This mazut storage has been designed in 4 groups with 5 tanks per group. Every single tank has a capacity of 10,000 m^3 (60 m x 40 m basement x 5 m 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

20. 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 Tashkent.

Figure 7. View of one of the groups constructed over the ground.

Figure 8. 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.

Figure 9. Interior view of one of the tanks from the top.

A layer of residual mazut can be observed.

Figure 10. Cisterns on the railway.

Cisterns are being filled with residual mazut to be transported to Tashkent by train.

B.2. WATER SUPPLY AND WATER TREATMENT SYSTEMS

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

22. 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.

23. 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.

24. 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.

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

26. 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.

27. 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.

B.3. Cooling water system

28. 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.

B.4. Drinking water system

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

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

B.5. Heating water system

31. The water-heating converter plant at Takhiatash TPP is designed for providing with heating water not only the administrative, residential and industrial buildings of the Takhiatash TPP itself but also part of Takhiatash city.

B.6. Effluents treatment system

32. Description of the treatment for 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:

33. **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:

34. - 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).

35. - Oily/greasy effluents 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.

36. - 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.

37. - 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).

38. **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.

39. 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.

40. **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.

41. **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).

42. 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 11. Evaporation ponds at Takhiatash TPP

43. 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.

44. 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.

45. 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[1] (oil sludge).

[1] 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 C.1.4.2. C of chapter C of the EIA)

B.7. WASTE MANAGEMENT SYSTEM

46. At the present, Takhiatash TPP waste management is organized as follows:

47. Reuse

- 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:
  - o 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.
  - o 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.
  - o 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

48. Recycle

- 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”.

49. Recover

- Oily rags, used anthracite and wood debris shall be temporarily stored and burned in boiler furnaces.

50. 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.

51. Places for temporary and permanent storage of wastes are presented in the following picture.

Figure 12. 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- Tyres
9- Used engine oil
10- Communal wastes
11- Insoluble residual of lime
12- Thermo-isolated material
13- Oiled sludge
14- Rags

B.8. ENVIRONMENTAL, HEALTH AND SAFETY MANAGEMENT

- **Health and Safety**

52. 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 the 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.

53. 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.

54. The occupational health and safety structure of the TPP is presented at the following figure:

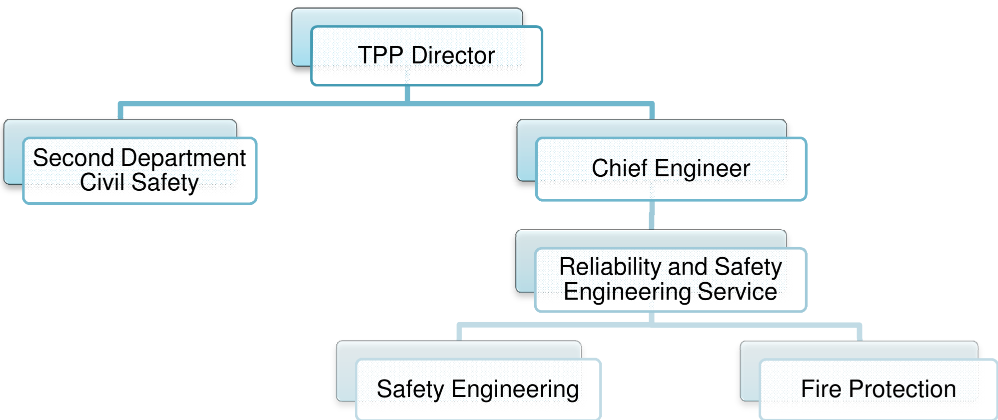


Figure 13. Occupational health and safety structure at the TPP

55. 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.

56. Safety engineering department submits reports on their activity in a quarterly basis, civil safety department annually and fire protection department every two years.

57. 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.

- **Environment**

58. Environmental management of the TPP is implemented by an environmental engineer. The environmental engineer is within the TPP production and technical department. The environmental engineer is in charge of:
  - Organization and coordination environmental performance of the TPP departments and workshops;
  - Compilation and endorsement of annual and prospective work plans;
  - Operational decisions of the present-day's environmental issues related with production process;
  - Compilation and endorsement of environmental protection materials prepared for submission for superior organization;
  - The timely preparation of environmental reports
  - Supervise the work of treatment facilities on TPP and monitor emissions level.
  - Development of proposals on reduction of industrial emissions, discharges and wastes
  - Analysis of increasing emissions and discharges (if is the case), design and implementation of mitigation measures.

59. In order to undertake the above tasks, the environmental engineer interacts with the TPP Environmental Laboratory (EL) and some external state agencies. The EL is part of the Water treatment facility of the TPP and is in charge of conduct water quality monitoring.

C. SUMMARY OF NATIONAL, LOCAL AND ANY OTHER APPLICABLE ENVIRONMENTAL LAWS, REGULATIONS AND STANDARDS

60. 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.

61. 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.

62. 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).

63. The below paragraphs summarize the host country (Uzbekistan) and other environmental standards required by ADB and World Bank Group that have been analyzed as a reference. 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

64. A very detailed analysis of the applicable legislation has been included in chapter C of the EIA.

C.1. STANDARDS ON AMBIENT AIR QUALITY

C.1.1. NATIONAL STANDARDS

65. 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

C.1.2. INTERNATIONAL STANDARDS

66. 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 Table 1Table 4.

Table 4. WHO Ambient Air Quality Guidelines (General IFC Guidelines, 2007

Pollutant	Averaging Period	Guideline value in µg/m^3
SO_2	24-hour	20
	10 minutes	500
NO_2	1 year	40
	1-hour	200
PM_{10}	1 year	20
	24-hour	50
$PM_{2.5}$	1 year	10
	24-hour	25
Ozone	8-Hour daily maximum	100

C.2. TAKHIATASH TPP'S STANDARDS ON AIR EMISSIONS

C.2.1. NATIONAL EMISSION STANDARDS

67. 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. Table 5 shows the MAE calculated for the Takhiatash TPP.

Table 5. Pollutants maximum allowed emissions for Takhiatash TPP

Pollutant	MAE	
	g/s	t/y
Nitrogen dioxide	441,8480	3126,2838
Nitrogen oxide	71,80000	508,02715
Carbone oxide	9,722000	164,16310

68. 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.

C.2.2. INTERNATIONAL EMISSION STANDARDS

69. 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)	SO_2 (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

C.3. TAKHIATASH TPP'S EFFLUENT STANDARDS

C.3.1. NATIONAL EFFLUENT STANDARDS

70. 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.

71. 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.

72. According to data provided into the “Permission on maximum allowed discharge of pollutants into the water body (Takhiatash TPP)” water quality in Suenly canal (receiver of discharging wastewaters from TPP) is characterized by the pollutants indicated in Table 7. Based on national water quality standards and ambient concentration of pollutants into the Suenly canal, State Nature protection Committee defines norms of pollutants (MAC) for Takhiatash TPP.

73. 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 q_e 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
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, sulfates, iron and oil products. MAD for these pollutants should not exceed ambient pollution of Suenly canal.

74. Discharge of pollutants not included in Table 7 is prohibited.

75. 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 (outlet 1).

#	**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	NO_3^-	0.158	45.0	12751.65
5	NO_2^-	0.043	3.3	935.121
6	NH_4^+	0.255	2.5	708.425
7	Fe	0.106	5.0	1416.85
8	Oil products	Abs	1.0	283.37
9	BOD_5	Abs	22.6	6404.162
10	Phosphates	-	2.5	708.425
11	pH		6.5-8.5	

Table 9. MAD for discharging into the municipal sewage network (outlet 1).

#	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 solids	94.35	500	90860.
2	Dry residual	1313	2000	363440
3	Chloride	157	350	63602
4	NO_3^-	0.204	45.0	8177.4
5	NO_2^-	0.203	3.3	599.676
6	NH_4^+	0.068	2.5	454.3
7	Fe	0.255	5.0	908.6
8	Oil products	Abs	1.0	181.72
9	BOD_5	Abs	22.6	4106.87
10	Phosphates	-	2.5	454.3
11	pH		6.5-8.5	

C.3.2. INTERNATIONAL STANDARDS

76. EHS IFC effluents standards for thermal power plants are shown in Table 10.

Table 10. 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
Mercury, Hg (mg/L)	0,005
Arsenic, As (mg/L)	0,5

Parameter	Discharge Limit
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.

77. For treated sanitary sewage discharges, IFC EHS general guidelines standards are as follows:

Table 11. 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

C.4. TAKHIATASH TPP WASTE MANAGEMENT AND STANDARDS

C.4.1. NATIONAL STANDARDS

78. 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, Table 12). 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, Table 12). Waste characteristics and content were developed in accordance with RD Oz RH 84.3.19.2005 "Terms and definition" (columns 7 and 8, Table 12).

79. In columns 9 and 10 of Table 12 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.

80. Those wastes which category starts by “A” correspond to Annex VIII and therefore are considered hazardous wastes.

81. Those wastes which category starts by “B” correspond to Annex IX and therefore are considered non hazardous wastes.

Table 12. Data on type, quantity, quality, main characteristics of waste and places of disposal.

Data on type, quantity, quality, main characteristics of waste and places of their disposal									
#	Name of wastes	Units (per year)	Limits (t)	Toxic class (National classification)	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	t	284.8	4	Scrap to “Vtorchermet”	Inorganic; solid; rehabilitation of wastes	Steel 50%; Cast iron 50%	B1010	
2	Non-ferrous scrap meta (bronze)	t	0.187	3	Scarp to “Vtorcvetmet”	Inorganic; solid; Repairing and replacement of energy equipment	Sn – 3-17% Zn – 5-12%, Pb – 3-17%	B1010	
3	Non-ferrous scrap meta (copper)	t	0.19321	2	Scarp to “Vtorcvetmet”	Inorganic; solid; Repairing and replacement of energy equipment	Ni 0 16% Cu – 84%	B1010	
4	Non-ferrous scrap metal (babbit)	t	0.42662	3	Scarp to “Vtorcvetmet”	Inorganic; solid; Repairing and replacement of energy equipment	Zn14-38%; Al- 2,5-6%	B1010	
5	Non-ferrous scrap metal (brass)	t	0.76208	3	Scarp to “Vtorcvetmet”	Inorganic; solid; Repairing and replacement of energy equipment	Mn – 2% Si- 3,5%, Fe – 3%	B1010	
6	Stub	t	0.552	4	Scrap to “Vtorchermet”	Inorganic; solid; welding	C-0.09% S – 0.04% P – 0.04% Mn- 0.5%	B1010	
7	Waste wood	m^3	66.43	4	Reused as raw materials	Organic; Solid;	Wool -100%		B3050

Data on type, quantity, quality, main characteristics of waste and places of their disposal									
#	Name of wastes	Units (per year)	Limits (t)	Toxic class (National classification)	Place for disposal	Type/ state of aggregation/Generating source	Waste content	Waste code in accordance with Basel convention	
						Replacement of wool construction and furniture repair			
8	Used fire-resistant and thermo-isolated materials	t	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	t	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	t	5.65	4	Sent for utilization into LLC "Artur"	Organic; Solid; Energy equipment repairing	S – 2% Rubber – 92-98%	B3040	
11	Waste paper	t	0.456	4	Sent to salvage	Organic; Solid; Replacement of electrical-isolation cardboard	Paper 85% Cardboard – 15%	B3020	
12	Used paranet	t	1.2359	3	Removed to landfill	Inorganic; solid; paronit replacement			A2050 (asbestos /rubber)
13	Oiled rags	t	2.625	3	Burned into the boiler furnace	Organic; Solid; Fitting in of electrical equipment	Cotton – 6-20% Wool – 14-28% Viscose – 13-	B3030	A3020 (As are textile wastes that are mixed

Data on type, quantity, quality, main characteristics of waste and places of their disposal									
#	Name of wastes	Units (per year)	Limits (t)	Toxic class (National classification)	Place for disposal	Type/ state of aggregation/Generating source	Waste content	Waste code in accordance with Basel convention	
							30% Residual of transformer and diesel oils		with hazardous wastes)
14	Mazut ashes	t	0.366	2	Stored in evaporation ponds	Inorganic; solid; Mazut burning in boiler furnace			Depending on composition
15	Used turbine oil	t	12.05	2	Reused	Organic; Liquid; Replacement of turbine oil		A3020	
16	Sludge from oil products	t	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	t	1598	4	Stored in evaporation ponds	Inorganic; liquid; During acid washing of boilers			B2120
18	Used anthracite	t	13.2	4	Burned into the boiler furnace	Organic; Solid Replacement of absorbents in mechanical filters	Coal 100%		B2060
19	Used cationite	t	23.496	4	Removed to landfill	Inorganic; Solid Replacement of absorbents in filters			A3050
20	Insoluble salt residuals	t	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	t	484.8	4	Removed to landfill	Inorganic; Solid;	Clue 65-88% Sand – 2-5%		

Data on type, quantity, quality, main characteristics of waste and places of their disposal									
#	Name of wastes	Units (per year)	Limits (t)	Toxic class (National classification)	Place for disposal	Type/ state of aggregation/Generating source	Waste content	Waste code in accordance with Basel convention	
						Dissolving lime	Limestone 8-33%		
22	Used oil from transformers	t	3.9466	2	Reused	Organic; Liquid; Replacement of transformer oil		A3020	
23	Used electrical isolated material	t	0.06	3	Removed to landfill	Solid; Composite; Replacement of electrical isolation	Polymers -65-85% Cotton isolation – 12-35%	A3020	
24	Used luminescent lamp	t	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	t	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	t	0.4046	4	Removed to landfill	Inorganic; Composite; Welding and cutting of metal	$Ca(OH)_2$ H_2O -12%		
27	Used tyres	t	1.561	4	Sent to utilization	Organic; Solid; Replacement	Rubber – 70% Viscose cord – 20% Metal cord – 10%	B3040	
28	Used engine oil	t	0.65117	2	Reused	Organic; Solid; Replacement		A3020	
29	Lead plates	t	0.33525	1	Scarp to	Inorganic;	Lead – 50-	A1160	

Data on type, quantity, quality, main characteristics of waste and places of their disposal									
#	Name of wastes	Units (per year)	Limits (t)	Toxic class (National classification)	Place for disposal	Type/ state of aggregation/Generating source	Waste content	Waste code in accordance with Basel convention	
	from battery				“Vtorcvetmet”	Solid; Replacement	60% PbS- 20%		
30	Cases of battery	t	0.08171	4	Scarp to “Vtorcvetmet”	Organic; Solid; Battery replacement	Ebonite	A2010	
31	Used electrolyte	t	0.12667	2	Reused	Inorganic; liquid; Battery replacement	H_2SO_4 -28%	A4090	
32	Communal wastes	t	257.283	Non-toxic	Removed to municipal landfill	Organic; Solid; Workers activity Cleaning of territory		B3060	

82. The toxic class referred to in Table 12 is in accordance with the National Uzbek classification as shown in Table 13.

Table 13. Toxic class in accordance with national classification is as follows:

Toxic Class	Waste hazardous grade
Class 1	Extremely hazardous
Class 2	Highly hazardous
Class 3	Moderately hazardous
Class 4	Low-hazardous

C.4.2. INTERNATIONAL STANDARDS

83. 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.

84. Waste management of the TPP should be based also on chapter 1.6. of the General EHS IFC Guidelines (April, 2007).

C.5. TAKHIATASH TPP NOISE STANDARDS

C.5.1. NATIONAL NOISE STANDARDS

85. 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 Table 14 shows.

Table 14. 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

C.5.2. INTERNATIONAL NOISE STANDARDS

86. 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 15. Maximum Allowable Noise Levels (IFC EHS General Guidelines, 2007)

Receiver	**One hour LAeq (dBA)**	
	Day time	**Night time**
	7:00 – 22:00	**22:00 – 07:00**
Residential, institutional and educational	55	45
Industrial and commercial	70	70

D. AUDIT AND SITE INVESTIGATION PROCEDURE

87. 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.

88. Three types of audit activities were used to assess the level of conformity of the Takhiatash TPP's operational environmental management system:

- Review of documentation
- Interviews
- Site visit

D.1. DOCUMENT AND RECORD REVIEW

89. 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 flow.
- Waste contracts

90. 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

91. All documents and existing records were submitted as documental evidence during the audit visit or after it.

92. 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.

D.2. SITE RECONNAISSANCE

93. 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.

D.3. STAFF INTERVIEWS

94. In addition, interviews were carried out during the audit with plant managers and personnel in order to verify the environmental management system.

Table 16. 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
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” UE
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

95. 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.

(i) General EHS management, monitoring and report

96. 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.

97. Regarding the TPP environmental management performance, several penalties have been paid for the following evidences:

- Year 2004:
  - Exceeding of the water intake flow limit
- Year 2008:
  - Leaking in sewage pipe that discharge effluents to municipal waste water treatment plant;
  - Storage of salt (used for hardness removal from water) on the open site.
  - Exceeding level of exhaust gas from vehicles belonged to TPP
  - Storage of asbestos materials kept on an open site.

98. 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.

99. 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.

100. The Takhiatash TPP annually submits two kinds of reports:

- 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:
- 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.

(ii) Air emission and ambient air quality

101. 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.

102. 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.

103. 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.

104. 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 Table 17 and Table 18.

Table 17. 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 18. 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

105. 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.

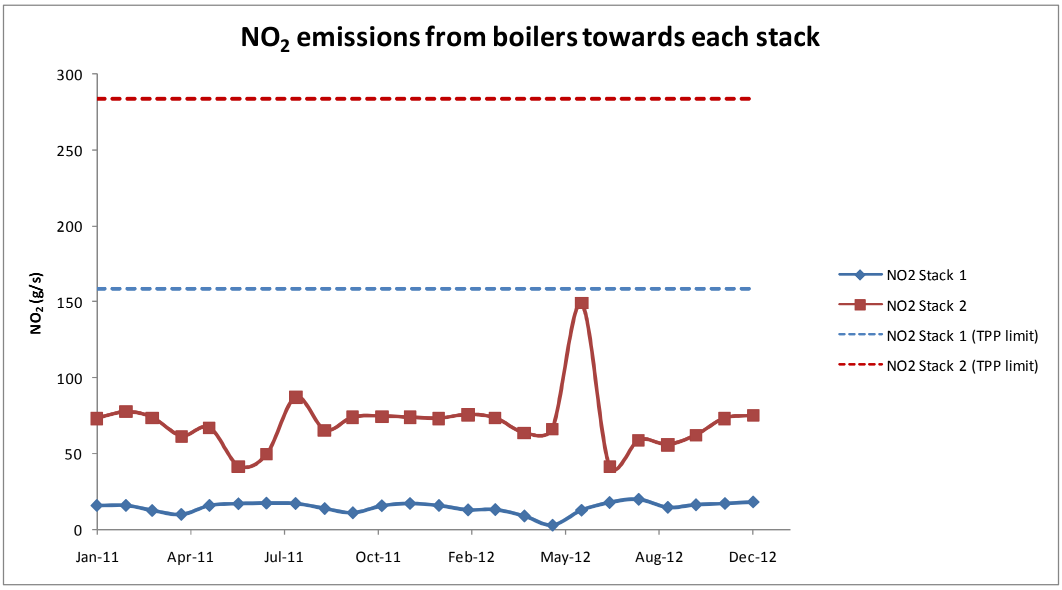


Figure 14. Comparison between NO_2 emissions from boilers towards each stack and the TPP's limits

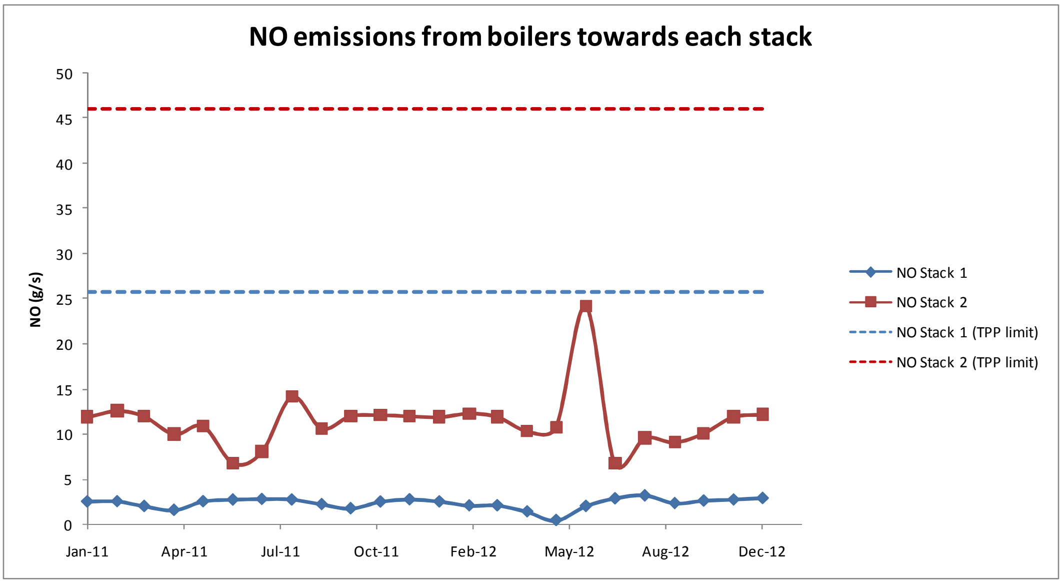


Figure 15. Comparison between NO emissions from boilers towards each stack and the TPP's limits

106. 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 NO_x emissions when burning natural gas. The WB standard for NO_x is 240 mg/Nm^3 (Dry gas, 3% O_2).

107. In the following figures the comparison between the World Bank standard and the monthly measurements between 2011 and 2012 can be observed.

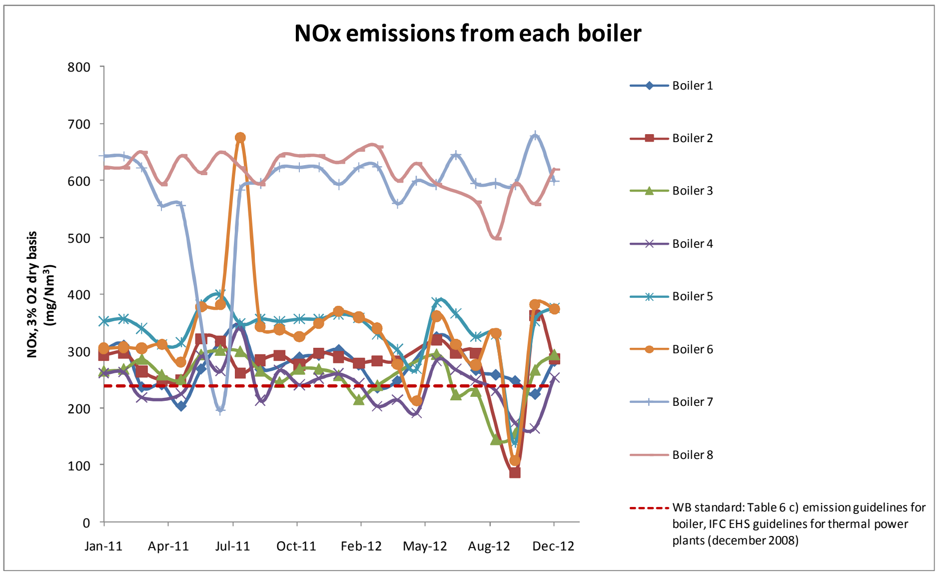


Figure 16. Comparison between total NO_x emissions (mg/Nm^3) from each boiler and the World Bank limits

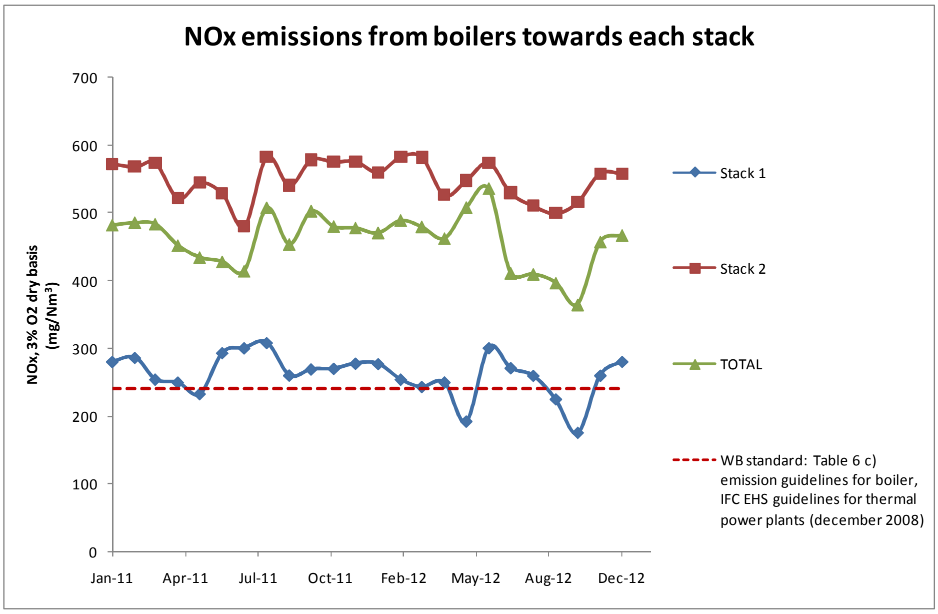


Figure 17. Comparison between total NO_x emissions (mg/Nm^3) from boilers to each stack and the World Bank limits.

108. 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.

109. There is no evidence of calculation of GHG emission at the TPP on an annual basis.

110. Regarding air quality measurements, they are not being undertaken by the TPP.

111. There are two existing air quality stations in Nukus and Kizketken settlement area whose 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 18. Location of the air quality monitoring stations.

112. 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.

113. 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 NO_2 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.

(iii) Waste water and ambient water quality

114. Takhiatash TPP intake and discharge is located in Suenly canal. In order to reflect the water quality conditions of the Suenly canal, a number of parameters are measured in both Takhiatash TPP intake and discharge points to the canal 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 19).

115. 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 whose results are shown in Table 19.

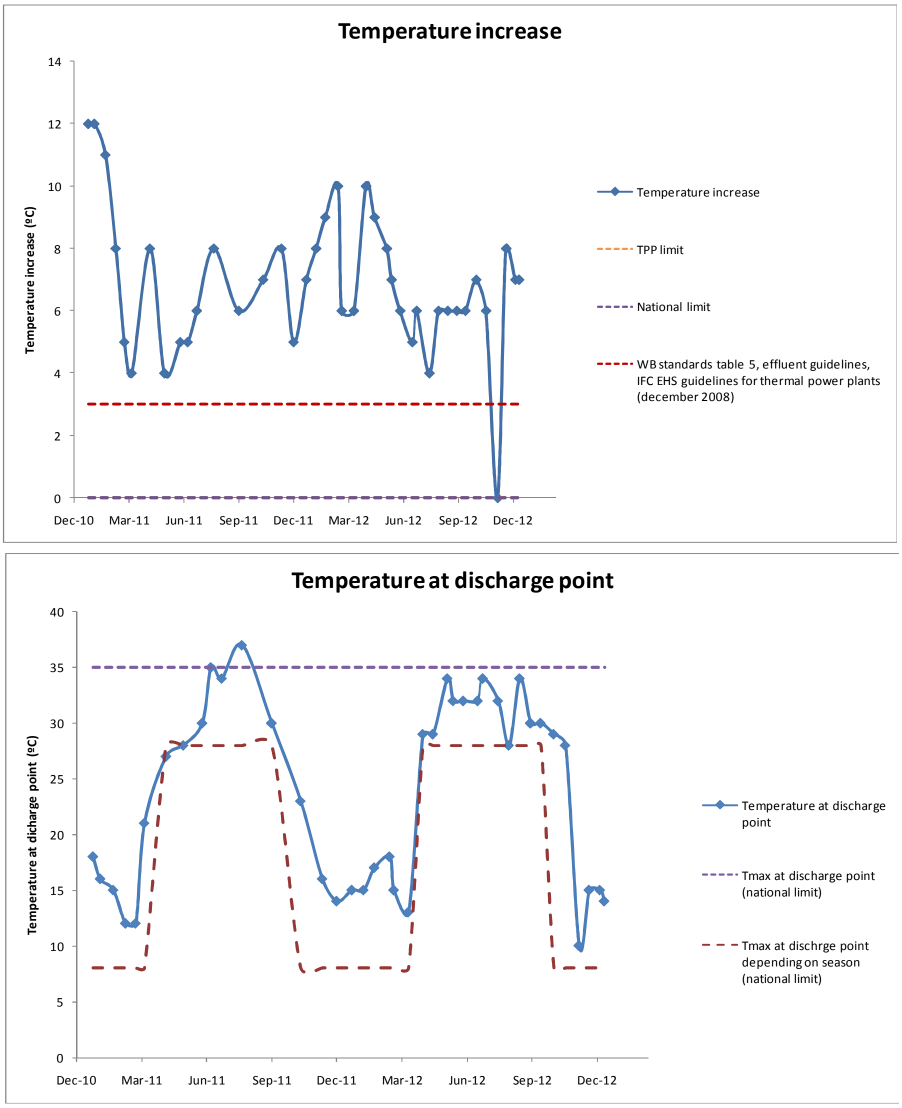
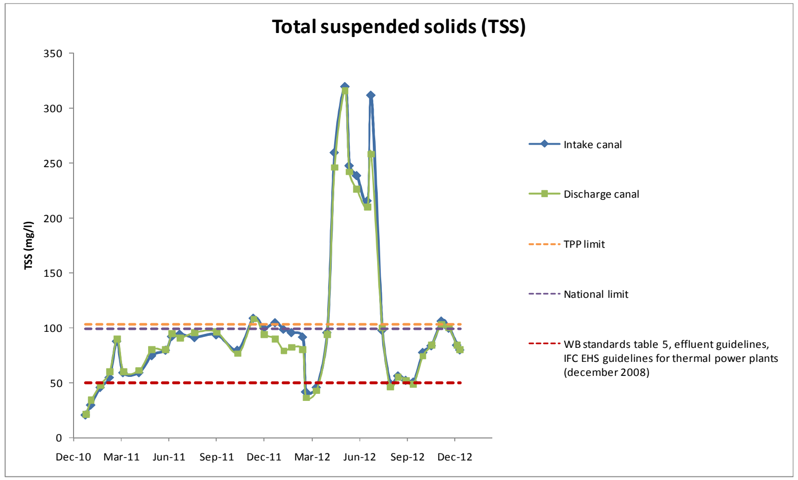
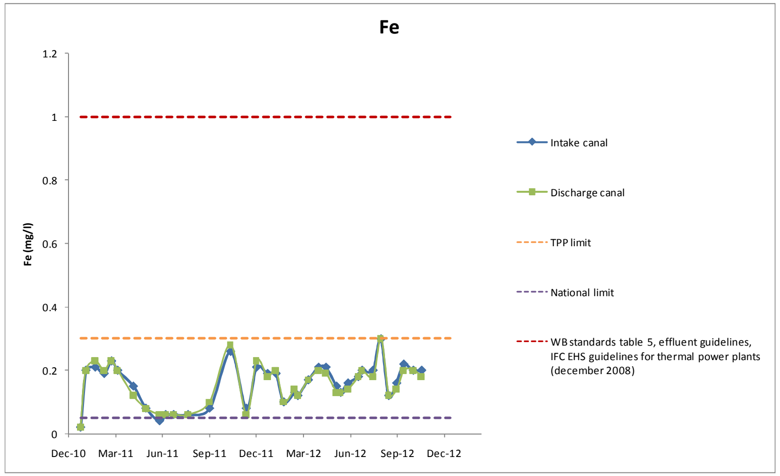
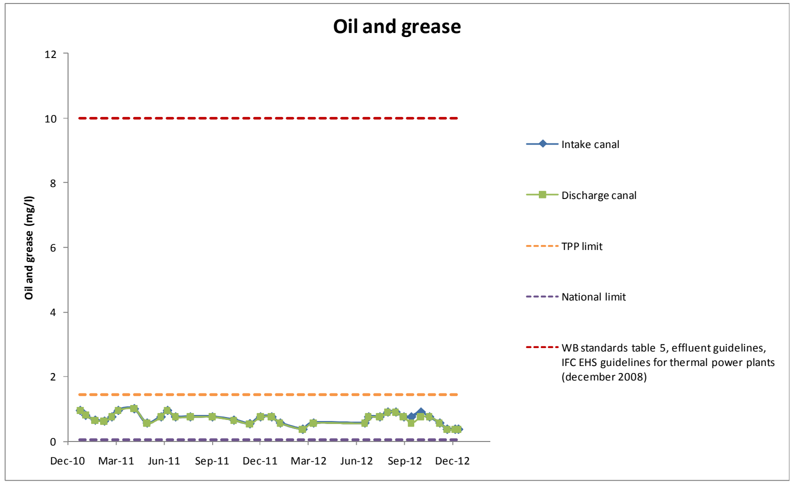


Figure 19. Results of surface water analysis conducted by the TPP.


Total suspended solids (TSS)
TSS (mg/l)
Intake canal
Discharge canal
TPP limit
National limit
WB standards table 5, effluent guidelines, IFC EHS guidelines for thermal power plants (december 2008)
Dec-10
Mar-11
Jun-11
Sep-11
Dec-11
Mar-12
Jun-12
Sep-12
Dec-12


Fe
Fe (mg/l)
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)
Intake canal
Discharge canal
TPP limit
National limit
WB standards table 5, effluent guidelines, IFC EHS guidelines for thermal power plants (december 2008)

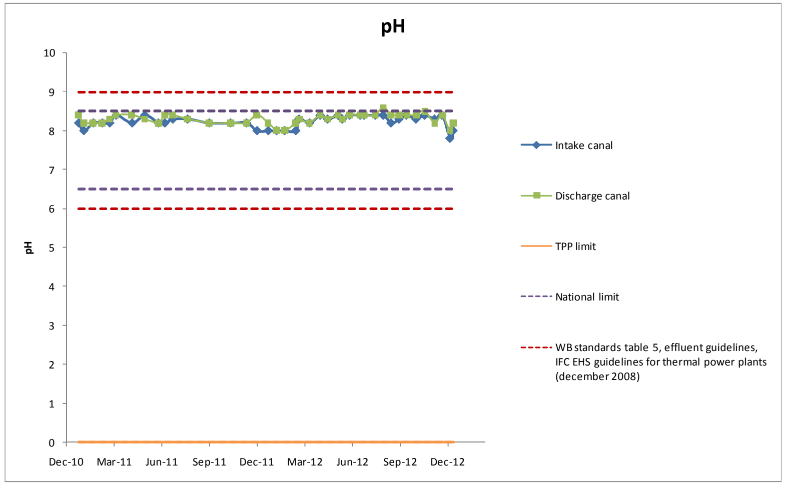

pH
pH
Intake canal
Discharge canal
TPP limit
National limit
WB standards table 5, effluent guidelines, IFC EHS guidelines for thermal power plants (december 2008)

Table 19. Results of surface water analysis conducted on 6th 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
Cr^{3+}	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	130	120	103	50
Residual chlorine	Not detected	Not detected	-	0.2
Oil products	0.08	0.22	1.45	10

- **Total suspended solids**

116. The content of total suspended matter widely varies from one measurement to the next, having reached values above 300 mg/l.

117. 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.

118. Following the above pattern, in the water analysis of the 6th of March, suspended solids World Bank standard is exceeded at the intake and discharge but the value is higher in the intake that in the discharge.

- **Iron**

119. 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.

120. Nevertheless, in the water analysis of the 6th of March, iron TPP standard is exceeded both at the intake and discharge points being increased in 1.1 times.

- **Oil and grease**

121. 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.

122. In the water analysis undertaken on 6th March, even if standards are fulfilled, there is an increase at the discharge of 2.75 times.

123. 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 20. Oil spot at the discharge point to Suenly canal, on January 18th 2013.

124. 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**

125. 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**

126. 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 3 ºC, value which is greatly exceeded by the TPP discharge.

127. 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 5 ºC in comparing average monthly temperature of the hottest month. As in this period of measurements (2011-2012) maximum temperature has been 30 ºC, increase allowed should not exceed 35 ºC 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.

128. Regarding the analysis on 6th 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.

129. 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.

130. 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:

Figure 21. Oily waste water evaporation pond

Figure 22. Detail of the cracked concrete material of the evaporation ponds

Figure 23. Detail of the cracked concrete material of the evaporation ponds

Figure 24. Acid waste water evaporation pond cracked and corroded concrete

131. 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.

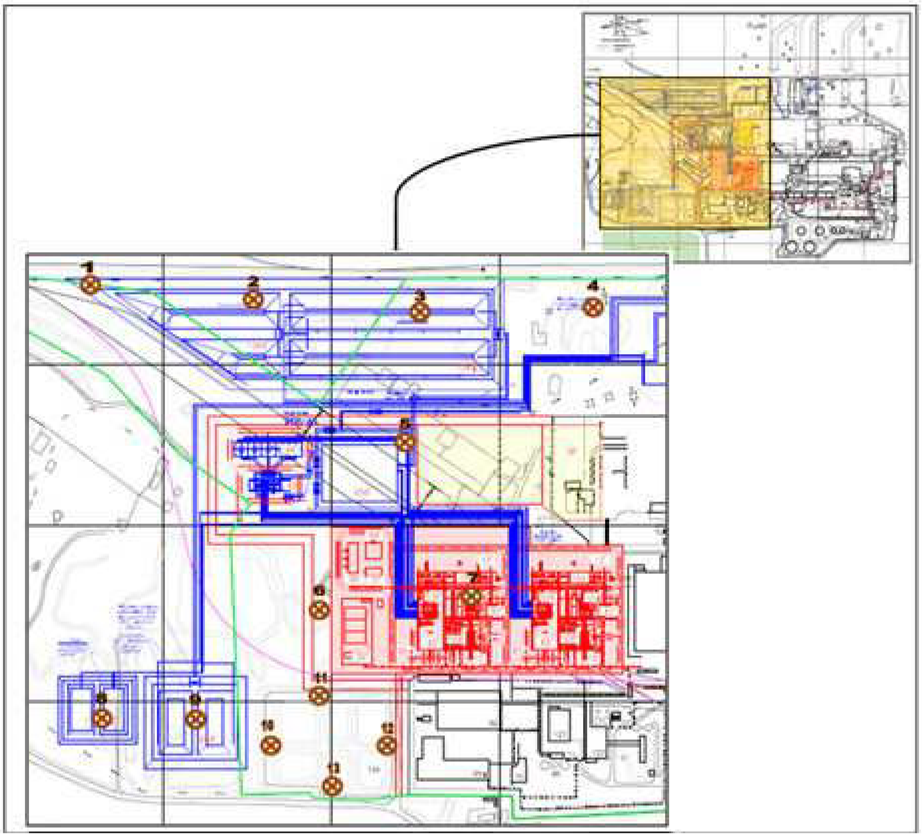


Figure 25. Soil sampling points within Takhiatash TPP plot.

132. All soil samples have been analyzed 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.

133. 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[2] (SQR) of The Netherlands).

134. 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.

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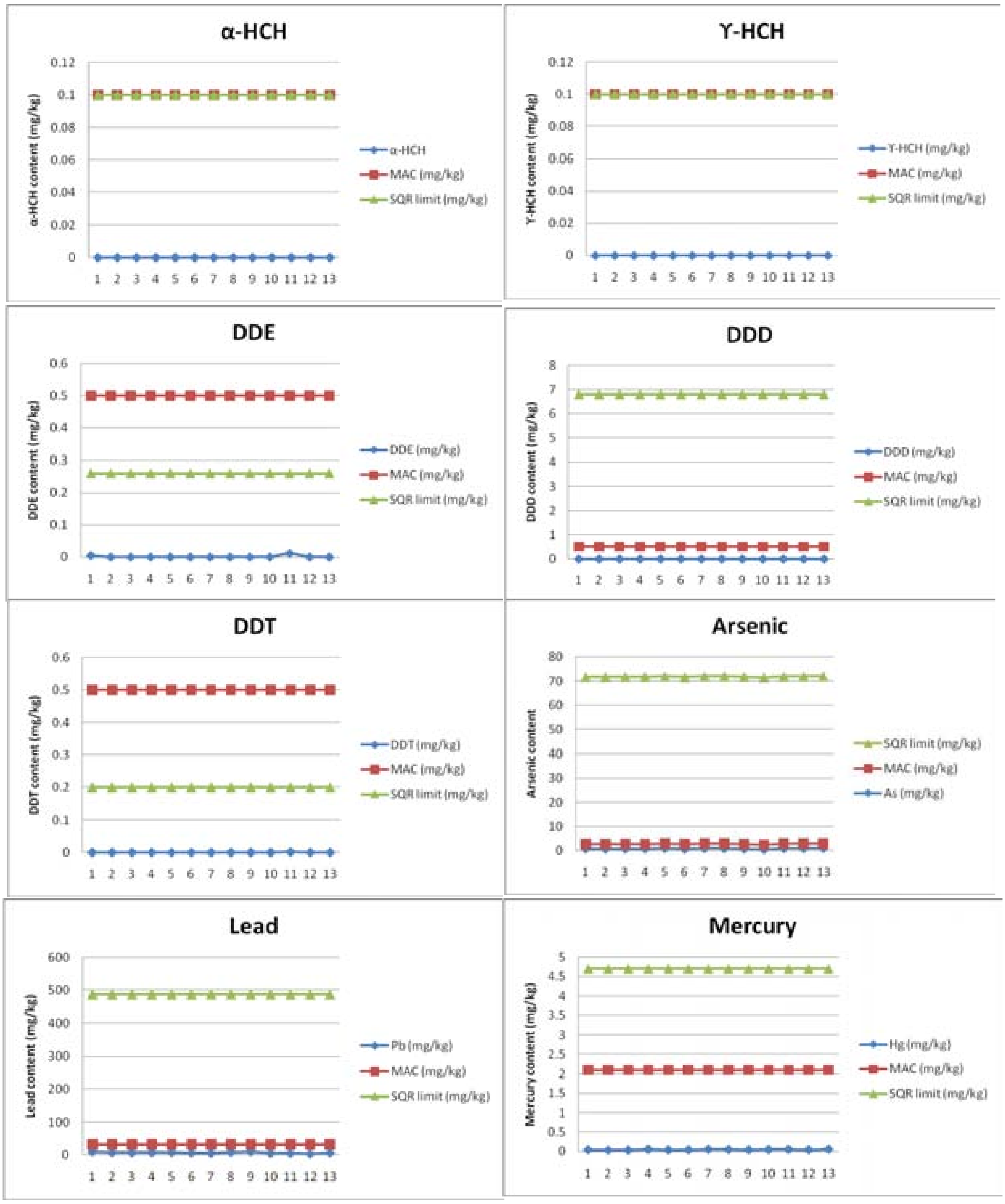
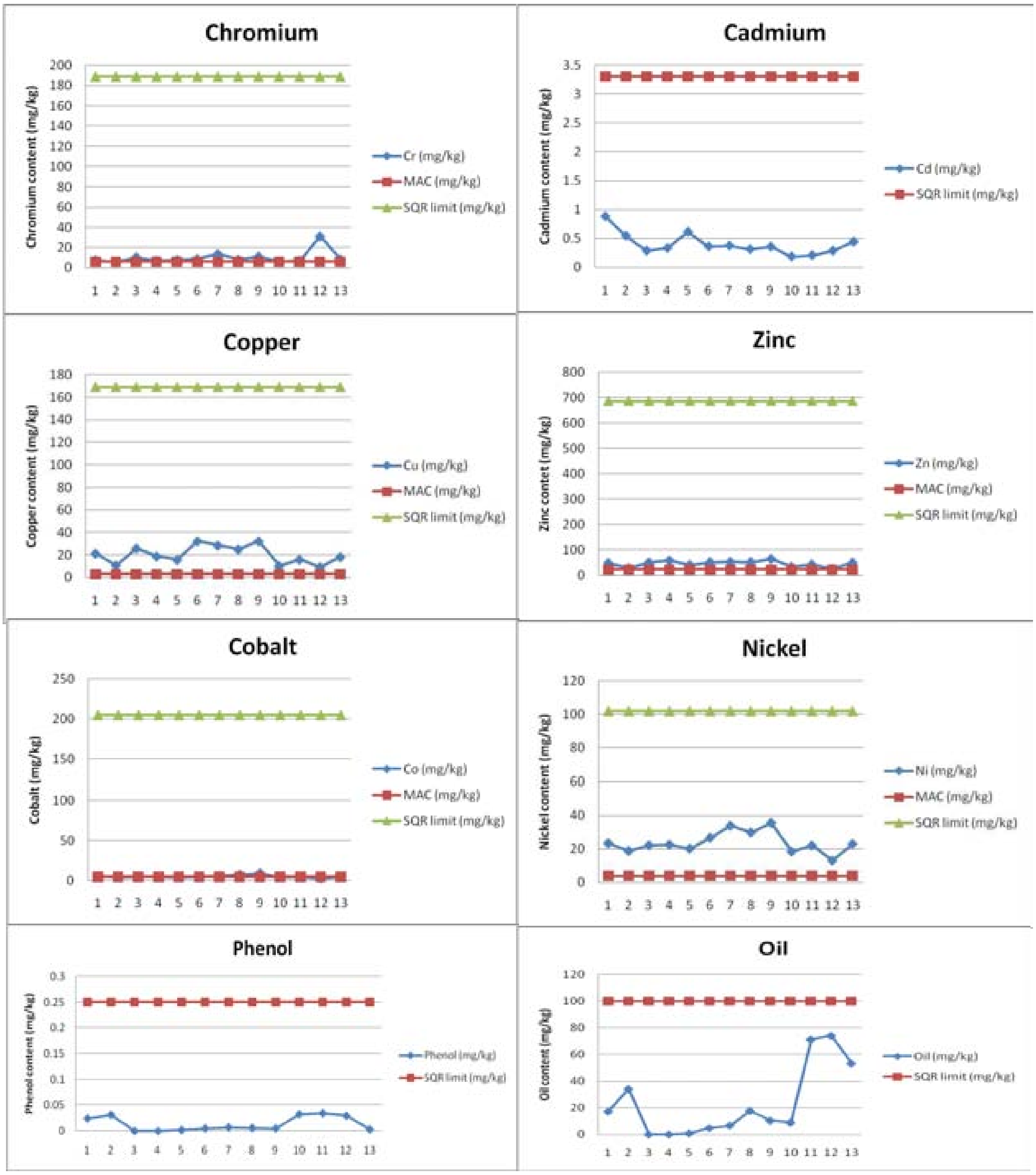
[2] ***Soil Quality Regulation***. State Secretary for Housing, Planning and the Environment and State Secretary for Transport, Public Works and Water Management of The Netherlands (2006).

135. In order to draw conclusions, the results of the analyses carried out are shown in the following graphs.





136. 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.

(iv) Hazardous materials management

137. 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 t (annual average is 94 t) of asbestos and 2528 kg of paronite were purchased.

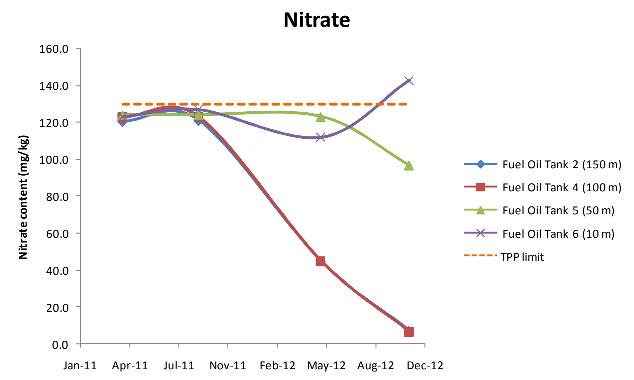
Figure 26. Bad condition of the pipe asbestos isolation that is exposed.

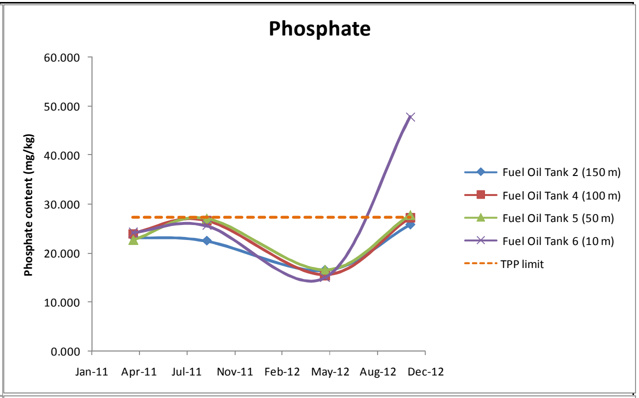
138. The mazut secondary containments are not made of impervious, chemically resistant material (which is a requirement of the World Bank guidelines) as shown in the following pictures:

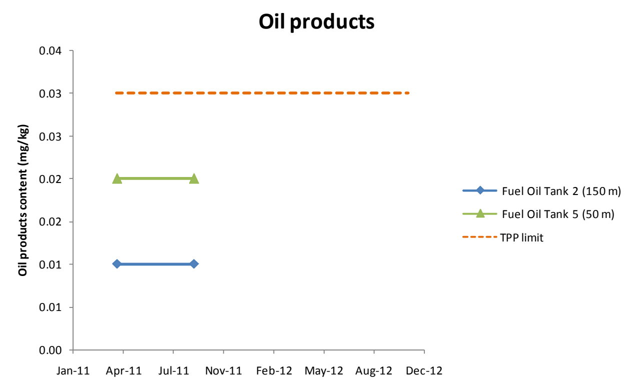
Figure 27. Mazut secondary containment material is soil. No impervious material.

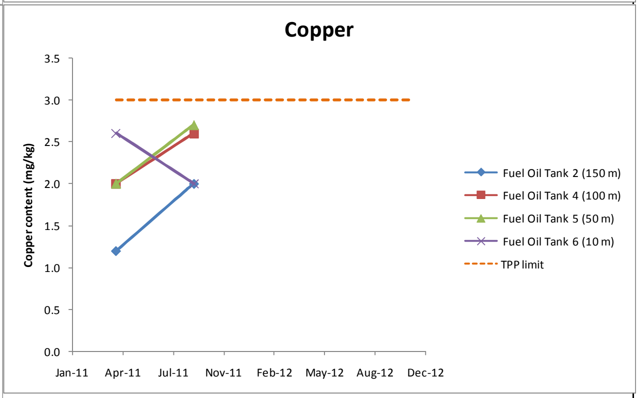
Figure 28. Potential mazut spot over the soil basement

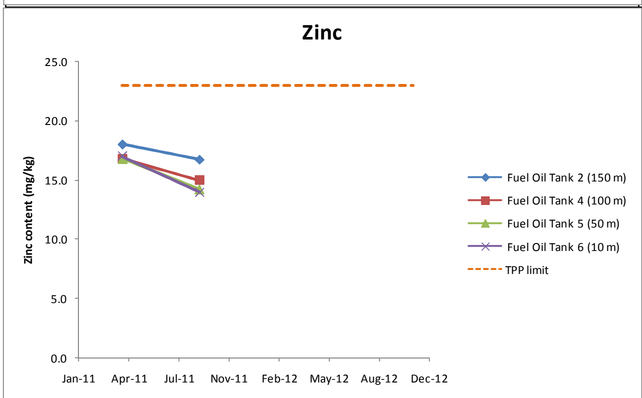
139. At the Takhiatash TPP, samples from four different points are analyzed in a twice-a-year basis. These points are located in the vicinities of the Mazut tanks, at 10, 50, 100 and 150 m of distance. The sampling depth ranges from 0 to 30 m. In the following charts, measurements of years 2011 and 2012 can be observed. Comparison with national soil standards has been also included.

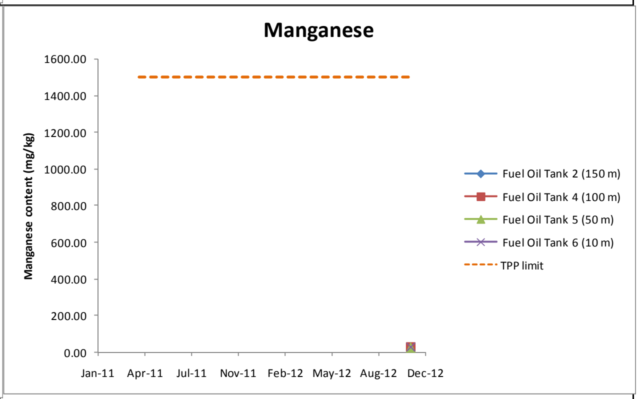












- **Nitrates and phosphates**

140. 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).Nitrates and phosphates levels in soil samples are high near fuel oil tank 6. Nitrates and phosphates high levels are due to agricultural activities and are not related with industrial activities as the TPP operation. Nitrates and phosphates are added as fertilizers but the risk of pollution came from the runoff of the excess amounts which in streams and other surface waters can accelerate aquatic plant growth causing rapid oxygen depletion or eutrophication in the water

- **Oil products**

141. 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**

142. 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.

143. 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.

144. There is no evidence of the size of the secondary containments fulfilling volume required by the World Bank.

145. Tanks of chemical products are bounded with impervious and chemical resistant material.

146. There is a chemical storage consisting in a closed warehouse with a basement of concrete, a ventilation valve and roofed.

147. There is no evidence of proper labeling of hazardous materials.

148. There is no evidence of absorption devices that facilitate gathering chemical products in the event of a spill.

(v) Waste management

149. During the audit site visit, the following evidences of solid waste storage and disposal were found:

Figure 29. Bin for communal wastes

Figure 30. Wood debris storage

Figure 31. Bin for oiled rags

Figure 32. Used oil bin

Figure 33. Room for storage lamps

Figure 34. Used batteries storage

Figure 35. Used rubber storage

Figure 36. Municipal landfill used by the TPP

150. 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

151. 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).

152. 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.

153. Asbestos, which are not allowed in industrialized countries, are being reused.

154. 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.

155. 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.

156. There is a tracking of waste generation trends by type and amount of waste generated, carried out on an annual basis.

(vi) **<u>Noise:</u>**

157. At the TPP site, there is not background noise data as a noise campaign has never been performed.

158. 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.

159. 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 37. Location of monitoring points for noise measurements.

160. For sound level measuring a Noise meter -003-M2_No 2431 was used, tested on 9th September 2012 with number of certificate 786/05.

161. 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.

162. 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 20. Results of the pre-operational campaign.

<table>
<tr><th rowspan="2">Point</th><th rowspan="2">Receiver</th><th colspan="2">Monitoring campaign results (dB(A))</th><th colspan="2">Reference standard, by law (dB(A))</th></tr>
<tr><th>Day</th><th>Night</th><th>Day</th><th>Night</th></tr>
<tr><td>P1</td><td>Industrial area</td><td>55</td><td>62</td><td colspan="2" rowspan="4">70</td></tr>
<tr><td>P2</td><td>Industrial area</td><td>54</td><td>60</td></tr>
<tr><td>P3</td><td>Industrial area</td><td>55</td><td>62</td></tr>
<tr><td>P4</td><td>Industrial area</td><td>51</td><td>44</td></tr>
<tr><td>P5</td><td>Residential area</td><td>53</td><td>54</td><td rowspan="4">55</td><td rowspan="4">45</td></tr>
<tr><td>P6</td><td>Residential area</td><td>58</td><td>64</td></tr>
<tr><td>P7</td><td>Residential area</td><td>48</td><td>40</td></tr>
<tr><td>P8</td><td>Residential area</td><td>45</td><td>43</td></tr>
</table>

(vii) <u>Land and groundwater contamination</u>

163. 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.

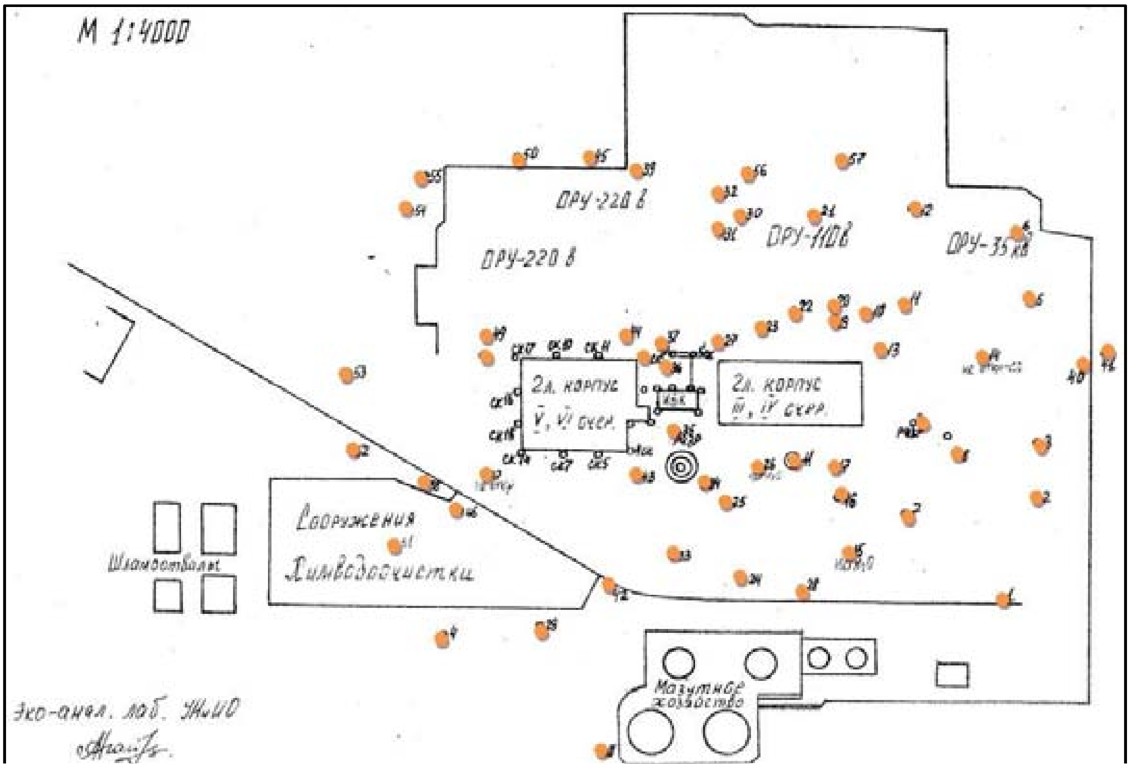


Figure 38. Groundwater sampling site.

164. Uzbekenergo carries out regular monitoring (every three months) of underground water quality inside the wells.

165. The parameters measured provided are typical to assess quality of groundwater but not potential contamination.

166. During the audit visit, a snow layer didn't allow to proper inspectorate potential soil visible spots or contamination.

167. There are no evidences of the previous use of the land on the TPP not to be industrial.

(viii) <u>Health and safety:</u>

168. 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:

- **Occupational health and safety**

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.

Communication and training

169. 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.

Physical hazards

170. Equipment on the TPP has maintenance guideline describing work safety procedures.

Chemical hazards

171. 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.

Personnel Protective Equipment

172. 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.

Special hazard environments

173. 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.

Monitoring

174. 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.

175. “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.

176. 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.

177. 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.

178. 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).

179. 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/m^3 and allowed 20 mg/m^3) at the boilers drum and lime dust (36 mg/m^3 and 6 mg/m^3 accordingly) at the chemical reagents storage house. Exceeding on asbestos dust have been observed during turbine repairing (14 mg/m^3 and 6 mg/m^3 accordingly).

180. 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.

181. 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.

- **Community health & safety**

Emergence preparedness and response

182. Emergency response procedure has not been provided and therefore has not been possible to check the level of compliance of the World Bank Guidelines.

(ix) Training

183. 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.

(x) Social management and communication

184. There is not a support or collaboration program with the local communities.

185. There is not a grievance or complaints mechanism ongoing.

186. Local communities are not informed of the environmental management plan results and environmental reports are not available to the public.

187. Emergency plan of the TPP is not communicated to the local population.

E. FINDINGS AND AREAS OF CONCERN

188. 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.

189. 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:

(i) General EHS management, monitoring and report

190. 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.

191. Environmental management performance should be improved in order not to incur in penalties.

192. 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).

193. 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.

194. 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.

195. 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.

196. 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.

197. 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.

198. Moreover, an effective management system brings many benefits to the organization:

- More efficient resource use
- Improved risk management
- Increase customer satisfaction
- Lower costs

199. 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)

(ii) Air emissions and ambient air quality

200. 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.

201. 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 NO_x. 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.

202. 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.

203. 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.

204. 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.

(iii) Waste water and ambient water quality

205. 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 3 ºC, 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.

206. 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.

207. 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.

208. Evaporation sludge ponds should be improved to assure impermeability.

209. Water quality analysis undertaken by the TPP every 15 days should include World Bank standards for effluents also.

(iv) Hazardous materials management

210. Use of asbestos should be avoided or replaced by a non-hazardous material. Asbestos exposure should be not allowed.

211. 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.

212. Evidence of the size of the secondary containments fulfilling volume required by the World Bank should be required to the TPP.

213. Hazardous materials should be correctly labeled and safety sheets visible.

214. Absorption devices and spill response procedure should be implemented.

(v) Waste management

215. 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 characterized, periodic characterization must be documented, and the waste must be properly handled, in particular hazardous waste. Final disposal must be undertaken in an environmentally sound manner.

216. 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 12).

217. 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.

218. 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.

219. The performance of regular audits on the waste segregation and collection practices shall be undertaken.

220. Types of wastes generated will be packaged and labeled in homologated containers.

221. 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.

222. 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

- Reuse

223. 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

224. 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

225. Only non-hazardous wastes can be burned in existing boiler furnaces.

- Dispose

226. 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 or minimized infiltration and facilitated 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

227. 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).

- Recycle

228. Fluorescent lights shall be delivered to a specialized organization on lamp utilization as it is being doing up to now.

- Recover

229. 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.

- Dispose

230. 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 stabilized 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

231. Direct discharge will be never allowed on the ground.

232. 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.

(vi) Noise

233. 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.

234. 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 the picture below).

Figure 39. Closer houses to the TPP at the southeast area

235. 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.

236. 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.

237. 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.

(vii) Contamination land and groundwater

238. 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:

239. Within the secondary containments of the mazut, oil and chemicals tanks

- Hazardous storage areas
- Evaporation ponds area

240. 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

241. If soil contamination is found (for instance, within the mazut secondary containments) this should be removed and treated as hazardous waste.

(viii) Health and Safety management

242. 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.

243. 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.

(ix) Training

244. Training system should be improved and completed with a specific environmental management course for all the workers.

(x) Social management and communication

245. A grievance mechanism should be designed, communicated and implanted.

246. Local communities must be informed of the environmental management plan results by means of having access to the annual environmental reports.

247. 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.

F. CORRECTIVE ACTION PLAN, COSTS AND SCHEDULE (CAP)

248. 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.

249. 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 21. 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 G (EMP) of the EIA)
2	There is not an integrated environmental, health and safety management system ongoing.	The implementation of an Integrated Management System is highly advisable. This would allow the TPP to integrate all the organization processes into 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	Short-term/medium-term period. The schedule of implementation must be agreed by the Takhiatash TPP management unit. The implementation could be undertaken in several stages in order to gradually	TPP director	Included in the future project of modernization (see mitigation measure nº 1 of chapter G (EMP) of the EIA)

CORRECTIVE ACTION PLAN					
No.	**LTA remarks**	**Corrective Actions**	**Target date**	**Responsible Party**	**Estimated Cost**
		legal framework.	integrate the EHS management into the normal operation of the TPP.		
Monitoring program					
3	There is no evidence of national methods of the monitoring program complying with international methodological standards. 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	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: 30000$US

CORRECTIVE ACTION PLAN					
No.	**LTA remarks**	**Corrective Actions**	**Target date**	**Responsible Party**	**Estimated Cost**
	quality (SO_2, NO_2, NO, TSP, PM_{10}, $PM_{2.5}$, CO); meteorological data (wind speed and direction, atmospheric 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
5	There is no evidence of sampling and	Sampling and analysis Quality Assurance/Quality control (QA/QC) Plans should be implemented.	As soon as the mobilization of	TPP EMT	Staff of the TPP.

CORRECTIVE ACTION PLAN					
No.	**LTA remarks**	**Corrective Actions**	**Target date**	**Responsible Party**	**Estimated Cost**
	analysis Quality Assurance / Quality Control Plans. Monitoring results are recorded in hardcopy	Analysis and monitoring results should be recorded in automatic and electronic format to facilitate their assessment.	implementation consultant		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 CCGT units	TPP EMT	Staff of the TPP
Air emission and ambient air quality					
7	The existing emission values in the TPP exceed World Bank emission standard for NO_x.	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 new CCGT units satisfies this requirement.	Commissioning of the new CCGT units 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.	As indicated in the World Bank Guidelines, "a continuously monitoring of emissions or indicative parameters" should be implemented.	Short-term/medium-term period. The schedule of implementation must	TPP EMT	720500 $US

CORRECTIVE ACTION PLAN					
No.	**LTA remarks**	**Corrective Actions**	**Target date**	**Responsible Party**	**Estimated Cost**
	National MAEs standards are based on flue mass rate units. This could allow the dilution of the exhaust gas emitted to the atmosphere.	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 G (EMP) of the EIA)	be agreed by the Takhiatash TPP management unit.		
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 G (EMP) of the EIA)	As soon as the mobilization of implementation consultant.	TPP EMT	(see mitigation measure nº 50 in chapter G (EMP) of the EIA)
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 G (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	Before the commissioning of the new CCPU	TPP EMT	Included in the future project of modernization. (see mitigation measure nº 11 in chapter G

CORRECTIVE ACTION PLAN					
No.	**LTA remarks**	**Corrective Actions**	**Target date**	**Responsible Party**	**Estimated Cost**
		quality station and a meteorology station (see mitigation measure nº 11 in chapter G (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 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.			(EMP) of the EIA).
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. Scope of supply included in the price is: Two submersible pumps Instrumentation of the basin (level transmitter) A coalescing separator for separating hydrocarbons (design flow approx 30-50 m^3/h) achieving maximum out put content of 5 ppm HC. Civil work	Immediately	TPP direction	182000 $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.	If the World Bank indicative values for treated sanitary sewage effluent standards of the general IFC EHS guidelines (2007) are not fulfilled (the needed analysis should be done at the Municipal Waste Water Treatment Plant discharge to check fulfillment), the necessary facilities should be included in order to fulfill these standards previously to the discharge to the Municipal Waste Water Treatment Plant.	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), impervious and chemically resistant to the sludge to storage. Previously to the	Short-term/medium-term period. The schedule of implementation must be agreed by the Takhiatash TPP	TPP director	74000 $US

CORRECTIVE ACTION PLAN					
No.	**LTA remarks**	**Corrective Actions**	**Target date**	**Responsible Party**	**Estimated Cost**
		arrangements, sludge should be correctly disposed according to their characteristics (see waste management corrective actions).	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 G (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 G (EMP) of the EIA)
Hazardous materials management					
17	Use of asbestos still ongoing at the TPP. These hazardous materials are not allowed in industrialized developed countries	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 composition). Asbestos exposure should not be allowed. An asbestos management plan for phasing out and replace asbestos in the existing units still in operation should be developed. Handling (repair or removal and disposal) of existing Asbestos Containing Materials (ACM) in buildings should:	Immediately	TPP director	Asbestos Management Plan: 97500 $US Considering: 1.- Asbestos = 1,365 $US/ton 2.- A regular annual requirement of isolation

CORRECTIVE ACTION PLAN					
No.	**LTA remarks**	**Corrective Actions**	**Target date**	**Responsible Party**	**Estimated Cost**
		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) 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 Cement Products).			material of 94 t/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)
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	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	Immediately	TPP EMT	Staff of the TPP

CORRECTIVE ACTION PLAN					
No.	**LTA remarks**	**Corrective Actions**	**Target date**	**Responsible Party**	**Estimated Cost**
	secondary containments	tank or 25% of the combined tank volumes			
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
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 G (EMP) of the EIA)	Immediately	TPP EMT	Staff of the TPP (see mitigation measure nº 51 in chapter G (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 E of this	Before the commissioning of the new CCPU	TPP EMT in close collaboration with local and national	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**
		document. (see mitigation measure nº 54 in chapter G (EMP) of the EIA)		authorities	in chapter G (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 G (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 G (EMP) of the EIA)
Contamination land and groundwater					
25	Potential soil and groundwater pollution is not well monitored and assessed within environmental	Some of the 57 wells located at the TPP are inactive 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:	Short-term/medium-term period. The schedule of implementation must be agreed by the	TPP EMT	Option 1: If new equipment is purchased for the new CCPU it can be used.

CORRECTIVE ACTION PLAN					
No.	**LTA remarks**	**Corrective Actions**	**Target date**	**Responsible Party**	**Estimated Cost**
	management at the TPP.	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.	Takhiatash TPP's direction.		Option 2: Cost for campaign for 4 wells 900 $US (3600 $US/yr)
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	Immediately	TPP EMT	Staff of the TPP

CORRECTIVE ACTION PLAN					
No.	**LTA remarks**	**Corrective Actions**	**Target date**	**Responsible Party**	**Estimated Cost**
		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 G (EMP) of the EIA)			
Health and safety management					
27	Some of the procedures of the TPP do not fulfill 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.	An update of the Health and Safety Plan and Procedures should be undertaken in order to assure the implementation of World Bank Guidelines (IFH 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			

CORRECTIVE ACTION PLAN					
No.	**LTA remarks**	**Corrective Actions**	**Target date**	**Responsible Party**	**Estimated Cost**
		Accident and Incident Management Definition of Structures and Responsibilities PPE Health and Safety Committee EHS Performance Surveillance and Measurement Confined Space 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.).	Immediately	TPP EMT	Staff of the TPP

CORRECTIVE ACTION PLAN					
No.	**LTA remarks**	**Corrective Actions**	**Target date**	**Responsible Party**	**Estimated Cost**
		A brief explanation of the TPP's environmental impact and the mitigation and monitoring measures 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 chapter H 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

250. In the following table a sum up summary of the CAP cost is shown.

Table 22. Corrective action plan

Part	№	Fix cost	Variable cost/year
General EHS Management	1	- USD	- USD
	2	- USD	- USD
Monitoring Program	3	30,000 USD	- USD
	4	30,000 USD	- USD
	5	30,000 USD	- USD
Report	6	- USD	- USD
Air Emission and Ambient Air Quality	7	- USD	- USD
	8	720,500 USD	- USD
	9	- USD	- USD
	10	- USD	- USD
	11	- USD	- USD
Wastewater and Ambient Water Quality	12	- USD	- USD
	13	182,000 USD	- USD
	14	- USD	- USD
	15	74,000 USD	- USD
	16	- USD	- USD
Hazardous Materials Management	17	97,500 USD	9,400 USD
	18	65,000 USD	- USD
	19	- USD	- USD
	20	- USD	- USD
	21	- USD	- USD
Waste Management	22	- USD	- USD
Noise	23	- USD	- USD
	24	- USD	- USD
Contamination Land and Groundwater	25	- USD	- USD
	26	- USD	- USD
Health and Safety Management	27	- USD	- USD
Training	28	- USD	- USD
Social Management and Communication	29	- USD	- USD
	30	- USD	- USD
	31	- USD	- USD
TOTAL		**1,229,000 USD**	**9,400 USD**

G. CONCLUSIONS

251. First of all, the audit team would like to acknowledge the assistance and good treatment received during the carrying out of this audit.

252. 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.

253. The non-conformities detected are related to non-compliance with regulatory requirements, as set out in the scope of the audit work.

254. 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.

255. 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 F (Corrective Action Plan), in order to improve the compliance with international requirements.

256. 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.

257. 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.

engineering

gasNatural fenosa

Environmental Impact Assessment
VOLUME 3/4
ENVIRONMENTAL IMPACT ASSESSMENT

July 2013
Version: 2

UZB: TAKHIATASH POWER PLANT EFFICIENCY IMPROVEMENT PROJECT

This EIA is prepared by the consultants for the Uzbekenergo of the Republic of Uzbekistan and for the Asian Development Bank (ADB)

Volumes

Volume I:	Non-Technical Executive Summary
Volume II:	Environmental Audit
Volume III:	Environmental Impact Assessment
Volume IV:	Annexes

ABBREVIATIONS

ADB	Asian Development Bank
APCS	Air Filtering and Conditioning System
BAT	Best Available Technology
CAP	Corrective Action Plan
CBD	Convention on Biological Diversity
CCGT	Combined Cycle Gas Turbine
CCGU	Combined Cycle Gas Unit
CCGT	Combined Cycle Power Unit
CEAP	Construction Environmental Action Plan
CEMS	Continuous Emission Monitoring System
CITIES	Convention on International Trade of Endangered Species
CM	Cabinet of Ministers
CNR (KMK)	Construction Norms and Rules
CSES	Centre for Sanitary and Epidemiological Supervision
CWP	Chemical Water Pre-treatment
DCS	Design and Supervision Consultant
DLN	Dry Low NOx
EA	Executing Agency
EHS	Environmental Health Safety
EHSGS	Environmental Health Social and Gender Specialist
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EMT	Environmental Management Team
EPA	Environmental Protection Agency (USA)
EPC	Engineering Procurement and Commissioning
ESGS	Environmental Social and Gender Specialist
FGD	Flue Gas Desulphuration
GBS	Gas Booster compression Station
GDP	Gas Distribution Plant
GDS	Gas Distribution Station
GFS	Global Forecasting System
GHS	Green House Gases
GIIP	Good International Industry Practices
GNFE	Gas Natural Fenosa Engineering
GOST	State Standards (used for USSR acronyms)

GOU	Government of Uzbekistan
GPF	Gas Processing Facilities
GRM	Grievance Redressing Mechanism
HPP	Hydro Power Plant
HRSG	Heat Recovery Steam Generator
IFC	International Finance Corporation
ISO	International Standarization Organization
JK	Jokargy Kenes
MAC	Maximum Allowable Concentration
MAD	Maximum Allowed Discharge
MAE	Maximum Allowed Emissions
MAWR	Ministry of Agriculture and Water Resources
MHRUz	Ministry of Health
MLSW	Ministry of Labour and Social Welfare
MPC	Maximum Permissible Concentration
MSW	Municipal Solid Wastes
MVD	Ministry of Internal Affairs
NCAR	National Centre for Atmospheric Research (USA)
NCEP	National Centres for Environmental Prediction
NGO	Nongovernmental Organization
OJC	Open Joint Company
OM	Oliy Majlis
Oz	Uzbekistan
PCR	Physical Cultural Resources
PCs	Public Consultations
PDD	Project Design Document
PER	Public Environmental Review
PFS	preliminary feasibility study
PM10	Particulate Matter under 10 µg
PM2.5	Particulate Matter under 2.5 µg
PMU	Project Management Unit
PPE	Personal Protection Equipment
QA/QC	Quality Assurance/Quality Control
RD	Regulation document
RUz	Republic of Uzbekistan
SanR&N	Sanitary norms and rules
SCNP	State Committee for Nature Protection
SEE	State Environmental Expertise
SPL	Sound Pressure Level

SPZ	Sanitarian Protection Zone
SR	Safeguard Requirements
SRMT	Shuttle Radar Topography Mission
SS	Substation
STP	Sewage Treatment Plan
TPP	Thermo Power Plant
TSP	Total Solid Particulate
UE	Uzbekenergo
UES TSO	Unified Energy System Transmission System Operator
UNFCCC	United Nations Framework convention on Climate Change
WDL	Waste Disposal Limit
WDS	Waste Data Sheet
WGN	Waste Generation Norm
WHO	World Health Organization
WHO	World Health Organization
WIS	Welfare Improvement Strategy
WRF	Weather Research Forecasting
WTP	Water Treatment Plant
WWD	Waste Water Drainage
WWTP	Waste Water Treatment Plant

GLOSSARY

Glavgosexpertisa	State Department responsible for Conducting Environmental Expertise Under SNPC
Khokim	governor of administrative unit
Khokimiyat	regional government authority
Makhalla	a community of neighbors, which is based on full independence and self-governance.
Som	local currency
OVOS	National acronym for EIA assessment process
PZVOS	National acronym for Concept Statement on Environmental Impact
Uzbekenergo	managerial body in the electric power and coal industries, which are major structural components of the national economy
Uzhydromet	state governing body specially authorized for the solution of tasks in the field of hydrometeorology in the Republic of Uzbekistan and in its activities it is accountable to Cabinet of Ministers
ZVOS	National acronym for Statement on Environmental impact
ZEP	National acronym for Statement on Environmental Consequences

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A. INTRODUCTION

A.1. Background

1. The Government of Republic of Uzbekistan (GOU) requested Asian Development Bank (ADB) to assist the Uzbekenergo (UE) to improve energy efficiency of Takhiatash Thermal Power Plant (TPP) with adoption of an energy efficient technology that will increase reliable power supply and contribute in climate change mitigation. This proposed project is classified as a class 1 project under the GOU environmental impact requirement, and therefore, environmental clearance from State Committee of Nature Protection is required. Based on ADB safeguard policy statement (SPS), 2009, this proposed project is categorized as an “A” project, and therefore environmental impact assessment (EIA) is required.

2. The EIA was entrusted to the GAS NATURAL FENOSA ENGINEERING (GNFE) company on behalf of the GOU and funded by ADB through the PPTA.

3. The EIA is prepared between January and June of 2013 within the framework of the Preliminary Feasibility Study of the Project “Construction of two 255 MW CCGT at Takhiatash TPP”. The project involves the demolition of the already dismantled units I and II, the decommissioning of the inefficient existing units III and IV and the construction and operation of two new combined cycle gas units (CCGTs) in the Takhiatash Thermal Power Plant (TPP), located in the Republic of Karakalpakstan, in north-western Uzbekistan.

4. Takhiatash TPP is owned by UE, the national company in charge of the electricity sector, and was constructed between 1961 and 1990 in six stages, as shown in table 1 below. In 1980 uneconomic and obsolete equipment of the I-II units was dismantled. The installed capacity of Takhiatash TPP is currently 730 MW. This TPP is the main power supply source for the Karakalpakstan and Khorezm regions with over 3 million people located in the western part of Uzbekistan. The power demand outlook is strong with a number of industrial development projects envisaged for the region, exceeding currently available capacity. Furthermore, operational lifetime of the Takhiatash TPP’s equipment is 22-43 years, resulting in its degradation and the increasing in the probability of accidental risk with potential negative consequences for the environment.

Table 1. Commissioning of Takhiatash TPP units

Units	I	II	III	IV	V	VI
Year of installation	1961	1964	1969	1974	1987	1990
Installed capacity of the unit, MW	24 demounted	28 demounted	200	110	210	210

A.2. Scope and methodology

5. GNFE has drawn up the Environmental Impact Assessment of the demolition of units I-II, the decommissioning of units III-IV and the construction and operation of the two new 255 MW CCGT units. Aside from using primary data collected directly from the field and carrying out this EIA study, GNFE has also used the EIA report prepared by Uzbekenergo to obtain the environmental clearance from the State Committee on Nature Protection to comply with the Government EIA requirement.

6. The methodology selected for drawing up the Assessment is as follows:

7. EIA scoping and gap analysis. This step aims to assess the scope of impact areas, scope of impact assessment, and scope of data required for the assessment. The scoping was done through desk study based on available report and data, as well as field visit undertaken in January and April 2013. It was determined that EIA prepared by Uzbekenergo to obtain environmental clearance is not adequate to comply with ADB SPS 2009 requirements. The outcome of the scoping process determined the primary data requirements and the existing secondary data that were sufficient for the assessment.

8. Policy, Legal, and Administrative Framework and Standards: Secondly, Uzbek legislation as well as ADB's and World Bank's legislation were reviewed with a purpose of identifying limits of the environmental protection framework, as well as the various international conventions to which Uzbekistan is a signatory. As required by the ADB safeguards, when host county regulations differ from international recognized standards, the project will achieve whichever is more stringent.

9. Description of the project: A description of the project was drawn up with data provided by UE in order to identify actions associated that might cause changes, both positive and negative, to the environment, drawing a distinction between decommissioning, construction and operation phases.

10. Description of the environment (Baseline Data): In the environmental baseline, the relevant physical, biological, and socioeconomic conditions within the study area were considered. Specifically, the most important environmental factors influencing the project's environment were described and assessed: climate, air quality, noise, geology, hydrography, water quality, vegetation, fauna, landscape, wilderness areas of interest, and in the socio-economic domain, demography, economic structure, occupational and community health and safety, vulnerable groups and gender issues, cultural heritage, urban planning programs and current and proposed development activities within the project's area of influence. In this stage we gathered relevant environmental data and information provided by the Administration database and completed it with primary data by means of site surveys (noise campaign, water quality analysis, soil analysis).

11. Analysis of Alternatives: Taking into account the description of the project and the environmental baseline, an analysis of Alternatives was carried out after. This section

examines alternatives to the proposed project site, technology, design and operation (including the 'no project' alternative) in terms of their potential environmental impacts.

12. Impacts analysis and assessment: Impact identification was carried out based on the analysis of interaction between actions of the project and environmental factors. The method consisted of creating a matrix, identifying impact where factors intersect, and determining which of those would be significant. The assessment of impacts was carried out by an interdisciplinary team. The assessment of significant impacts was carried out by following the approaches below:

- Describing potential impacts. The extent and quality of available data, key data gaps, and uncertainties associated with predictions and specifies topic that did not require further attention were identified and estimated.
- Characterizing impacts by means of the attributes defining them, as follows: Signs (positive or negative), immediateness, accumulation, synergy, momentum, persistence, reversibility, recoverability, periodicity and continuity;
- Determining the incidence of each impact type;
- Determining the magnitude of each impact type in qualitative and quantitative terms;
- Finally, defining the end value of each impact type, depending on the level of incidence and magnitude previously determined.

13. The assessment includes also potential transboundary and cumulative impacts as appropriate for both plants during the transition period. Opportunities for enhancement were also explored.

14. For some potential impacts, specific assessments with more in-depth analysis were carried out taking into account types of synergy that could arise with other activities (both existing and planned):

- For purposes of analyzing atmospheric impact and in order to calculate stack height, modeling was carried out using AERMOD program. The Pollutants NO2, NO and CO were assessed. 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. 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.

- As the meteorological data required for the modelization was incomplete and not representative of the local conditions at the closest meteorological station, a meteorological simulation of 2012 was carried out with the model Weather Research and Forecasting model (WRF) at the site. WRF is a new generational non-hydrostatic and modular structure meteorological model developed by the National Center for

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

- In the model, topography and sensitive receptors (residential areas, air quality stations, etc) were included in order to predict the specific potential impact.

- The atmospheric impact includes the analysis of the fulfillment of the air quality standards with the future facilities in operation. The stack height was calculated to fulfill these standards.

15. Analysis of the improvement of air quality due to the replacement of the old units III and IV by the new CCGT units was also undertaken.

16. Environmental Management Plan (EMP). The EMP is prepared to reduce, to eliminate or to compensate significant negative impact arising from the project were proposed. The EMP is also prepared with understanding that the proposed measures will be carried out and will be effective, but also to monitor any further unforeseen environmental impact. The monitoring measures were described with technical details, including parameters to be measured, sampling locations, frequency of measurements and definition of thresholds that signaled the need for corrective actions. The monitoring and reporting procedures to ensure early detection of conditions that necessitate particular mitigation measures and document the progress and results of mitigation were also described. The EMP includes: (i) implementation arrangements describing institutional or organizational arrangements, who is responsible for carrying out the mitigation and monitoring measures, and (ii) implementation schedule showing phasing and coordination with overall project implementation.

17. Information Disclosure, Consultation and Participation. Three step consultations were carried out with participation of affected people, community based organizations, and other stakeholders. The first consultation was held on 18th April 2013. The information disclosed during the first consultation includes: (i) description of the proposed project, (ii) potential impacts and proposed mitigation measures with special attention paid to the needs and concerns of vulnerable groups, including women and the poor, the further planned on information disclosure (including the type of information to be disseminated and the method of dissemination) and the process for carrying out consultation, and the proposed grievance mechanism for resolving complaints about environmental performance was included. The second consultation was carried out on 29th April 2013, before project appraisal by ADB. In this second consultation, the discussion focused on how inputs providing during the first consultations were incorporated. The two previous consultations disclosed the project to the public when just one CCGT unit was planned. The third consultation was held on 8th July 2013 in order to disclose to the public the project update to two CCGT units.

18. Conclusion and recommendation: This section highlights all important findings and provides a brief recommendation from the assessment.

19. Executive Summary. The Executive Summary concisely describes the critical facts, significant findings and recommended actions. The Executive Summary was redacted in a form and language understandable to affected people and other stakeholders.

B. PROJECT DESCRIPTION

20. This project description is based on the preliminary feasibility study (PFS), including a draft EIA prepared by Uzbekenergo in 2012, and modified to incorporate subsequent information obtained during further investigations and discussions.

B.1. Needs for project

21. Uzbekistan is a rich country in energy resources. It holds sizeable hydrocarbon reserves, mostly natural gas, so that the energy sector has substantial export potential and provides the foundation for the country's growth.

22. Uzbekistan's primary energy demand is expected to increase at 1.8% per year through 2030, from 47.0 MTOE in 2005 to 72.6 MTOE in 2030, as shown in Figure 1.

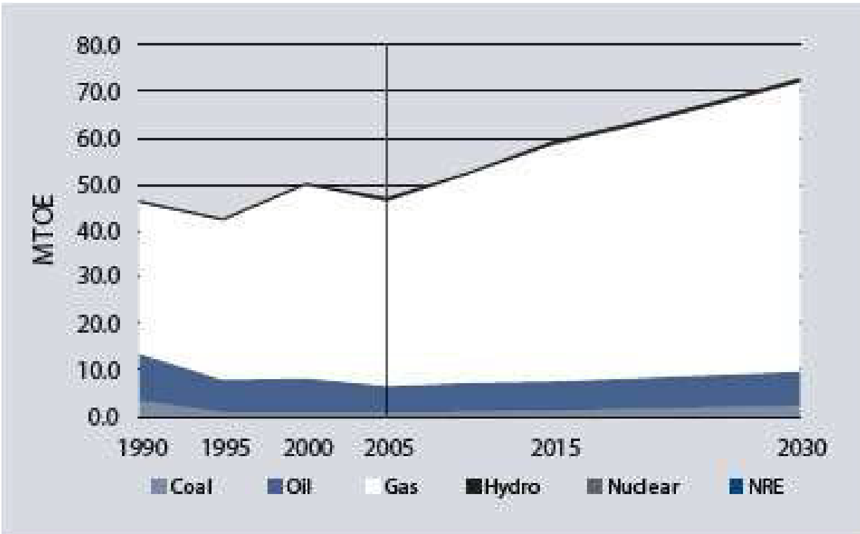


Figure 1. Primary energy demand in Uzbekistan (Source: APERC analysis, 2009)

23. After declining from 2000 to 2005, the final energy demand is likely to rebound with a faster annual growth rate of 2.4% in the near term (2005–2015) and a slower pace of 1.5% in the longer term, from 35.4 MTOE in 2005 to 56.2 MTOE in 2030 (Figure 2).

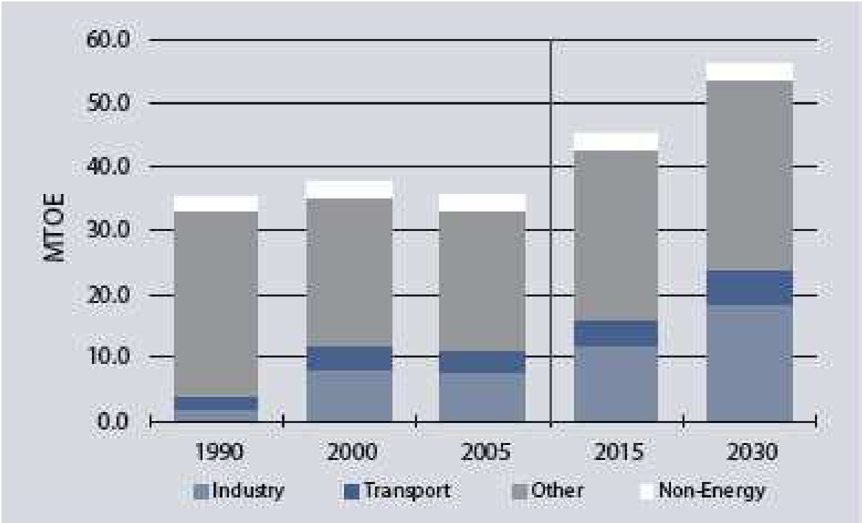


Figure 2. Final energy demand in Uzbekistan (Source: APERC analysis, 2009)

24. Due to the economic growth, power demand has gradually increased since 2002 and it is expected to continue increasing at 2.0–3.5% per year in the short and medium term and at an annual 1.1% through 2030. This trend is slower than in other countries of the same area. Industry's energy demand is expected to grow at a relatively fast pace of 3.6% per year, and this will result in substantial increases in CO_2 emissions.

25. The total installed capacity for power generation in the country is about 12,400 MW. However, the available capacity is less than 10,000 MW. In 2010, Uzbekistan generated about 51,935 GWh of electric power, out of which 2% was exported. In accordance with the electricity demand trend, total electricity generation is also likely to show moderate growth of 1.0%, increasing up to 61,200 TWh in 2030. These figures are shown in Table 2

Table 2. Primary energy demand, electricity demand, electricity demand and generation and CO_2 emission

Indicator	**Annual value**					**Annual growth rates**	
	1990	**2000**	**2005**	**2015**	**2030**	**1990-2005**	**2005-2030**
Primary energy demand (MTOE)	46.4	50.4	47	59.2	72.6	0.10%	1.80%
Electricity demand (TWh)	42.9	39.8	39.4	45.1	52.2	-0.60%	1.10%
Electricity generation (TWh)	56.3	46.8	47.7	53.9	61.2	-1.10%	1.00%
CO_2 emission (million tons of CO_2)	110.3	101.6	96.1	120.4	149.8	-0.60%	1.80%
CO_2 per total primary energy (tons CO_2/ TOE)	2.38	2.02	2.04	2.03	2.06	-0.60%	0%

26. Uzbekenergo (UE) is the national company in charge of the electricity sector through joint-stock companies in which the State is the main shareholder. Uzbekenergo owns and operates 10 thermal power plants (TPPs) and 28 hydropower plants (HPPs), which represent 87.6% and 12.4% of the total generation capacity, respectively.

27. Uzbekistan's power generation plants are generally old and inefficient, requiring urgent replacement and/or modernization. More than 75% of the power plant units are over 30 years old, reaching or exceeding their economic life. Since 1991, only two power capacity expansion projects have been completed: (i) rehabilitation of two 300 MW steam cycle units at Syrdarya TPP, and (ii) construction of an 800 MW steam cycle unit at Talimarjan TPP.

28. Natural gas is used for 94% of thermal power generation in Uzbekistan. Conventional TPPs run with an average thermal efficiency of 31%, compared with 55% of advanced combined cycle gas turbine (CCGT) technology.

29. Energy security, affordability, and efficiency are key priorities of the government's energy strategy. The government has adopted policy and legal frameworks with clear goals to reduce energy intensity and losses, and enhance sector investments and institutional change. The government aims to (i) maximize savings through rational use and application of clean energy technology, (ii) integrate energy efficiency into national planning, (iii) improve sector performance through commercializing utility operations, (iv) attract private sector participation, and (v) increase energy exports on a commercial basis. Energy plans leading to 2020 and 2030 have been announced, but are not yet in the public domain.

30. The government's $5.2 billion power sector development plan, 2011–2015 covers physical and non-physical aspects to ensure (i) uninterrupted and reliable power supply to all customers in Uzbekistan; (ii) CAPSs' security and reliability; (iii) equal access to the transmission system; (iv) investment for reconstruction, modernization, and expansion of power generation, transmission, and distribution systems; (v) fuel mix diversification for power generation; and (vi) management, operations, and performance improvement of utilities based on commercial principles.

31. The government also has a $19.4 billion investment plan for the oil and gas sector to develop new production and modernization projects, 85% of which are expected to be financed through foreign direct investment and external loans.

32. Within this framework, two of the main objectives for the energy sector in Uzbekistan settled by the ADB by 2016 are:

- Thermal power generation efficiency increased from current 31 % to 50%.
- Greenhouse gas emissions reduced from 4.1 to 2.7 $mtCO_2e$/GDP.

33. As mentioned in the Country Partnership Strategy 2012–2016 for Uzbekistan (August 2012), ADB will provide support for energy efficiency enhancement as this is closely aligned with Uzbekistan's emphasis on promoting energy security and affordability, and reducing energy intensity. Uzbekistan's energy intensity per unit of GDP is one of the highest in the world and significantly above other middle-income countries. As a result of intensive industrial use of energy, carbon emissions per unit of GDP in Uzbekistan are among the highest in the world. Lowering energy

intensity and carbon emissions will increase the economy's competitiveness and mitigate climate change impacts.

34. In this respect, power generation from burning gas in a CCGT is the cleanest method of generation using fossil fuels. The CCGT turbines burning natural gas produce significantly less greenhouse gases than traditional coal or oil fired thermal power stations, as a result of both the less greenhouse intensive nature of natural gas and the greater inherent energy conversion efficiency of CCGT technology. Replacing the existing power generation assets with the energy efficient CCGT technology is a key strategy for Uzbekistan in order to save energy, secure reliable power supply and mitigate climate change impacts.

35. Three CCGT power plants (total installed capacity of about 1,650 MW) are planned to be constructed by 2014, which will reduce the natural gas use per unit of electricity generated.

36. Takhiatash TPP is the main power supply source for the Karakalpakstan and Khorezm regions with over 3 million people, located in the western part of Uzbekistan. The power demand outlook is strong with a number of industrial development projects envisaged for the region, exceeding currently available capacity. Furthermore, Takhiatash TPP not only provides the North-West region of the country with electricity but also heats water to supply the consumers in Takhiatash town and for its own needs.

37. Operational lifetime of Takhiatash TPP's equipment ranges from 22 to 43 years, which is the main reason for the equipment reliability degradation and increases the probability of accidental risks with potential negative consequences for the environment.

38. Considering this framework, Uzbekenergo has identified Takhiatash TPP's project as a priority. It involves the replacement of the obsolete equipment of III and IV units by the construction of two new CCGT units with the capacity of 255 MW ±10% each.

39. The implementation of this project will allow cutting operational expenses, increasing the efficiency and the reliability of the energy supply to consumers, as well as improving the environmental quality in its area of influence according with the Government and ADB strategies.

B.2. Project description

40. At the moment, power and heat production at Takhiatash TPP is based on a conventional steam power technology. In accordance with the aforementioned plans of implementing energy-efficient technologies, it is designed to construct in Takhiatash TPP two CCGT units with capacity of 255 MW each consisting of one gas turbine, one HRSG (heat recovery steam generator) and one steam turbine, what can significantly improve the efficiency of the plant.

41. The current installed capacity of Takhiatash TPP is 730 MW. With the commissioning of the new CCGT units, the decommissioning of existing units III and IV (composed of four boilers and three turbine units with a total capacity of 310 MW) will be undertaken. The installed capacity of the new combined cycle plant will be 255 each unit MW, resulting in a total installed capacity of 930 MW for

Takhiatash TPP. Table 3 shows an overview of both current and prospective capacities and indices of the TPP.

Table 3. Takhiatash TPP's current and prospective units and indices

Unit	**I**	**II**	**III**	**IV**	**V**	**VI**	**CCGT 1**	**CCGT 2**
Year of installation	1961	1964	1969	1974	1987	1990	2016	2016
Installed capacity of the line, MW	24	28	200	110	210	210	255	255
Current installed capacity of TPP, MW	*	*	730				-	-
Prospective installed capacity of TPP, MW	*	*	**	**	930			

Index	**Current indices (before CCGT commissioning)**		**Future indices (after CCGT commissioning)**		
	III and IV	**V and VI**	**V and VI**	**CCGT 1**	**CCGT 2**
Installed capacity (MW)	310	420	420	254	254
Operating hours (h)	3083	5525	1014	6912	6912
Load factor (%)	35%	63%	12%	79%	79%
Annual electricity output (GW·h)	955.9	2320.4	425.9	1755.6	1755.6
Total	3276.3		3937.2		
Annual electricity output from buses (GW·h)	888.1	2194.6	402.8	1696.5	1696.5
Total	3082.7		3795.8		
Annual electricity output to the mains (GW·h)	885.3	2187.6	401.5	1691.2	1691.2
Total	3072.9		3784.0		
Heat rate for electricity supply (kJ/kW·h)	15215	11474	11585	6787	6787
Total	12552		7296		
Annual heat supply (Gcal)	3240	-	-	139100	
Total	3240		139100		

* Dismantled

** Decommissioned

42. Both the existing facilities of the units that are currently operating at Takhiatash TPP and the new CCGT units are described in detail below.

B.2.1. Description of the existing power plant (units III-VI)

43. 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.

44. Karakalpakstan borders with the Republic of Kazakhstan in the north and west, the Navoi region in the east, the Khorezm and Bukhara regions in the south-east and with Turkmenistan to the south. The location of Karakalpakstan within Uzbekistan and the wider region is illustrated in the following figures.

Figure 3. Takhiatash TPP location

Figure 4. Karakalpakstan Province location

45. The capital city of the Republic, Nukus, is located 20 km to the north of TPP industrial site and Khodjeyli regional centre is 18 km to the north-east of TPP. The Nukus-Khodjeyli highway runs 4 km to the north of TPP and railway runs at the distance of 1.3 km.

Figure 5. Location of the TPP, city of Takhiatash, Amudarya River and the intake and discharge Suenly canal

Figure 6. Aerial photograph of the existing Takhiatash TPP

46. 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. In 2011 the TPP generated 3,276 million kWh of electricity and 3,240 GCal of heat.

47. Old units I and II were dismantled in 1980. The building, foundations and the 65 m stack are still there. Buildings are used as occasional workshop and warehouse facilities.

48. The different facilities of the plant are explained in detail below and a layout of the existing plant is showed in Annex I. The Takhiatash TPP is currently occupying 69.18 ha

B.2.1.1. Fuel system facilities

49. 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 underground pipelines. The GDP is located at 2 km from the TPP.

50. 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.

51. Fuel oil facilities consist of a mazut pumping station and a mazut storage with an overall capacity of 250,000 m^3: 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)) and 20 tanks outside the TPP in Nukus city, with a capacity of 10,000 m^3 each tank. The tanks within the TPP terrains are bordered in order to prevent any fuel oil spreading but the secondary containment is not made of impervious, chemically resistant material.

52. Fuel oil transportation from receiver tank to reservoirs and from there to the boiler units is carried out in a closed circuit to prevent overflowing. There is a mazut storage at 35 km from the TPP whose capacity is 200,000 m^3. The location of this storage is shown in the following picture.

Figure 7. Location of mazut storage place

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

Figure 8. View of mazut storage place from satellite

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

 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.

B.2.1.2. Power island

55. III and IV units, which include six gas and oil boilers and three steam turbines with a total installed capacity of 310 MW, are to be dismantled whereas V and VI units, each one with a capacity of 210 MW and including two boilers and two steam turbines, will continue operating as back up units.

56. <u>III and IV Units</u>

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. 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.

III unit include two steam turbines with capacity of 100 MW each and IV unit include one steam turbine with capacity of110 MW.

57. <u>V and VI Units</u>

V and VI units consist of two 210 MW blocks with the following main and auxiliary equipment:

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 4. 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/cm^2; 540°C
12 gas and oil burners frontal located</td><td colspan="2">TGM-151-B
220 t/h; 110 kgf/cm^2; 540°C
4 gas and oil burners frontal located</td><td colspan="2">TGME-206
670 t/h; 140 kgf/cm^2; 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/cm^2; 535°C</td><td colspan="2">2 steam turbines
(K-215-130)
- Condensing type
- Single-shaft
- HP, IP and LP
- 130 kgf/cm^2; 540°C</td></tr>
</table>

B.2.1.3. Water supply and water treatment systems

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

59. Figure 9 shows an image representative of the location of the TPP, Takhiatash city, Suenly canal and Amudarya River.

Figure 9. Location of Takhiatsh TPP, Takhiatash city, Suenly canal and Amudarya river

60. 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 being used 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 sent to the mechanical filtration.

- **Mechanical filtration -** Clarified water is driven to mechanical filters where there is a complete removal of suspended solids. 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.

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

62. 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.

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

64. 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.

65. 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 and impurities, etc.

B.2.1.4. Cooling water system

66. 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 the intake.

67. Annual water intake from Suenly Canal for cooling purposes is detailed in point B.4.1.3.

B.2.1.5. Drinking water system

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

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

B.2.1.6. Heating water system

70. The water-heating converter plant at Takhiatash TPP is designed for providing with heating water not only the administrative, residential and industrial buildings of the Tahiastash TPP itself but also part of Takhiatash city.

71. The current water-heating system consists of four heaters fed by steam coming from the pressure reducing desuperheating station (PRDS) of units III and IV, an atmospheric deaerator for oxygen removal, three boiler boost pumps, four network pumps and five tanks with a total capacity of 2,300 m^3. Water in a total mass flow of 650 t/h is heated from 70º C to 150ºC; 250 t/h are dedicated to self-consumption within the TPP's facilities whereas 400 t/h are delivered to the municipal network.

B.2.1.7. Effluent treatment system

72. Description of the treatment for 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:

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

74. - 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).

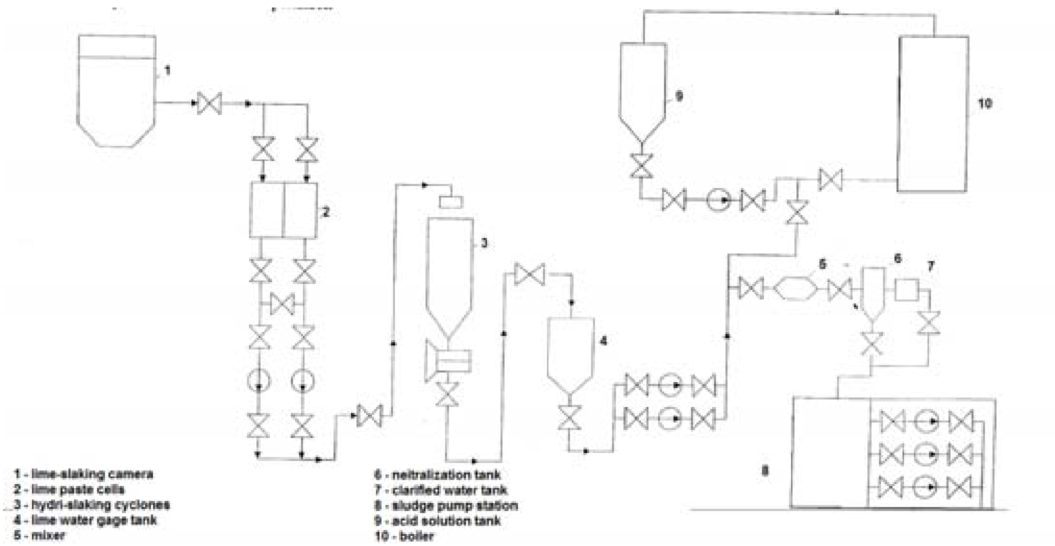


Figure 10. Water treatment scheme at the Takhiatash TPP

75. - Oily/greasy effluents 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.

76. 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.

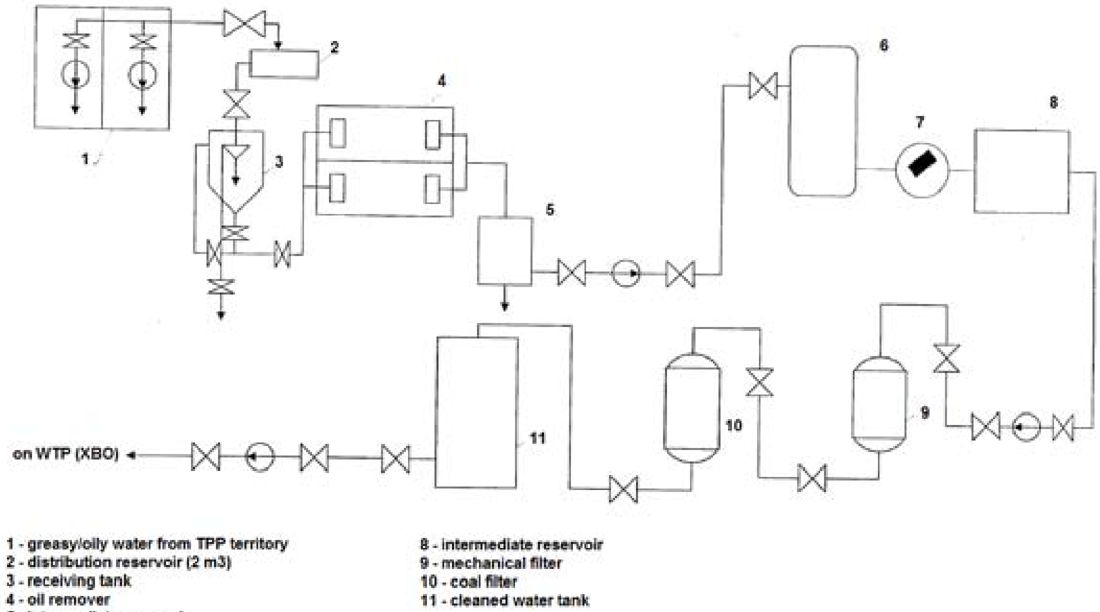


Figure 11. Scheme of comprehensive treatment of industrial sewage

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

78. **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 the Suenly canal.

Cooling system is once-through therefore the volume of water intake is almost equal to the water discharge.

79. Water used for technical water supply 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.

80. **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.

81. **Water treatment plant (WTP) effluents**. Blownwater 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).

82. 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 12. Ponds for industrial sewage disposal

83. All the sludge disposal sites are non-filterable with impervious screens at the bottom and sides in the form of poured asphalt of 20 mm 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.

84. The calculated area of evaporation is 3,300 m^2. The complete evaporation of flows is ensured. The capacity of the sludge collector is 1,700 m^3. Currently, sludge tanks are 1/3 full.

85. On the regular base lime wastes are supplied to the specialized building organizations. According to the TPP statistical data the whole amount of accumulated wastes is 84 tons, 0.065 tons of them are of III toxic class of hazard (oil sludge).

B.2.1.8. Chemical storage

86. There is a chemical storage consisting of a closed warehouse with a basement of concrete, a ventilation valve and roofed.

B.2.1.9. Power evacuation

87. The TPP currently supplies electricity to the National Grid and to a regional grid. The availability of the existing blocks is low and so is the quality of the service being provided to the demand. Power generated by the existing units of the TPP is evacuated via 35 kV, 110 kV and 220 kV.

B.2.2. Description of the new Combined Cycle Power Units (CCGT)

88. A combined cycle thermal power unit brings together two cycles: a gas cycle (Brayton cycle) and a steam cycle (Rankine cycle). Its main characteristic lies in the use of the thermal energy contained in the gas cycle exhaust gases to generate steam with sufficient energy to be used in a steam turbine.

89. The CCGT units that will be installed in the Takhiatash TPP will be formed by two power generation cycles, the first one represented by the gas turbine (178.7 MW) and the second by the steam cycle (75.2 MW), with a total power of 253.9 MW each CCGT.

90. Each CCGT comprises one gas turbine, a heat recovery steam generator (HRSG) and one steam turbine (1:1:1 concept) which operate together as a single integrated module.

91. The first cycle is represented by the gas turbine. After passing through the Air Filtering and Conditioning System (APCS) air is compressed and passed into the combustion chamber with a reciprocating compressor. Here fuel mixed with air is burned to produce a hot high pressure combustion gas which is expanded through a turbine, where the kinetic energy of the gas stream is converted into mechanical revolution of the turbine’s rotor. The turbine drives both the compressor and the electrical generator to produce electricity. Gas temperature before the gas turbine, depending on the series turbine is in the range between 1100-1500º C.

92. The gas turbine generates approximately two thirds (2/3) of the electricity. The only problem arising in these systems is the formation of nitrogen oxides (hereinafter NO_X) due to the high temperatures reached in the combustion chamber. The combustion chamber used has dry method low NO_X burners to reduce these emissions, not requiring any water or steam consumption.

93. This technology is based on performing the natural gas combustion with air in two stages, in such a way that the fuel and the oxidizer are mixed first, allowing for a homogeneous temperature distribution to be achieved and, therefore, a stable low temperature flame that reduces NO_X formation.

94. The second cycle is a steam cycle. The exhaust gas from the gas turbine is still hot (510 ºC) and is passed through a special gas pipe into a Heat Recovery Steam Generator (HRSG), where the heat energy of the flue gas is transferred to feed water to generate steam at high pressure. This steam is used to drive a steam turbine which powers a further electrical generator, generating one third (1/3) of the electricity.

95. Once expanded in the steam turbine, exhaust steam is sent to condenser where the heat exchange between the steam and the cooling water occurs. Condensate is pumped out by the condensate pump and sent to the HRSG where it is again converted into steam, closing the steam-water cycle.

96. Gases from the HRSG are discharged into the atmosphere through the stack at a temperature of 125 °C.

97. Therefore, the layout of each CCGT is a two-shaft arrangement with two electric generators for gas and steam turbines.

98. A simplified process flow diagram of the CCGT units of Takhiatash TPP is shown in Figure 13.

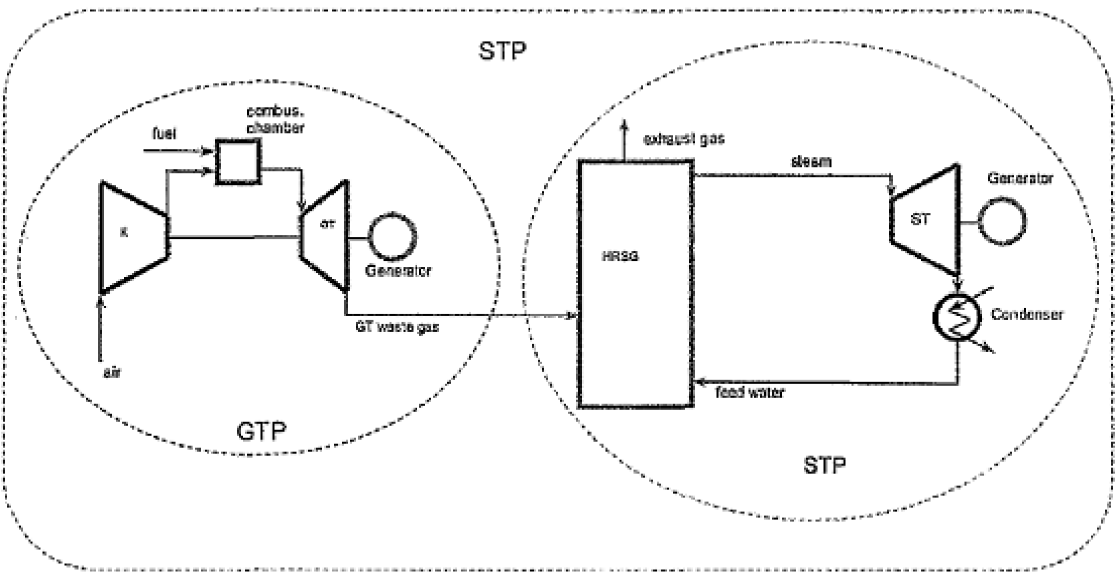


Figure 13. Simplified process flow diagram of the CCGT of Takhiatash TPP

99. The use of combined cycle power plants allows the recovery of part of the energy contained in the gas turbine exhaust gases which would be released into the atmosphere. The good global performance of this type of cycles is due precisely to the high recovery of part of this energy. The exhaust gases at the gas turbine outlet are at approximately 510 °C, being at approximately 125 °C at the heat recovery steam generator (HRSG) outlet. Such a low temperature is possible thanks to using natural gas as the fuel, since the content of sulfur is very low and does not give the problem of acid condensation at low temperatures, leading to the fast corrosion of the last stages of the heat recovery steam generator (HRSG) and the stack, as in the case of other fossil fuels whose greater content of the aforementioned element harms the lifespan of the equipment and the environment.

100. Efficiency of standard gas turbine power unit (basic cycle) is 34-40%. In the combined cycle efficiency is in the range of 50-60% depending on the selected design. This represents both an environmental improvement, thanks to a more efficient use of the primary energy, and a reduction in generation costs.

101. The aforementioned power and operating parameters for the new CCGT units have been calculated with the simulation software Thermoflow for the selected fuel characteristics and the specific atmospheric conditions of the TPP's site (average annual temperature 13.64 °C, pressure 0.004 bar, relative humidity 58%). This software allows selecting the gas turbine model within a rich library containing a wide range of commercial models from the main suppliers. The model used for the simulation, was selected according to the project's requirements (178.7 MW), which does not mean that this must be with certainty the model selected for the final design. The whole CCGT (gas turbine, HRSG and steam turbine) has been simulated.

102. The new main buildings (one per each CCGT unit) are separated from the existing main building and the following auxiliary structures and equipment are located on the CCGT units' site:

- Ten forced draft cooling towers (five per each CCGT)
- Gas processing point with gas booster compressors and gas-control point;
- Blow off and waste gas pipe system;
- Facility and technological equipment for boiler feed preparation of units' water-flow cycle makeup
- Heating-water converter plant with a line-pump
- Chemicals for boiler unit metering system to support a chemical state
- Tank farm
- Emergency oil drain system
- Express laboratory
- Warehouse for oil stored in containers
- Chemicals active storage
- Materials active storage
- Nitrogen generator with receivers
- Pressurized air compressors with receivers
- Backup diesel generator in case of emergency power shutdown of units' auxiliaries

- Technological pipe-line racks
- Pump for transfer of waste water polluted with oil products
- Engineering and domestic building

103. Gas processing point, chemicals storage, warehouse for oil stored in containers and expendables storage are planned to be located on the south side of the CCGT units. Electric devices' site is located on the west side of the CCGT units. A new relay cabinet building is planned to be located near the existing one.

104. Technical water supply facilities: circulating pumping station with fire suppressing pump, water cooling towers, chemical water pre-treatment (CWP) for preliminary filtering of make-up water are planned to be located on the west side of the warehouse. Settling pit and pulp waste dump are located further to the west.

105. It is planned to allocate a new cuttings ditch for CWP preliminary filtering and evaporation pond for chemical wash of waste-heat boiler near the existing Takhiatash TPP's cuttings ditch.

106. This project also includes all necessary buildings such as administration building, the fire fighting facilities and the gate house.

107. Construction site for the two new CCGT units is planned on the south side of Takhtiatash TPP with 40 hectares. Main portion of those 40 ha land belong to Takhiatash city and 2.29 ha belong to affected households to which will be provided adequate displacement and rehabilitation assistance to restore or improve their pre-project standard of living (this matter has been analyzed in the Land Acquisition and Resettlement Plan, a document independent from the EIA).

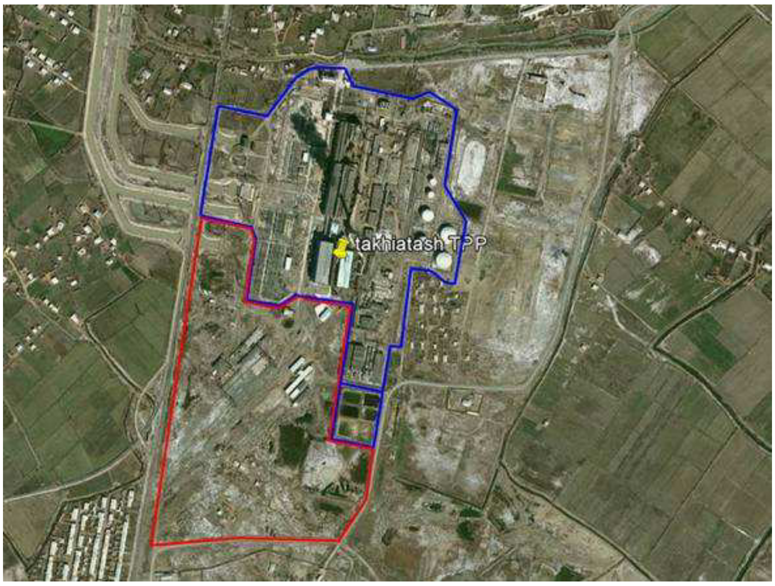


Figure 14. Current fence of the TPP in blue. Future 40 ha extension in red.

108. In addition to the CCGTs units, a new gas pipeline has to be constructed. For this purpose about 2 km right-of-way will require 4.55 ha temporary land acquisition for construction of underground gas pipeline from the gas distribution station to Takhiatash TPP.

109. The different facilities of the CCGT units are explained in detail below and a layout of the new plant is showed in Annex I.

B.2.2.1. Fuel system facilities

110. Natural gas is the main and backup fuel for both CCGT units and it will be supplied from the GDP (Gas distribution plant) to the Gas Processing Facilities (GPF), located at the left part of the design site. In accordance with preliminary estimates, the gas will be done through two new gas pipelines with a minimum diameter of 300 mm. Gas pipeline to the GDP will have a 2 km length (4.55 ha temporary land acquisition will be required) and the final tack is still not defined. It could be traced parallel to the existing pipeline or a new path could be needed. Taking into account the decommissioning of units III and IV, the GDP will be sufficient for the natural gas CCGT needs with the installation of gas compressors.

111. The GPF includes the Gas Booster compressor Station (GBS), a gas metering unit with two pipelines (one working and one backup), system of blow off and discharge gas to vent stacks. The GBS is designed to compress gas and to stabilize its pressure before it is supplied to the GPF. Dust collectors will be installed upstream the GBS. Purging and waste gas pipe system will be provided to remove fuel gas and nitrogen from dry packing of GBS, and to provide periodic purges, as well as to ensure emergency discharge from safety devices.

B.2.2.2. Power island

112. Each CCGT is a one-piece combined-cycle plant designed to produce electricity in the basic mode of operation, and at the same time to cover heat schedule of heating loads of hot water supply.

113. Each CCGT is a combination of steam turbine and gas turbine units, connected by joint technological cycle (combined cycle). The combination of these units into one whole unit allows getting extra power and increasing the efficiency in comparison with the steam turbine and gas turbine power plants, as well as reducing the emissions of oxides of nitrogen and sulphur in the atmosphere.

114. The CCGT equipment includes one gas turbine (178.7 MW) with electric generator, a HRSG, one steam turbine (75.2 MW) with an electrical generator

115. The gas cycle performance rises as the temperature of the combustion chamber gases increases. In contrast, the temperature rise implies an increase in the NO_X formation speed. The combustion chamber of the gas turbine is equipped with dry type low NO_X burners, not consuming any water or steam, to counteract this harmful effect on the environment, achieving emissions below 25 ppm with 15% O_2 (approximately 51 mg/Nm^3 at 15% O_2, dry basis).

116. In order to reduce the emissions of nitrogen oxides, in comparison with the units operated at the present day, dry low emission burners are used during the natural gas combustion process. This technical solution allows emission of NO_X 3.5 times lower compared to concentration of flue gases in existing boilers and boilers to be dismantled. Furthermore, another design solution to decrease the emission levels of NO_X is the use of structural features of the combustion chamber of the gas turbine that allows a combustion mode in which the fuel is almost completely burned.

117. The exhaust gases of each CCGT, at 125 ºC, will be disposed of through one each 112.5 m high individual stacks with a diameter of 6.3 m, located outside each building of the boiler room. They will be metallic and shall be equipped with a slide gate valve and a noise suppressor. Final height of the two stacks was determined by the atmospheric modeling results (Annex III) and the World Bank EHS Guidelines (2007)

B.2.2.3. Water supply and water treatment systems

118. Amudarya River will be the source of raw water at the new CCGTs' facilities through the existing intake canal of the existing facilities of Takhtiatash TPP. Just a new pump station within the existing intake canal will be needed to be constructed.

119. Water is used for the following purposes:

- Make-up water losses due to evaporation in cooling towers
- Make-up the blowdown of the circulating water systems
- Steam cycles make-up
- Auxiliary needs of the chemical water treatment (CWT) of the steam cycles make-up
- Auxiliary needs of the pre-treatment plant

120. Primarily, the raw water initially settles in a settling tank to remove suspended particles. Settling tank is two-sectioned trapezoidal cross-section, performed in earthen bed with bulk embanks of clay loam. The bottom and the slopes of the settling tank are protected with cladded concrete encasement in two 120 mm layers with impervious membrane shield between the layers.

121. The clarified water is supplied to Chemical Water Pretreatment (CWP) after the settling tank for further processing with use of clarified water pumping station.

122. Due to the high content of solids and hard salts in raw water of Amudarya river, it is recommended to provide water clarification pre-treatment using clarifiers and soda lime treatment (Na_2CO_3, CaO) with coagulation($FeSO_4$ coagulant) followed by mechanical filtering process. This pre-treatment allows removing the most part of calcium ions in processed water.

123. It is proposed that, within the total volume of intake water (952 m^3/h), only 500 m^3/h will be exposed to such treatment.

124. After clarification process, this volume of treated water (500 m^3/h) will be distributed as follows:

- 72 m^3/h will be used as makeup water for the Chemical Water Treatment of water-steam cycles (36 m^3/h for each CCGT's steam cycle).
- 110 m^3/h will be used to meet the auxiliary needs of the pretreatment plant (clarified water for the preparation of shaft turning gear reagent solutions, etc).
- 318 m^3/h will be mixed with the non-treated flow (452 m^3/h) and will be further used as make-up water for the cooling system (385 m^3/h per each CCGT unit).

125. The following describes the main intake water uses:

a) Make-up water for circulating water systems

126. Each CCGT unit will have its own circulating system. Circulating water systems for the new CCGT units are designed in closed circuit, including the installation of ten mechanical draft cooling towers (five per CCGT unit) and the auxiliary hydraulic engineering structures according to the Law of the Republic of Uzbekistan "On water and water use" № 837-XII from 06.05.1993.

127. It is planned to install 5 mechanical draft cooling towers per CCGT unit (ten towers in total) with an irrigation area of 16x16 = 256 m^2 each tower.

128. Circulating water cooled in each circuit of cooling towers will be supplied with circulation pumps to the steam-turbine's condensers and to all auxiliary equipment of each respective CCGT. After the heat exchange in the condenser, the heated water will be sent back to the cooling towers, for cooling. Further, the cycle repeats. The total volume of circulating water in each cooling system of the new CCGT units has been estimated at 12,862 m^3/h (25,724 m^3/h for both CCGT units).

129. The cooling system of each CCGT unit requires 385 m^3/h for making-up losses due to evaporation in cooling towers and losses due to blowdown in circulating system. The total make-up water flow for the cooling systems of both CCGT units is 770 m^3/h, out of which only 318 m^3/h will have been previously pre-treated in the CWP.

130. A water stream from the clarification process (318 m^3/h) will be mixed with a non-treated water stream (452 m^3/h) from the settling tank. This mixed water stream, with a total volumetric flow of 770 m^3/h, will be subsequently stabilized by a correctional treatment using polyphosphonates in order to prevent the salt fouling of the equipment, pipe lines and cooling towers' sprinklers.

131. Next, the water is supplied to the pumping station's water intake, where it is mixed with chilled on cooling tower circulation water, and it is directed to the cooling mechanisms of each CCGT.

132. To prevent the fouling, biocide treatment equipment is proposed, which uses a sodium hypochlorite as the main component. Maintenance of working dosage of both components in the circulation water is carried out by automatic insertion of the product in proportion to the amount of make-up water. This processing will make it possible to partially soften the water sufficiently under given salt content of the source water to ensure stable operation of the circulation systems.

133. The information on chemicals consumption for the clarifying treatment of circulating water systems' makeup water is provided in point B.4.1.2.

b) Make-up water for CCGTs' steam cycle

134. The quality of the makeup water fed to each heat recovery steam generator shall comply with manufacturer requirements. To meet these strict requirements, the complete desalination of raw water is required at a previous stage. The composition of the intake water from Suenly canal is given in Table 5.

Table 5. Composition of intake water from Suenly canal

№	Parameters	Units	Value
1	Salt content	mg/dm^3	1360
2	Solid residual	mg/dm^3	1147
3	Suspended matter	mg/dm^3	434
4	pH	-	8.3
5	Sulfates (SO_4^{2-})	mg-eq/dm^3	8.4
		mg/dm^3	403
6	Chlorides ($Cl^{-)}$)	mg/dm^3	3.66
		mg/dm^3	128.1
7	Total hardness	mg-eq/dm^3	12.1
8	Hardness Ca^{2+}	mg-eq/dm^3	6.5
		mg/dm^3	130.3
9	Hardness Mg^{2+}	mg-eq/dm^3	5.6
		mg/dm^3	68.1
10	Alkalinity	mg-eq/dm^3	sl-2.25
11	Hydrated acid (SiO_2)	mg/dm^3	8.4
12	Oxidation characteristics	mg/dm^3	1.4
13	Iron (Fe^{3+})	mg/dm^3	0.22
14	Nitrites (NO_2)	mg/dm^3	0.2
15	Nitrates (NO_3)	mg-eq/dm^3	0.1
		mg/dm^3	6.2
16	Sodium (Na^+)	mg-eq/dm^3	2.31
17	Anions	mg/dm^3	14.61
18	Cations	mg/dm^3	14.63

135. It is planned to build a new water treatment plant for total water desalination with a production rate of 72 m^3/h in order to meet the makeup water requirements of each CCGT's steam cycle (30 m^3/h). The appropriate water treatment method shall be determined according to both the raw water composition and the treated water quality requirements.

136. A water flow of 72 m^3/h will be supplied to the Chemical Water Treatment (CWT) in order to generate desalinated water to makeup losses and blowdown of the water-steam cycles. Out of that flow, 60 m^3/h are required for the make-up of the CCGT units (30 m^3/h per CCGT).

137. This Chemical Water Treatment (CWT) comprises a two-stage Na-cation exchange followed by a reverse osmosis process and the adjustment of chemically desalinated water's parameters on mixed-bed filters.

138. For highly mineralized water, the continuous operation of osmotic equipment is allowed after particular ionization (Na-cation exchange) of clarified water only. It is proposed to install 4 filters with diameter of 2.6 m on the first stage, and 2 filters on the second stage. Two tanks of soda-lime treated water and two tanks of sodium cation-exchanged water will be provided to ensure trouble-free operation of plant.

139. The reverse osmosis plant will consist of 2 units and 2 plants. The capacity of the reverse osmosis plants will be designed in order to cover the water needs of both CCGT units.

140. The sequence of plant operation is as follows. High-pressure pumps boost the plant inlet pressure and treated water goes to the reverse osmosis membrane elements. The water flow exposed to reverse osmosis pressure is divided into two streams on semi-permeable membranes. 1-2% of the total salt flow penetrates into the less concentrated stream; (permeate). After adjustment in MBF filters, this stream is supplied for the cycle makeup.

141. The second stream (concentrate) containing the bulk of dissolved salts is discharged to plant drainage. The portion of this water can be used for salt solution preparation for further regeneration of Na-cation filters.

142. Reverse osmosis plants shall be flushed periodically to ensure their efficiency. There are two types of flushing:

- During the operation, membranes are flushed at set intervals by the supply of permeate to the concentrate pipeline.
- Chemical flushing of membrane modules will be provided if permeate productivity of plant is reduced by 10%, or if permeate salt content increases by 10%, or if pressure difference between treated water and concentrate increase by 15% of the initial difference.

143. Further, permeate is supplied to cartridge MBF filters, and after advanced treatment and pH adjustment, the treated water is supplied to CCGTs' heat recovery steam generators makeup. Two backup condensate tanks (one is in operation, one is standby) with a capacity of 1000 m^3 each will be provided to ensure trouble-free operation of the plant. Preliminary data on chemicals consumption in the makeup water processing for the CCGT's steam cycle is detailed in point B.4.1.2

144. Water sent to the steam-water cycles required conservation in boilers with hydrazine and ammonia in the mode boiler stop with supply of the conservation solution into the feed water line before the

economizer and the line of phosphate in the boiler drum is provided. This system is designed to maintain optimum chemical conditions in the boiler units.

c) Water for fire fighting

145. On the other hand, the fire protection system of the new CCGT units draws the firewater from the cooling tower basin. This basin must store the volume of water required to meet the needs for fire suppression. The design volume of water for firefighting purposes will be provided in power ponds and the minimum required duration of water supply is 3 hours, in accordance with regulatory requirements.

146. At this current design stage, a firewater water pump station is provided with two firewater pumps installed in parallel (one working and one standby pump), with a discharge capacity of 500 m^3/h and a pressure of H=63 m.

147. The new CCGTs' site includes a pressurized water ring feeding system equipped with stop valve and fire hydrants in manholes. Firewater is supplied from the firewater pump station to the water ring surrounding the CCGTs' site via two pipelines.

B.2.2.4. Heating water

148. A new heating-water converter plant is designed in order to substitute the current water-heating plant after the decommissioning of units III and IV. It will provide with heating water not only the administrative, residential and industrial buildings of the Tahiastash TPP itself but also part of Tahiatash city.

149. The new heating-water system will consist of four heaters fed by a steam extraction from the steam turbine, four line pumps and two condensate pumps for ensuring the pumping of steam condensate from the water system heaters to a steam-water cycle unit. The water-heating system uses softened water that is treated in the existing water treatment plant. Steam pipeline (laid from heat extraction steam removal) passes through the heating-water converter plant room.

150. The table below shows the current and estimated heat supply indices for the current TPP and the future CCGT units, respectively, broken down in winter and summer seasons. By comparing both values it can be observed that the volume of heating water supplied by the future CCGT units will be 43 times higher than in the current term.

Table 6. Heating-water indicators

Description of indicators	Units	Current TPP	Future CCGT
Heat Supply (Winter)	Gcal	3,118	109,800
Heat Supply (Summer)	Gcal	122	29,200
Total Annual Heat Supply	Gcal	3,240	139,000
Auxiliary Power Consumption by heat supply system	kW·h/Gcal	33	25
	kW·h	107,000	3,476,000
Mass flow	t/h	650 = 250 + 400	ND
Water Temperature IN	ºC	70	70
Water Temperature OUT	ºC	150	150
Water Pressure IN	kgf/cm^2	10	10
Water Pressure OUT	kgf/cm^2	0.8	0.8

* ND: There are no data on that indicator in the Pre-Feasibility Study

B.2.2.5. Drinking water

151. Urban water supply networks are the main source of services and drinking water. Water supplied from the municipal network to the CCGTs' site is used for drinking and sanitary needs (showers, eye washers, toilets, etc.).

152. Drinking water supplied from the city mains will fill the two existing tanks, with a capacity of 600 m^3. It is planned to build a new drinking and service water pumping station at the place of the existing one for the supply of the newly designed buildings and constructions of the CCGT units. The design of this new pumping facility has been approved in accordance with the regulations of KMK 2.04.01-98 "Building internal water supply and sewage system".

B.2.2.6. Effluents System

153. The expected effluents generated by operation of the new facilities of CCGT units are:

Domestic effluents

154. Domestic wastewater or sanitary effluents (4,401 m^3/h) from buildings and structures of the CCGT units are discharged with no treatment through the pipeline by gravity flow into the newly designed sewage pumping station. After that, effluents are pumped to the networks of the TPP's industrial site and then fed to the sewage treatment facilities.

155. At the current design stage, an underground sanitary sewerage pump station with 1.5 m diameter and with pumps providing capacity 6-16 m^3/h and pressure lift 5-27 m, is provided. Manholes are installed along gravity-flowing sewerage networks at distance 35-50 m on straight piping, turns and interconnections.

Rainfall effluents

156. Rainwater from the roof of the CCGT main buildings and from the roofs of auxiliary buildings and other facilities will be collected along the territory and discharged into the existing storm water sewage system. The final storm water discharge point is located in the area of the existing main building runoff drain system. At this stage, the coordinates of the connection point are not defined and they will be specified during the preparation of the detailed design documentation for the project.

Oil and Chemical effluents

157. Certain volume of oily wastewater will be generated within the operation of the new CCGTs facilities in activities such as washing the equipment, washing the floors, drainage of transformer sites, washing the compressors, oily effluents in the stormwater, etc. These oily effluents will be collected and led to the oily effluents treatment facility.

158. New facilities are used for the treatment of effluents from the Takhiatash TPP's CCGT units without using the existing effluent treatment facilities. In particular, new effluent neutralization units and oil traps for oily wastewater treatment are used as part of the new Chemical Water Treatment.

159. Chemical effluents from the water treatment plant and from the heat-recovery boiler blowdown, in a total amount of 115 m^3/h, are collected in the CCGTs' slime lagoons and then discharged into the TPP's discharge channel. All effluents directed into surface-stream flow should comply with requirements of "Sanitary Rules and Norms for the protection of surface waters against pollution" SanPiN Nº0056-96, Tashkent, 1996.

160. Furthermore, the following measures are proposed to improve the process and reduce effluents:

- Washing and backwashing water from the Na-cation filters is pumped back into the clarifiers.
- Washing water from the reverse osmosis facilities is collected and used for backwashing of the Na-cation filters and further on, after reuse, is pumped back into the clarifiers.
- The Na-cation filters recycling water is collected and neutralized in a separate neutralization unit (taking the concentration of salts in this stream into consideration) and then directed to the wet salt storage.
- The bitter-water concentrate from the reverse osmosis facilities is collected and partially used to replenish water losses from the preparation of salt solution at the salt storage and the remaining volume is discharged with the flushing of the circulation system.

Circulation system blowdown

161. In the closed cooling water circuits a constant evaporation of the water takes place. As a result, the remaining water has a high concentration in solids and dissolved salts, what makes it necessary to bleed it periodically. Blowdown water from cooling towers is relatively clean so that it is directly discharged into the outlet channel with no treatment.

162. The temperature, flow rate and pH of cooling water will be monitored in order to check its compliance with the discharge limits to the canal, according to current regulations.

B.2.2.7. Storage facilities

163. Three different storage facilities are located within Takhiatash TPP terrains. These are the chemical agents' active storage, the materials active storage and the drummed oil storage, whose dimensions are shown in Table 7.

Table 7. Dimensions of storage facilities

Building	Function
Active storage of chemical agents	Active storage with chemical stocks for 15 days
Active storage of materials	Storage of spare parts and materials required for preventive maintenance and current repair of process equipment.
Drummed oil storage	Pure drum oil storage to supply oils to the main building consumers. Drums will have a capacity of 200 l, a preliminary estimation. Drum oil will be delivered to the main building by transport means. Pans and containers will be handled using automated lift trucks. Oil pans will be arranged in warehouses using self-propelled stacker-truck

164. Also, there is an underground emergency drain oil tank with the turbines with dimensions 4x3 m located above the engine room o the gas turbine plant.

B.2.2.8. Laboratories

165. The expansion project includes an express laboratory that will be designed to systematically perform the express-analysis of water and steam quality.

B.2.2.9. Fire fighting system

166. Automatic fire-extinguishing at the facilities of newly CCGT units is executed by the means of modern automatic fire fighting microprocessor system, which includes tools for fire detection, as well as for automatic fire-extinguishing at the relevant facilities. Fire precaution measures are provided in accordance with current fire safety rules and regulations for utility companies at Uzbekistan (2004) and ShNK 2.04.09-2007 "automatic fire-fighting equipment for buildings and structures" as well as the correspondent international standards.

B.2.2.10. Power control system

167. The automated control system is designed to perform the functions of the logical control in automatic and manual modes, emergency and restrictive protection systems, warning and alarm, monitoring, displaying and archiving of technological parameters, high-speed recording of major events and figures in emergency situations.

B.2.2.11. Power evacuation

168. Power output of the new CCGT units will be evacuated through the existing 110 kV and 220 kV substations and through the existing switchgears and transmission lines with minor upgrades on the switchyard. For the adaptation of the substation to the new units, existing transformer could be moved. If so, transformer oil must be managed in an environmental friendly way and taking good international practices in order to not cause soil pollution.

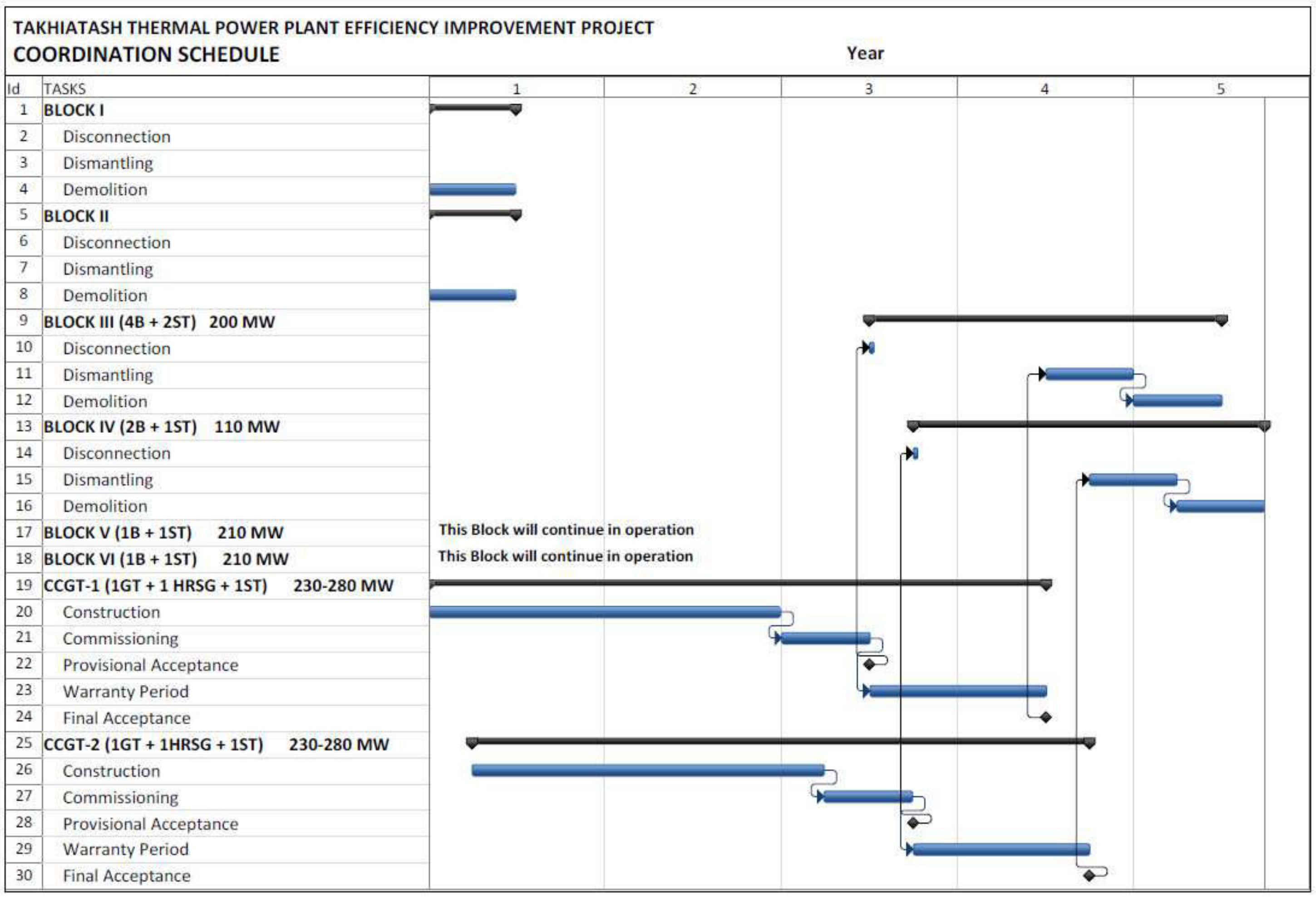
169. The current transmission capacity of the existing transmission line is 540 MW (the power consumption in 2011 had a maximum load at 466 MW), which is not enough to evacuate the installed capacity of the remaining units V-VI and the new CCGTs. Nevertheless, according to current electricity demand, units V-VI are planned to operate only as back-up units during maintenance operations of the CCGTs so that this project does not require an extension project of the transmission lines in the short term.

170. Nevertheless, by 2020 the power consumption is expected to reach a maximum load of 620 MW. Uzbekenergo however has a plan to expand the transmission capacity to improve the stability and reliability of the grid in the future. This extension project shall be accompanied by its corresponding EIA project.

B.3. Description of works

171. The decommissioning activities will be carried out following all applicable and recommendable health, safety and environmental measures and keeping available at any time enough power generation capacity to supply the current demand of electricity. Therefore, the decommissioning activities shall be coordinated with the CCGTs commissioning activities.

172. Coordination of main construction and commissioning activities of the two new combined cycles and dismantling & demolition activities of units I, II, III and IV are shown in the following figure.


TAKHIATASH THERMAL POWER PLANT EFFICIENCY IMPROVEMENT PROJECT
COORDINATION SCHEDULE
Year
Id
TASKS
1
2
3
4
5
1 BLOCK I
2 Disconnection
3 Dismantling
4 Demolition
5 BLOCK II
6 Disconnection
7 Dismantling
8 Demolition
9 BLOCK III (4B + 2ST) 200 MW
10 Disconnection
11 Dismantling
12 Demolition
13 BLOCK IV (2B + 1ST) 110 MW
14 Disconnection
15 Dismantling
16 Demolition
17 BLOCK V (1B + 1ST) 210 MW
This Block will continue in operation
18 BLOCK VI (1B + 1ST) 210 MW
This Block will continue in operation
19 CCGT-1 (1GT + 1 HRSG + 1ST) 230-280 MW
20 Construction
21 Commissioning
22 Provisional Acceptance
23 Warranty Period
24 Final Acceptance
25 CCGT-2 (1GT + 1HRSG + 1ST) 230-280 MW
26 Construction
27 Commissioning
28 Provisional Acceptance
29 Warranty Period
30 Final Acceptance

173. Units I and II, have already been dismantled. Some civil structures of these blocks such as turbine generators foundations, buildings and chimney are kept. it is considered the start of the demolition of those structures at the beginning of the project activities.

174. Units III and IV will be disconnected once the Provisional Acceptance of the CCGT-1 and CCGT- 2 takes place, respectively.

175. The construction of CCGT-2 will begin 3 months after the starting date of CCGT-1

176. After the Final Acceptance of the CCGT-1 and CCGT-2 the process of dismantling and demolition of units III and IV shall proceed, respectively.

177. According to the schedule, the construction phase of the first CCGT is preliminary planned to finish in April 2018, whereas the construction of the second CCGT is scheduled by July 2018. Construction, commissioning and decommissioning periods are likely to last 24, 6 and 12 months per unit, respectively. Unit III shall be decommissioned by September 2019 since they are the most worn out boilers; for December 2019, unit IV shall be decommissioned. The total duration of the project is approximately 4 years and 9 months.

B.2.1. Construction phase

178. Due to the fact that the present project is not to build a new Thermal Power Station, but to extend an existing plant, and in view of the fact that the new CCGT units will be located at the same site as the Power Station, it will not be necessary to build new access routes and certain infrastructure, since these are already in place for existing Units (for instance, no new water intake and discharge canal or transmission line are needed). Consequently, the extent and volume of the works will be less than those necessary for a new Power Station being built on a new site.

179. For the construction of CCGT units and its auxiliary buildings and facilities, a land plot of 40 hectares shall be acquired to set new boundaries of the plant’s protected territory. This area will be located on the southern border of the TPP, at the end of the main building. Construction of the CCGT units shall involve removal of guardhouse, gatehouse, some production facilities and replacement of rail track. As part of the CCGTs construction it is planned to organize 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.

180. Before the construction of the new CCGT units it is important to make a preparation of the site, which includes: the dismantling of buildings, railways and security zone transfer

181. A description of the construction phase of the new CCGT units and the new infrastructure required for operating (gas pipeline included) is detailed below.

New CCGT units

Phase 1: Civil works

182. - Site grading and leveling. This consists of removal and storage of top soil and any old backfilled material in the site. The disposal excavated material will be transferred outside the area. Rough and finish grading, back filling and compaction will be done as agreed. Site grading will provide self-draining, graded site, and will be sloped away from buildings and equipment foundations to avoid ponding. The edges of all filled and excavated areas will be sloped and drained to give stable profiles. Prior the compaction of filled material, compaction trials will be carried out using the proposed equipment and procedures.

183. - Preparation of the temporary on-site buildings, in which will be housed the cabins and storage space for the various companies working on the construction site. The various materials supply zones will be properly marked out, in order to facilitate a clean and orderly site. A specific space for machines will be marked out.

184. - Excavations and building foundations, and equipment belonging to the new plant

185. - Building separation networks for drainage collecting (chemical substances, residual sanitary oily and clean rain water) and channelling for conduits, electrical conduits and cabling.

186. - Construction of the various warehouses and buildings. Design of the buildings will pay special attention to protection against fire and noise. Safety will be a priority. Each building will possess the facilities required according to its type and its function: Lighting, low voltage lighting, heating, air conditioning, ventilation, communication, floating cranes etc.

187. - Construction of internal roads and adaptation of the existing ones.

Phase 2: Assemblage

188. - As soon as the civil engineering phase has been completed, the various machines that constitute the Power Station will be assembled. Sequencing will be as follows: Mechanical assemblage, electrical assemblage and instrument assemblage.

189. - During the mechanical assemblage phase, hydraulic tests of all circuits will be carried out in the various systems.

190. - Before commissioning, ventilation and chemical cleansing of the boilers will be carried out. Demineralized or osmosis-processed water will be used for that purpose, to which will be added certain chemical reagents. The cleansing solutions will be maintained in circulation for a certain time, and at the end of the procedure, will be handed back to an authorized service provider.

Phase 3: Trials and commissioning

191. - Testing the various types of equipment (pumps, valves, etc).

192. - Systems trials.

193. - Operation guarantees trials of the new plant.

Gas pipeline

194. - Construction of gas pipeline. The works carried out for the installation of the gas pipeline are similar to those performed for any other buried lineal infrastructure. It will be necessary to perform a track opening. The ditch will be excavated once the work track is opened and the pipe sections are lined up along it. The ground coming from the ditch excavation will be kept next to the track (in the direction of progress of the work), to later be used as infill if the material can be used as such.Therefore, the corresponding milestones in the gas pipeline works will be the following:

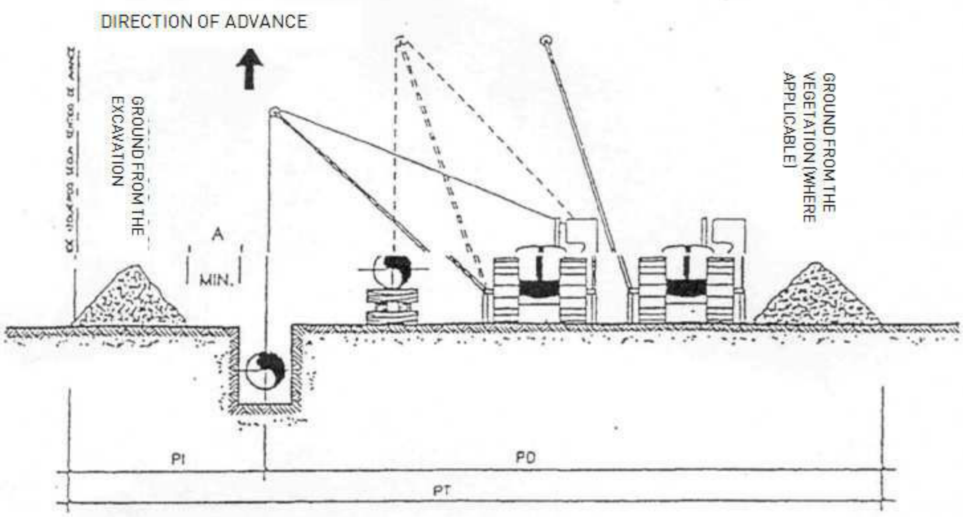
- Work track
- Ditch opening
- Laying of the duct, raising and lowering the duct from/to the ditch
- Directional drilling (the final tack is still not defined therefore directional drilling only will be required if is necessary to cross the Suenly Canal or another watercourse)
- Duct signposting

195. After the infill and compacting of the ditch, the work materials and leftovers will be removed carefully, in the same way as the land affected by the works on the temporary work track will be restored. At the same time, all the elements already in existence at the start of the works will be put back to the state they were in before the works commenced.

196. The construction of the duct will force a land strip to be available, of a sufficient width to allow for the correct operation of the construction equipment.

197. The width of this track is directly related to the diameter of the duct. This track is called “normal track”. Its width may be reduced exceptionally and at very specific points or areas, then going on to be called “restricted track”.

198. The dimensions of the normal and restricted work tracks are indicated as follows:



	DUCT DIAMETER	WITH IN METERS			A (m)
		P.I.	P.D.	P.T.	
NORMAL TRACK	2"-6"	3	7	10	0.4
	8"-16"	4	10	14	
	>16"	5	14	19	
RESTRICTED TRACK	2"-6"	3	5	8	0.4
	8"-16"	4	7	11	
	>16"	5	8	13	

Figure 15. Dimensions of the normal and restricted work tracks

199. - The width of the work track is directly related to the diameter of the duct, in this case being 30 cm (12", for duct diameter between 8" and 16") the normal track will be 14 m width and the restricted track will be 11 m width.

B.3.2. Decommissioning phase

200. "Decommissioning" a power plant can be defined as the cessation of the operations and the withdrawal of the facility from service, followed by its transformation into an out-of-service state and eventually, its complete removal.

201. An inventory report of non metallic materials must be done by a specialized company. The results of this report will determine the procedures for removal and disposal of nonmetallic materials

202. Decommissioning/dismantling implies the need of having available certain facilities such as a landfill for hazardous materials. The TPP has proposed to use hazardous waste material landfill an existing unused mazut storage area belonging to the TPP.

203. Final condition of areas occupied by units I, II, III and IV shall be free of any waste material, piece of equipment and old structure even above or below ground. The land shall be left filled to level. Definitive interfaces shall be arranged making provision of the future use of the land.

204. The dismantling and demolition activities must be carried out by a company which offers complete solutions that ensure the minimum disruption to business continuity in active blocks and the least environmental impact on the surrounding community

205. Main activities involved in the demolishing/decommissioning until the complete removal of the facilities and the estimated duration of them, for both units as whole, are as follows:

Table 8. Main activities involved in the decommissioning

№	Activity	Description	Duration
1	Demolition of structures of blocks I and II	Existing turbine pedestals, turbine and boiler building and chimney are demolished until complete removal of them, above and below ground. Land remediation of the space left is done.	Six (6) months
2	Shut down and cool down of the units III & IV	Operation to be performed, according to current operation procedures, until the complete shutdown of all steam turbines, boilers and auxiliaries except service utilities, control system and fire fighting system.	Three (3) days
3	Disconnection of main interfaces	Units III and IV are physically disconnected from the HV switchyard and gas system. Motor control centers are disconnected from the supply bus bars. The low and medium voltage bus bars will be kept energized as required for the supply of basic services such as lighting, air compressors, service water, fire fighting systems, etc...	One (1) week
4	Emptying and cleaning of tanks and fluid systems	Stored liquids (oil, demineralized water, mazut, among others) will be reused as much as possible. Stored liquids below the pumping level of tanks and drains of cleaning activities will be drained and treated and properly disposed of by mean of authorized waste management agents or managed under good international practices regarding with the protection of the environment.	Two (2) months

№	Activity	Description	Duration
5	Removal and disposal of hazardous waste materials (thermal and acoustic insulation/ mineral fibers from older production /sealing materials)	All these materials will be identified, inventoried and removed. Asbestos will be disposed of properly. Waste disposal comes under the remit of the provisions of the applicable legislation (stringer option between national and international standards).	Six (6) months
6	Dismantling of systems and components	In general technical equipment and components will be demounted in an inverse sequence as they were erected, starting from wiring and cabling and following with instruments, tubing, piping, equipment and supporting structures. Some equipment or components with remaining life could potentially be reused as spare parts for the remaining blocks or prepared for refurbishment. These activities will be performed in accordance with an established schedule and procedures, avoiding impact on operating units.	Nine (9) months
7	Demolition of buildings and structures	It will be carried out after complete dismantling of equipment and components. Demolition of units III and IV buildings will be engineered considering existing interfaces such as: Electrical and control Utilities Building access	Six (6) months
8	Waste management	Produced hazardous and non hazardous waste materials will be disposed of in accordance with applicable norms and permits from the Environmental Authorities and international standards.	Two (2) months
9	Land remediation	Potential remaining land contamination will be assessed and afterwards materials potentially hazardous will be removed and disposed off. This activity will be carried out in accordance with international, national and local environmental regulations. The land formerly occupied by the units III and IV and related facilities will be finally released at a “green field” condition, ready for a new potential use.	Two (2) months

206. The affected area defined decommissioning perimeter is shown in Annex I, appendix 3.

B.4. The project's environmental and social aspects

207. The implementation of the project for construction of the new CCGT units to replace obsolete and worn-out boiler units shall help to improve the environmental situation in the concerned area.

B.4.1. Natural resources, chemical substances and water

208. After the construction of the CCGT units, the production activity of Takhiatash TPP will be accompanied by withdrawal natural resources (natural gas), water and consumption of chemical substances.

B.4.1.1. Fuel consumption

209. Takhiatash TPP is based on a dual-fuel concept, firing natural gas as primary fuel and a liquid fuel oil (mazut) as a back-up for emergency situations. For the new CCGT units natural gas will be both primary and back-up fuel.

Natural gas

210. The primary fuel used in Takhiatash is natural gas with the composition and properties showed in table 9 and 10, respectively.

Table 9. Mole composition of natural gas fired in Takhiatash TPP

Component	Formula	Mole fraction (%)
Methane	CH_4	92.93
Ethane	C_2H_6	3.58
Propane	C_3H_8	0.78
n-butane	C_4H_{10}	0.18
iso-butane	C_4H_{10}	0.14
n-pentane	C_5H_{12}	0.05
iso-pentane	C_5H_{12}	0.06
Hexane	C_6H_{14}	0.16
Oxygen	O_2	0.08
Carbon dioxide	CO_2	1.30
Nitrogen	N_2	0.74

Table 10. Natural gas main properties at 20 ºC and 760 mm Hg (reference conditions)

Property	Value
LHV (kcal/m^3)	8278
Wobbe index (kcal/m^3)	11,780
Density (kg/m^3)	0.73

Current consumption of natural gas

211. Natural gas consumption from Bukhara field in Takhiatash TPP in 2011 amounted to 1,117.0 million m^3 per year (at reference conditions of 20 ºC and 760 mm Hg), for an annual electricity output to the mains of 3,072.9 GW·h. The heat rate of the TPP was 12,552 kJ/kWh.

Future consumption of natural gas

212. The consumption of natural gas expected for the new CCGT units at 100% of the load in the average environmental conditions of the area is approximately 341.3 million m^3 per year per CCGT unit. The total consumption of natural gas at Takhiatash TPP operating units V and VI as back-up and the both CCGT units will be 817.2 million m^3 per year. The total heat rate will be 7,296 kJ/kWh, being 11,585 kJ/kWh and 6,787 kJ/kWh for the blocks V-VI and each CCGT, respectively. All these values are shown in Table 11.

Table 11. Main technical indices and fuel consumptions for current and future

Index	Current indices (before CCGT commissioning)		Future indices (after CCGT commissioning)		
	III and IV	V and VI	V and VI	CCGT 1	CCGT 2
Installed capacity (MW)	310	420	420	254	254
Operating hours (h)	3083	5525	1014	6912	6912
Load factor (%)	35%	63%	12%	79%	79%
Specific consumption of natural gas for heat supply (kJ/kcal)	5.570	-	-	4.509	4.509
Total	5.570		4.509		
Annual natural gas volumetric consumption (million m^3)	390.4	726.5	134.6	341.3	341.3
Total	1117.0		817.2		
Annual natural gas mass consumption (kton)	285.0	530.4	98.3	249.1	249.1
Total	815.4		347.4		
Gas savings for the same electricity supplied to the mains of 3784 GW·h (million m^3)	-		525.1		
Increase of electric supply to the mains at the same fuel consumption rate of 1117 million m^3/year (GW·h)	-		2105.1		

213. Considering these figures, the current natural gas supply capacity, taking into account the dismantling of units III and IV, will be quite sufficient after the commissioning of the two CCGT units and the indices of Takhiatash TPP will clearly improve. The reduction of the heat rate for electricity supply is estimated at 5,256 kJ/kWh, from 12,552 kJ/ to 7,296 kJ/kWh. The reduction of the specific fuel consumption for heat supply is estimated at 1.056 kJ/kcal, from 5.570 to 4.509 kJ/kcal. The increase of annual electric supply to the mains is estimated at 2,105 GW·h at the same fuel consumption level of 1,117 million m^3 per year. Annual gas savings, compared to the current consumption in the existing equipment of Takhiatash TPP, are estimated at 525.1 million m^3 for an equal electricity output of 3,784 GW·h.

Fuel oil (Mazut)

214. Mazut, a distillate fuel oil, is required as a back-up fuel for emergency situations as, for example, a power supply failure just in the existing facilities. 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. Table 12provides main average technical characteristics of used mazut. The future CCGT units will not require mazut as back-up fuel.

Table 12. Main average technical characteristics of the mazut used

Property	Value
Low operating heat value, $Q^p_н$	38.345 MJ/kg
Contain in fuel working mass of:	
Sulphur S^p,%	3.1
Ash A^p,%	0.031
Density p (at 0 ^{0}C and 760 mm.of Hg)	945 kg/m^3

B.4.1.2. Chemical products and materials consumption

215. In the following table, consumption of chemical and raw materials of the existing facilities at Takhiatash TPP during 2012 are presented.

Table 13. Information on main and auxiliary raw materials

№	Name	Type	Quantity	Units
1	Metal		260,067	t
2	Brass	19×1×700	9,600	units
3	Welding die	Разные	4,879	t
4	Wool		14	m^3
5	Asbestos	A5-50	131.1 (1)	t
6	Technical rubber		957	t
7	Salt		207	t
8	Lime		390	t
9	Cations	Ку-2-8	55.9	m^3
10	Sulphate coal	DAK	5,100	t
12	Car tire	Разные	31	units
13	Oil		9,100	l
15	Transformer oil	TP-22	50,961	kg
16	Turbine oil		540	kg
18	Luminous lamp	DB-40	90	units
19	Paronite	Разные	2,528	kg
20	Benzin	AI-80	89,361	l
21	Dizel		97,986	t
22	Accumulators	Разные	23	units

(1) Average amount of asbestos is 94 t/year

216. In the future situation, the above consumptions will be reducing as units III and IV are going to be decommissioned. The future consumption of chemical and materials will be a sum of the part of the above table corresponding to the consumption due to the operation of the remaining units V and VI and the consumption due to the operation of the new CCGT units.

217. The estimated annual consumption of chemicals for treating the make-up water for the circulating water system of the new CCGT units is given inTable 14.

Table 14. Chemical products consumption in CWP of water for cooling and auxiliary purposes

Product	**Consumption rate** (kg/m^3 water)	**Annual consumption** (t)	**Comments**
Lime carbonate	0.050	147.9	I-stage clarification with sodium carbonate. Water consumption from Amudarya river = 2,958,000 m^3/yr
Sodium carbonate	0.30	887.4	
$FeSO_4$ coagulant	0.053	156.8	
Polyphosphonate (analogue- IOMS-1)	0.010	53.2 (on a per 770 t/h basis)	
Sodium hypochlorite (10%)	0.02	106.4 (on a per 770 t/h basis)	

218. The estimated annual consumption of chemicals for treating the make-up water for the steam cycle of the new CCGT units is given in Table 15.

Table 15. Chemical products consumption for the treatment of the steam-water cycle make-up

Product	**Consumption rate** (kg/m^3 water)	**Annual consumption** (t/yr)	**Comments**
Lime carbonate	0.050	24.9	I-stage clarification with sodium carbonate. Water consumption from Amu Darya river = 498,000 m^3/yr
Sodium carbonate	0.3	149.4	
$FeSO_4$ coagulant	0.053	26.4	
Sodium chloride (100%)	1.0	498.0	Two stage cationization
Chlorine hydride (30%)	0.033	16.4	On reverse osmosis units
NaOH alkali (100%)	0.01	5.0	

B.4.1.3. Water requirements

219. Water supply is required for service and drinking purposes, production purposes and emergency fire-fighting.

220. The water required for normal operation of all units at Takhiatash TPP (the new CCGT units and those already existing) can be classified in two types depending on its source, as follows:

a) Service and drinking water from pipeline supply system of Takhiatash city

221. Service and drinking water consumption for the existing TPP amounted to 3,460,000 m^3 in 2011. After the decommissioning of the III-IV units and the commissioning of the new CCGT units, drinking water needs are likely to remain at the same level, as number of workers will remain approximately the same. There is no need of extension of the service and drinking water supply.

b) Water from Suenly canal used in cooling system, replenishment of steam cycle blow downs and auxiliary services of the water treatment plant

222. Both existing blocks of the TPP and the new facilities of the CCGT units require water from canal Suenly for replenishment of losses and blow downs in cooling system, production of demineralized water to feed the steam cycle and auxiliary services of the water treatment plant. In both cases the main consumption corresponds to cooling water systems. In the first case, the circulation water system is an open circuit, so that the water taken from the canal for cooling is discharged again with no consumption (non-consumptive use). In the second case, the cooling water systems of the CCGT units are closed circuit, thus reducing the water intake from canal for cooling purposes but increasing the water consumption due to evaporation losses.

223. Estimated water consumed in cooling towers due to evaporation would be 257m^3/h for each CCGT unit (513 m^3/h for both CCGT units). Considering that the cooling towers could work with 3 concentration cycles (CC=3), total blow down flow rate would be 128 m^3/h per CCGT unit (256 m^3/h both CCGTs) and therefore, the water used for cooling purposes would be 385 m^3/h per CCGT unit (770 m^3/h in total), as shown in table 16,. Considering 6,912 operation hours for each CCGT, the total annual water use for cooling purposes would be 5.322 million m^3.

224. Make-up water flow rate for each steam cycle is estimated at 36 m^3/h. Therefore, the annual water consumption for the make-up of each CCGT unit's water-steam cycle would be 0.249 million m^3 per unit (0.498 m^3/yr in total).

225. To summarize, the estimated consumption of water per each CCGT unit is 476 m^3/h, including 385 m^3/h for replenishment of losses in cooling towers due to evaporation and blow downs, 36 m^3/h to makeup each CCGT's water-steam cycle and 55 m^3/h for the auxiliary services of the Chemical Water Treatment (CWT). Consequently, the annual water intake from Suenly canal will amount to 6.580 million m^3 in total for both units.

Table 16. Water use of the new CCGT units

Water consumption	Hourly water flow per CCGT unit (m^3/h)	Annual water consumption per CCGT unit (million m^3/yr)	Total annual water consumption (million m^3/yr)
Steam cycle make-up	36	0.249	0.498
Cooling tower make-up	385	2.661	5.322
Make-up water pre-treatment unit for auxiliaries	55	0.380	0.760
Total	**476**	**3.290**	**6.580**

226. For the current situation, the water intake at Takhiatash TPP is 104,145 m^3/h, including the water requirements of units III and IV (50,145 m^3/h) and for units V and VI (54,000 m^3/h). On the contrary, the water intake needed for cooling water makeup for both new CCGT units is estimated at 952 m^3/h in total (476 m^3/h per CCGT).

227. Table 17 shows that the annual water intake volume from Suenly Canal in the current situation amounts to 453.0 million m^3, whereas the future water requirements have been estimated at 61.3 million m^3. Therefore, the decommissioning of units III-IV and the commissioning of the new CCGT will lead to an annual reduction in the water intake from Suenly Canal estimated at 391.7 million m^3.

Table 17. Current and future technical water requirements from Suenly Canal

Parameter	Units	Current (before CCGT units commissioning)		Future (after CCGT units commissioning)		
Operating units	-	Units III-IV	Units V-VI	Units V-VI	CCGT 1	CCGT 2
Operating hours	h	3,083	5,525	1,014	6,912	6,912
Hourly water requirements for each unit	m^3/h	50,145	54,000	54,000	476	476
Total hourly water requirements for the TPP	m^3/h	104,145		54,952		
Annual water requirements						
Consumptive use	million m^3/yr	0	0	0	3.3	3.3
		0		6.6		
Non-consumptive use	million m^3/yr	154.6	298.3	54.8	0	0
		453.0		54.8		
Total	million m^3/yr	154.6	298.3	54.8	3.3	3.3
		453.0		61.3		
Water requirements reduction	million m^3/yr	-		391.7		

228. The change from the open once-through cooling system of units III-IV towards a closed circuit with cooling towers of the CCGT units will lead to the reduction of the large water intakes and, at the same time, it will reduce the discharge of large amounts of warm cooling water to the canal and may also reduce the consumption and emission of chemicals.

229. However, regarding actual water consumption terms, the net technical water consumption of the TPP will increase due to make-up water needs for evaporation losses in the cooling towers of the CCGT units. The explanation lies within the net water consumption of the current open cooling circuit, which is almost zero because all the intake water is subsequently discharged back to the canal.

B.4.2. Generating sources

230. Generation sources for the Takhiatash TPP are and will be:

- Emissions
- Noise
- Effluents
- Waste
- Jobs

B.4.2.1. Emissions

Current emissions

231. In the TPP at present, the emission of pollutants into the air is caused by the exhaust gas from the combustion of natural gas in units III to VI. Natural gas is considered a clean fuel as it produces less atmospheric contamination than other liquid or solid fuels, due to the following reasons:

- Natural gas combustion gases lack any particles.
- They have a lower emission level of volatile organic compounds when compared with other fossil fuels.
- The presence of unburned fuel is lower due to the close contact between the natural gas and the oxidiser (air).
- It is the fossil fuel with the lowest carbon content. The greater H/C ratio of the natural gas composition with regard to other fossil fuels makes its combust release less CO_2.
- Natural gas almost entirely lacks any sulphur in its composition, so SO_2 emissions are insignificant. The low natural gas sulphur content is simply due to a small concentration of an odorant (Tetrahydrothiophene-THT), a mercaptan containing sulphur and which, for safety reasons, is added to natural gas to enable its detection. Under exceptional conditions resulting from faults in the supply system, natural gas may arrive with higher sulphur contents for short periods of time.

232. Taking into account all of the above, it can be concluded that the only pollutant emitted to the atmosphere in significant amounts is NO_X.

233. 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 (unit III and IV), 7 (unit V) and 8 (unit VI) are discharged through the 150 m high stack. The table below is a summary of the main emission source parameters in the existing situation.

Table 18. Emission sources' main parameters

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

234. 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. According to these calculations, in 2011 total emissions of NO_2 and NO amounted to 2170.25 and 352.67 t/yr, respectively. In the same way, in 2012 total emissions of NO_2 and NO amounted to 2050.82 and 333.26 t/yr, respectively, as shown in Table 19.

235. 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 Table 20.

236. As can be observed in the graph below, the existing emission values in the TPP are under the MAE.

Table 19. 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 20. 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

237. Monthly instrumental measurements of NO_2, NO, CO, SO_2 and benzopyrene in exhausted gases at the boilers have been conducted by the enterprise “Uzenergosozlash”. Having analyzed the 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 strange to have a 0 value in these parameters). The NO_2 and NO values are shown in the following graphs.

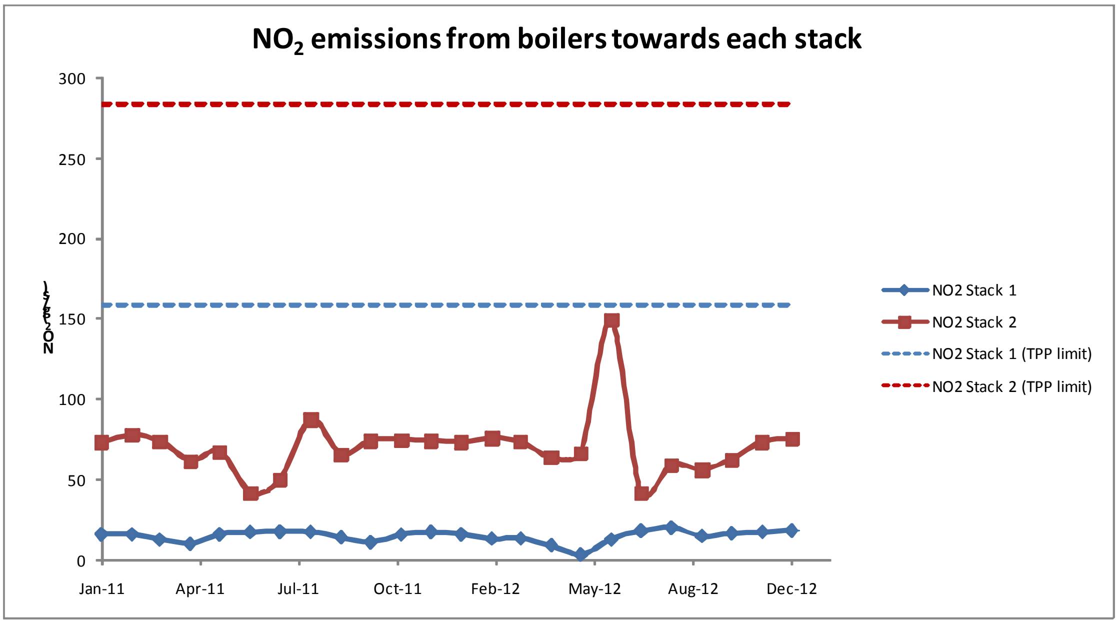


Figure 16. Comparison between NO_2 emissions from boilers towards each stack and

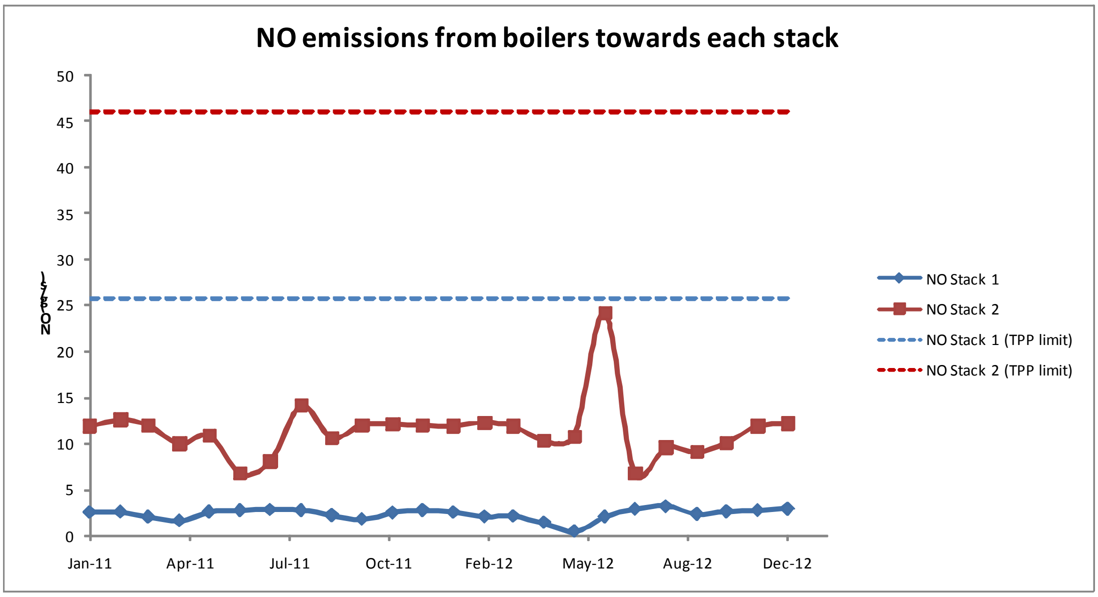


Figure 17. Comparison between NO emissions from boilers towards each stack and

238. Results of measurements showed that emissions from TPP do not exceed the approved MAEs.

239. 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 NO_X emissions. The WB standard for NO_X is 240 mg/Nm^3 (Dry gas, 3% O_2).

240. In the following graphs the comparison between the World Bank standard and the monthly measurements between 2011 and 2012 can be observed.

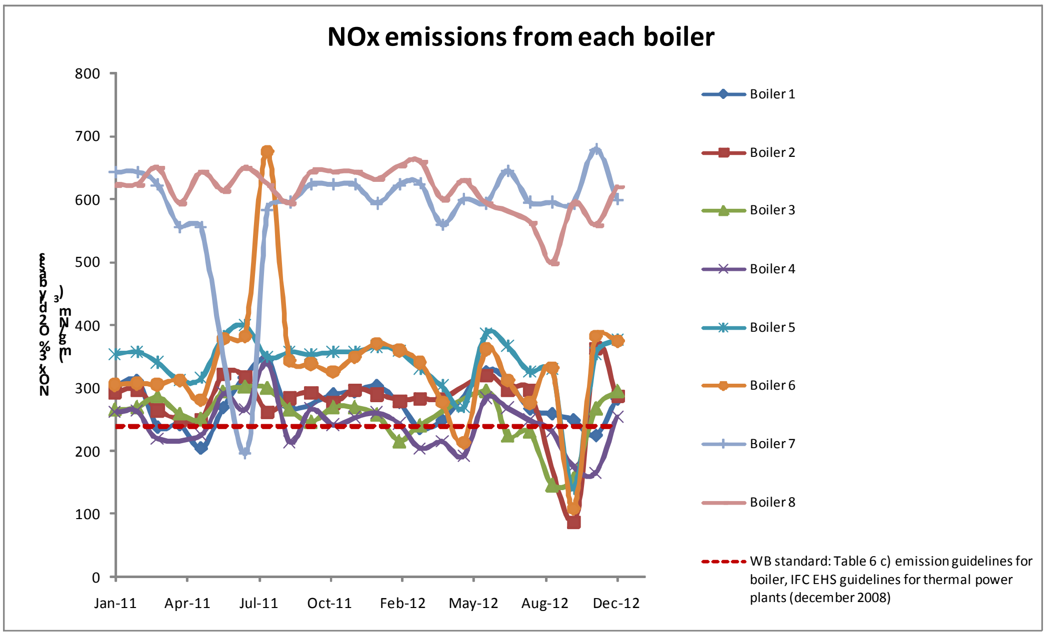


Figure 18. Comparison between total NO_X emissions (mg/Nm^3) from each boiler

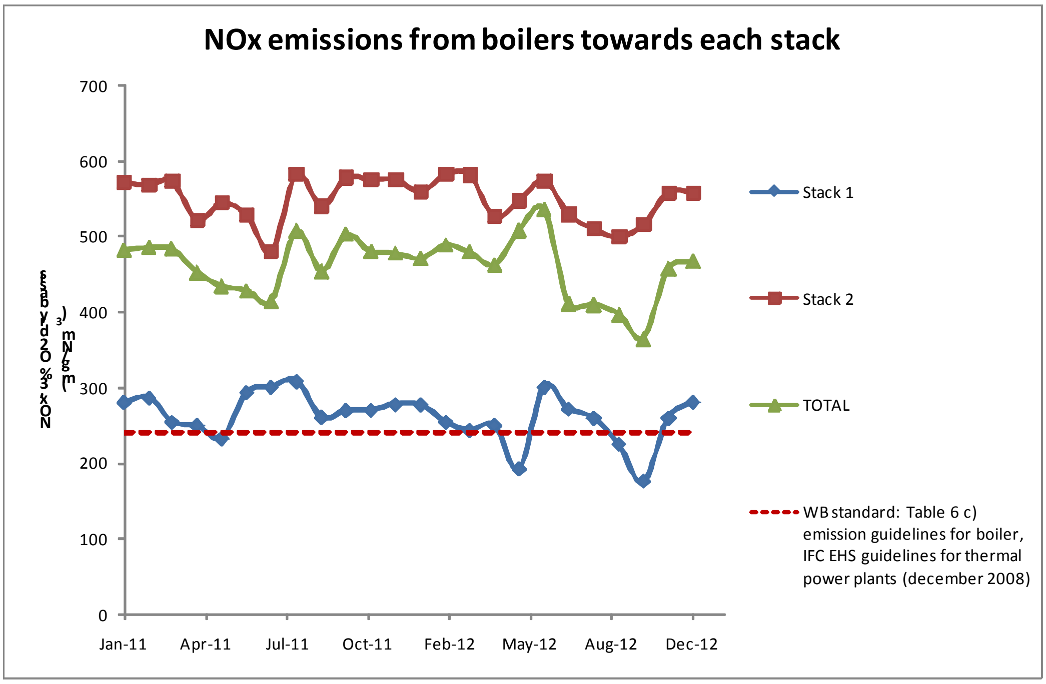


Figure 19. Comparison between total NO_X emissions (mg/Nm^3) from boilers to each stack

241. As can be observed, stack 2 exceeds World Bank standard, being boilers 7 and 8 the highest contributors. Stack 1 exceeds World Bank standard the most of the time, being the contribution of boilers 1 to 4 quite similar.

242. The CO_2 emission per year for the existing TPP is 2,117,000 tCO_{2e}.

Future emissions

243. In the future operation of the Takhiatash TPP, 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 CCGT units.

244. The exhaust gases of the remaining boilers 7 and 8 will be disposed of through the 150 m high existing stack and the exhaust gases of the CCGT units through two 112.5 m high individual stacks, one dedicated for each CCGT unit. Final height of the new stacks were determined by the atmospheric modeling results (Annex III) and the World Bank EHS Guidelines (2007).

245. Taking into account the previous measurement of years 2011 and 2012 we already concluded that the results showed that emissions from the remaining units V and VI do not exceed approved MAE. Nevertheless, if we take into consideration the World Bank standard indicated above, the following graph shows how this standard is always exceeded.

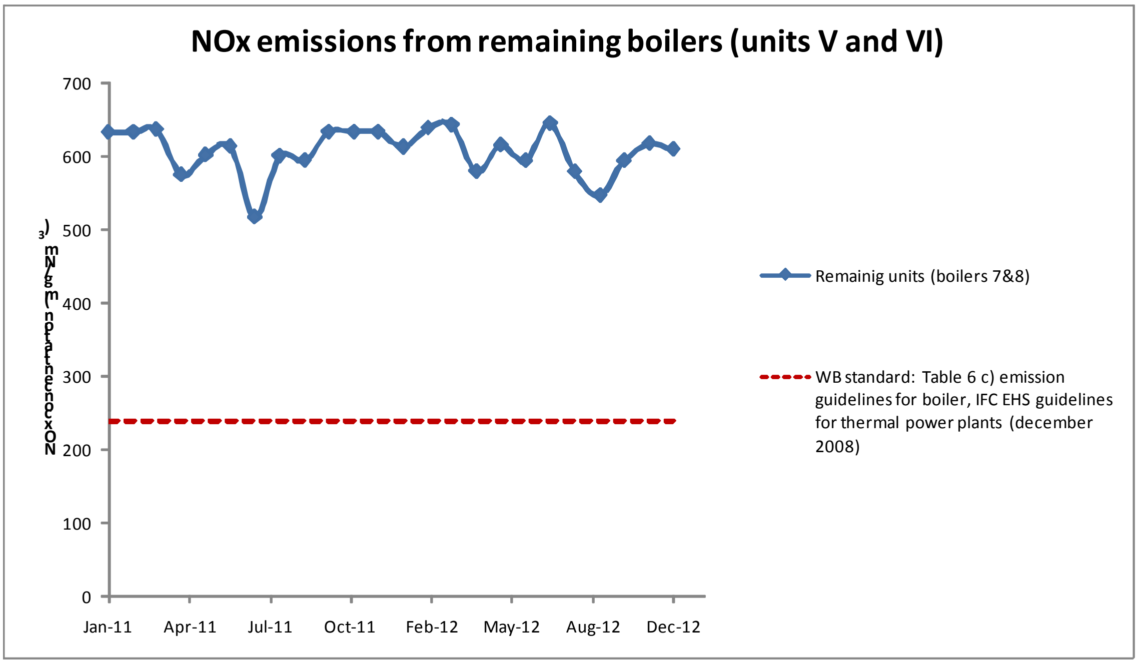


Figure 20. Comparison between total NO_X emissions (mg/Nm^3) from boilers of the remaining units (V and VI) to each stack and the World Bank limits.

246. As it was explained previously, natural gas is considered a clean fuel and also, the greater performance of the cycles, gives a 60% lower CO_2 emission than that of a conventional thermal power plant, with the resulting greenhouse effect reduction.

247. The gas cycle performance rises as the temperature of the combustion chamber gases increases. In contrast, the temperature rise implies an increase in the NO_X formation speed. The combustion chamber of the gas turbines will be equipped with dry type low NO_X burners (Dry low NO_X Hybrid Burner Ring (HBR)), to counteract this harmful effect on the environment, achieving emissions below 25 ppm with 15% O_2 (approximately 51 mg/Nm^3 at 15% O_2, dry basis).

248. For the future CCGT units, emission concentration levels for the various pollutants 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 6 B) is 51 mg/Nm^3 (dry gas, 15% O_2). This emission limit has been taken into account for the atmospheric dispersion model.

Table 21. Emission rates estimated for the future CCGT units.

Parameters	**Emission of the CCGT mg/Nm^3 (dry gas, 15% O_2)**
NO_2 emission rate*	51
NO emission rate**	43
CO emission rate***	20

*Worst case hypothesis: all NO_X emitted as NO_2
**Considering 84% of NO_X is emitted as NO
***Bibliographic data (very conservative)

249. The below table is a summary of the main emission source parameters in the future situation. The above stack MAE for the existing TPP have been taken into account for the calculation of the emission rates of the remaining units V and VI. Thermoflow program was used for the calculation of the gas emission parameters for the new CCGT units.

Table 22. Main parameters of emission sources

Parameters	**Stack 2 (V and VI units)**	**Stack 3 (CCGT 1)**	**Stack 4 (CCGT 2)**
Stack diameter (m)	7.2	6.3	6.3
Gas output speed (m/s)	21.2	20.6	20.6
Flow rate (m^3/s)	650.41	643.4	643.4
Temperature (ºC)	191	125	125
Stack height (m)	150	112.5	112.5
NO_2 emission rate (g/s)	83.381	20.738	20.738
NO emission rate (g/s)	13.549	17.627	17.627
CO emission rate (g/s)	4.238	8.133	8.133

Table 23. Emission limits at the stacks

Pollutant	MAE	
	Stack 2 + Stack 3 + Stack 4 = Total	Stack 2 + Stack 3 + Stack 4 = Total (1014 / 6912 / 6912 operating hours/yr)
	g/s	t/y
Nitrogen dioxide (NO_2)	83.381+20.738+20.738=124.857	304+516+516=1336
Nitrogen oxide (NO)	13.549+17.627+17.627=48.803	49+439+439=927
Carbon oxide (CO)	4.238+8.133+8.133=20.504	16+202+202=420

250. Calculating NO_X will result from the adding of NO and NO_2 of the remaining units V and VI and NO_2 of the CCGT units (as it has been considered that all NO_2 is NO_X). Then, the reduction in the annual emission of NO_X from the existing situation (4881 t/y) to the future one (1336 t/y) will be approximately 27%.

251. Regarding CO_2 emissions, Uzbekistan is a country not listed in Appendix I of Kyoto protocol, and is therefore not required to limit its emissions of CO_2.

Table 24. CO_2 emissions for the different stages of the project

UNITS	CO_2 Emission (1,000 tCO_2e)
New Power Units (CCGT) (6912 h)	739 x 2 = 1478
Decomissioning of III and IV units	- 741
Reduction in operation hours of V and VI units (5525 h →1014 h)	- 1123
Current TPP (units III-VI)	2117
After New Project	1731
Net change	**386**

B.4.2.2. Noise

252. Environmental noise campaigns in the existing TPP have never been undertaken. No historical data on this issue can be analyzed.

Works phase

253. During the decommissioning and construction phase temporary noise emissions may be caused by:

- Decommissioning equipment
- Construction equipment
- Concrete mixing plant
- Pile driving for construction
- Rock blasting and drilling
- Earth moving activity
- Generators
- Vehicles used for material transport

254. The following table shows equipment to be used in the Works phase and accompanying noise levels. The data was obtained from measurements carried out on similar construction sites. They therefore have an error margin of ± 3 dB(A).

Table 25. Equipment noise levels

Equipment	Maximum noise level dB(A)	Use factor
Air compressor	98	0.4
Backhoe	101	0.16
Cement mixer	97	0.4
Cement pump	100	0.4
Cement vibrator	99	0.1
Crane	91	0.12
Crawler tractor	98	0.16
Generator	100	0.4
Grader	105	0,05
Drilling machine	102	0.1
Loader	92	0,16
Pneumatic tool	99	0.04

Equipment	Maximum noise level dB(A)	Use factor
Pump	100	0.4
Saw	98	0.1
Truck	90	0.3
Power shovel	97	0.2
Welding station	90	0.3

255. Noise levels will vary overtime depending on the machines that may be operating at any given moment. The following graph shows the noise level variation from the noisiest equipment (105 dB(A)), with distance.

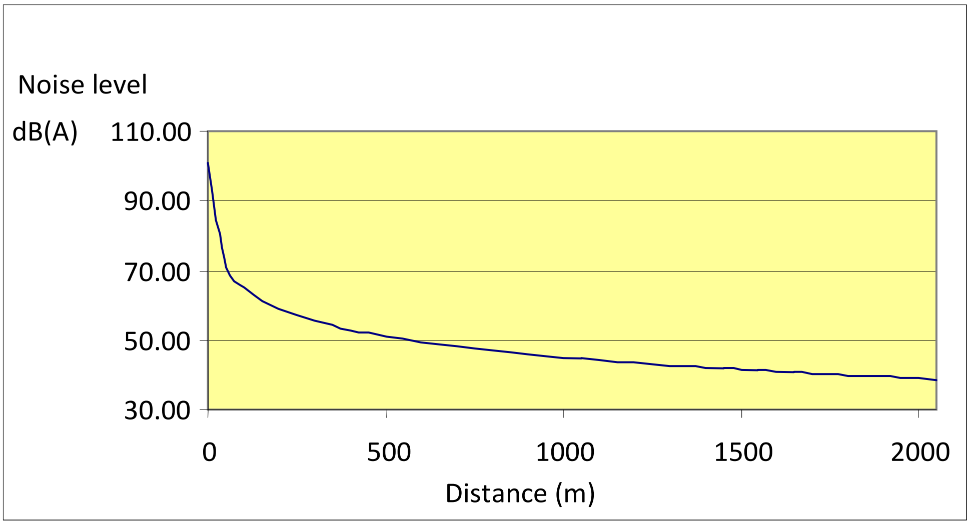


Figure 21. Reduction of noise levels generated by equipment, with distance

256. Construction activities which may cause excessive noise shall be programmed for normal working hours.

Operating phase:

257. Draft equipment, electrical equipment, turbines, generators, pumps, gas pipe-lines and compressors are the main sources of noise and vibration on Takhtiatash TPP.

258. Much of the equipment in the new CCGT units will create high noise levels during operation. After the commissioning of the CCGT units, new sources of noise will be added to the existing ones: gas turbines exhausts, steam turbines, generators, transformers, stacks, air filtering and conditioning system (AFCS), gas booster stations, water cooling towers' fans and make-up water and clarified water pumps.

259. The level of noise must not exceed 80 dB(A) in the operational zone one meter apart from equipment on rigid foundation according to SanPiN № 0120-01 (Uzbek legislation).

B.4.2.3. Effluents

260. Effluents treatment processes and systems are described in the previous point B.2.2.4

261. The overall flow of effluents shall notably decrease after decommissioning of the obsolete units III and IV and the commissioning of the new CCGT units. The effluents discharged to Suenly canal come from two different sources: cooling system blowdowns and effluents from the CWP.

262. For the future situation with the commissioning of the CCGT units, cooling water system blow down flow for the worst scenario (July, the hottest month with 45º C) has been estimated in 256 m^3/h in total (128 m^3/h per CCGT unit).

263. Flows from boiler and turbine section, blow-off water from the evaporating plants, cooling water from the oil coolers, bearings and packings of the rotating machinery glands are treated in the CWP and come into the waste water drainage system (WWD) to be further discharged into Suenly canal. After having been treated in the CWP, the flow of effluents discharged to Suenly canal will be 230 m^3/h.

264. Therefore, the overall volume of effluents discharged from the CCGT units into the canal will be 486 m^3/h (3,360,000 m^3/year).

265. The annual water flow discharged to Suenly canal from cooling system of units V-VI, which will work working as back-up, will be 53.5 million m^3/year. So that the total volume of effluents discharged into Suenly canal are estimated at 56.86 million m^3/year.

266. The level of waste water dumped into Suenly canal after the TPP treatment facilities in 2011 amounted to 442 million m^3/year. Therefore, the decommissioning of units III-IV and the commissioning of the new CCGT units will reduce the volume of effluents discharged into Suenly canal in 87%.

B.4.2.4. Waste

a) <u>Construction phase</u>

267. Waste resulting from construction of the new CCGT units will be classified as hazardous and non hazardous. Hazardous waste will mostly be oil and/or solvent soaked rags, empty metal or plastic paint pots, resin or solvent containers etc.

268. Non hazardous waste includes the group of household and similar waste (all domestic waste, waste generated in offices and toilets, packaging, plastics, paper, cardboard, wood, palettes etc.) and waste such as concrete, brick, rubble, iron scrap etc.

b) Operation phase

Current Wastes

269. During TPP operation 32 types of industrial and communal wastes are being generated. General information on generating wastes and way of their disposal are presented in the below table. Total volume of wastes accumulated by the plant in 2011 was 85.521 tons, including 0.065 tons of toxic wastes.

270. Data on 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, Table 26). 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 temporare 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). Waste characteristics and content were developed in accordance with RD Oz RH 84.3.19.2005 "Terms and definition" (columns 7 and 8).

271. In columns 9 and 10 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 introduced.

272. Those wastes whose category begins with "A" correspond to Annex VIII and therefore are considered hazardous wastes.

273. Those wastes whose category begins with "B" correspond to Annex IX and therefore are considered non-hazardous wastes.

Table 26. Wastes generated at the Takhiatash TPP

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**	**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	t	284.8	4	Scrap to "Vtorchermet"	Inorganic; solid; rehabilitation of wastes	Steel 50%; Cast iron 50%	B1010	
2	Non-ferrous	t	0.187	3	Scarp to	Inorganic; solid;	Sn – 3-17%	B1010	

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	Place for disposal	Type/ state of aggregation/Generating source	Waste content	Waste code in accordance with Basel convention	
	scrap meta (bronze)				“Vtorcvetmet”	Repairing and replacement of energy equipment	Zn – 5-12%, Pb – 3-17%		
3	Non-ferrous scrap meta (copper)	t	0.19321	2	Scarp to “Vtorcvetmet”	Inorganic; solid; Repairing and replacement of energy equipment	Ni 0 16% Cu – 84%	B1010	
4	Non-ferrous scrap metal (babbit)	t	0.42662	3	Scarp to “Vtorcvetmet”	Inorganic; solid; Repairing and replacement of energy equipment	Zn14-38%; Al- 2,5-6%	B1010	
5	Non-ferrous scrap metal (brass)	t	0.76208	3	Scarp to “Vtorcvetmet”	Inorganic; solid; Repairing and replacement of energy equipment	Mn – 2% Si- 3,5%, Fe – 3%	B1010	
6	Stub	t	0.552	4	Scrap to “Vtorchermet”	Inorganic; solid; welding	C-0.09% S – 0.04% P – 0.04% Mn- 0.5%	B1010	
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	t	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	t	46.731	3	Reused	Inorganic; solid; Rehabilitation of thermo-isolation of	Asbestos cardboard – 25-35%, asbestos cord	A2050	

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	Place for disposal	Type/ state of aggregation/Generating source	Waste content	Waste code in accordance with Basel convention	
						boilers, ponds, pipelines	– 10-15% Asbestos-vermiculite tile – 50-65%		
10	Technical rubber	t	5.65	4	Sent for utilization into LLC “Artur”	Organic; Solid; Energy equipment repairing	S – 2% Rubber – 92-98%	B3040	
11	Waste paper	t	0.456	4	Sent to salvage	Organic; Solid; Replacement of electrical-isolation cardboard	Paper 85% Cardboard – 15%	B3020	
12	Used paranet	t	1.2359	3	Removed to landfill	Inorganic; solid; paronit replacement			A2050 (asbestos /rubber)
13	Oiled rags	t	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	t	0.366	2	Stored in evaporation ponds	Inorganic; solid; Mazut burning in boiler furnace			Depending on composition
15	Used turbine oil	t	12.05	2	Reused	Organic; Liquid; Replacement of turbine oil		A3020	
16	Sludge from oil products	t	1.89	3	Stored in evaporation	Composite; Discharges from	Mazut – 2-15%		A4060

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	Place for disposal	Type/ state of aggregation/Generating source	Waste content	Waste code in accordance with Basel convention	
					ponds	chemical treatment from oil products	Oil 3-18% Water 5-24% Clue 25-45%		
17	Sludge from water treatment plants	t	1598	4	Stored in evaporation ponds	Inorganic; liquid; During acid washing of boilers			B2120
18	Used anthracite	t	13.2	4	Burned into the boiler furnace	Organic; Solid Replacement of absorbents in mechanical filters	Coal 100%		B2060
19	Used cationite	t	23.496	4	Removed to landfill	Inorganic; Solid Replacement of absorbents in filters			A3050
20	Insoluble salt residuals	t	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	t	484.8	4	Removed to landfill	Inorganic; Solid; Dissolving lime	Clue 65-88% Sand – 2-5% Limestone 8-33%		
22	Used oil from transformers	t	3.9466	2	Reused	Organic; Liquid; Replacement of transformer oil		A3020	
23	Used electrical isolated material	t	0.06	3	Removed to landfill	Solid; Composite; Replacement of electrical isolation	Polymers -65-85% Cotton isolation – 12-35%	A3020	
24	Used luminescent	t	0.23828	1	Removed to demercuriatio	Inorganic;	Al – 80.67%	A1030	

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**	**Place for disposal**	**Type/ state of aggregation/Generating source**	**Waste content**	**Waste code in accordance with Basel convention**	
	lamp				n	Solid; Burned lump replacement	Vo- 1.437% Cu – 7.05%		
25	Bottom sediments of mazut	t	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	t	0.4046	4	Removed to landfill	Inorganic; Composite; Welding and cutting of metal	$Ca(OH)_2$ H_2O -12%		
27	Used tyres	t	1.561	4	Sent to utilization	Organic; Solid; Replacement	Rubber – 70% Viscose cord – 20% Metal cord – 10%	B3040	
28	Used engine oil	t	0.65117	2	Reused	Organic; Solid; Replacement		A3020	
29	Lead plates from battery	t	0.33525	1	Scarp to "Vtorcvetmet"	Inorganic; Solid; Replacement	Lead – 50-60% PbS- 20%	A1160	
30	Cases of battery	t	0.08171	4	Scarp to "Vtorcvetmet"	Organic; Solid; Battery replacement	Ebonite	A2010	
31	Used electrolyte	t	0.12667	2	Reused	Inorganic; liquid; Battery replacement	H_2SO_4 -28%	A4090	

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**	**Place for disposal**	**Type/ state of aggregation/Generating source**	**Waste content**	**Waste code in accordance with Basel convention**	
32	Communal wastes	t	257.283	Non-toxic	Removed to municipal landfill	Organic; Solid; Workers activity Cleaning of territory		B3060	

274. At the present, Takhiatash TPP waste management is organized as follows:

275. 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:
  - Waste engine oil shall be temporarily stored in a metal container with 0.2 m capacity and reuse as a lubricant for lifting and rotating mechanisms as needed for no more than 180 days, the rest 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 as designated 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

276. 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.
- Wool 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 is fulfilling the Cabinet of Ministers’ Decree No 266 from 21.09.2011 "On approval of the collection and disposal of used mercury-containing lamps”.

277. Recover:

- Oily rags, used anthracite and wool debris shall be temporarily stored burned in boiler furnaces.

278. Treat and dispose:

- Solid sediment and undead lime sludge, black oil and oily effluents and neutralized effluents are send 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. All the oily wastes stored in the oil storage are finally, once there is enough quantity, send 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.

279. Places for temporarily and permanent storage of wastes are presented at the following picture.

Figure 22. 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 residual of lime
12- Thermo-isolated material
13- Oiled sludge
14- Rags

280. In Annex II pictures of the above facilities are shown. During the site visit, no evidence of the following storage was found:
   a. Concrete covered storage for asbestos and thermo isolation materials
   b. Metal container for paronite

Future wastes

281. The same kind of hard waste as in existing conditions will be formed after the commissioning of the new CCGT units at Takhtiatash. Nevertheless, for the construction of the CCGT units asbestos will be not permitted as their use is forbidden by the good international practice. Therefore, waste asbestos will not be produced in the operation of the new units.

282. The waste management for the future Takhiatash TPP should be adapted to international guidelines and those wastes considered by the Basel Convention to be hazardous will under no circumstances be dumped on the terrain. A general guideline on waste management will be included in the EMP.

283. A new type of waste, hereinafter referred as pulp, will be generated in the operation of the CCGT units. Makeup water from Amudarya River initially settles in a settling tank to remove suspended particles. Settlement tank cleaning from silt is provided with dredgers with storage in pulp dump. Settlement tank cleaning is periodic and performed sequentially in case of siltation of each section. Settled clarified water from pulp dump using pulp dump's clarified water pumping station is driven back to settling tank. Pulp dump, on the analogy of settlement tank is implemented in a dam with clay loam with bottom device and internal slope of impervious screen (concrete-membrane-concrete). The pulp dump is meant to be cleaned by excavators and transportation on dump-trucks for usage in agricultural needs but this procedure cannot be followed if the pump doesn't meet the sanitary conditions for this purpose. A complete analysis of the pulp must be undertaken to classify it under international standards as non hazardous previously to be used for agricultural purposes. 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.

c) Decommissioning phase

284. The list of waste materials expected to be generated in the decommissioning and dismantling of units III and IV and the demolition of units I and II is shown inTable 27. They have been classified as hazardous or non-hazardous according to the exposed by "Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal".

Table 27. List of waste materials from the decommissioning of units III and IV and the demolition of units I and II.

№	Materials	Name of equipment	Quantity per equipment (t)	Total quantity (t)	Hazard (according to Basel Convention)
1	Asbestos cement plaster	Turbines № 1-3	40.5	278.4	Hazardous (Annex I; A2050; Y36)
		Steam pipelines	5.4		
		Point Deaerator	4.95		
		Steam pipeline point РОУ	6.15		
		Boilers № 1-6	221.4		
2	Basalt extra-thin fibre	Turbines № 1-3	14.4	37	Non-hazardous
		Steam pipelines	6.4		
		Point Deaerator	2.1		
		Steam pipeline point РОУ	8.25		
		Boilers № 1-6	5.85		
3	Wire netting	Turbines № 1-3	3	16.95	Non-hazardous
		Steam pipelines	2.2		
		Point Deaerator	1.5		
		Steam pipeline point РОУ	2		
		Boilers № 1-6	8.25		
4	Fire resistant concrete	Boilers № 1-6	1,080	1,080	Non-hazardous
5	Thermo-isolated concrete	Boilers № 1-6	762	762	Non-hazardous (except if containing asbestos)
6	Structural steel	Building units I-II	640	1685	Non-hazardous
		Building units III-IV	1,045		
7	Structural concrete	Building of units I-II	22,356	65,671	Non-hazardous (except if containing asbestos)
		Stack of units I-II	3,082		
		Building of units III-IV	36,440		
		Stack of units III-IV	3,793		

285. It should be noted that there are piled deposits of asbestos collected outside the plant that presumably come from the dismantling of the groups I and II. These deposits should be properly treated as hazardous wastes.

286. Mineral fiber, in case of being included within the materials to be decommissioned, could also contain asbestos and therefore should be classified as hazardous.

287. The above table shows an initial classification and should be reviewed by the specialized enterprise in charge of the decommissioning. For the decommissioning phase a specific plan must be undertaken. This plan should include a Health and Safety plan and a waste management plan. Hazardous waste (especially asbestos) should be disposed in a specific landfill or storage complying national and international standards. If there is not an appropriate storage place at regional or national level, temporary hazardous waste storage should be constructed at the site. The TPP has proposed to use hazardous waste material landfill an existing unused mazut storage area belonging to the TPP.

B.4.2.5. Jobs

Current Jobs

288. At present, the number of employees of Takhiatash TPP is presented in the following table:

Table 28. Number of employees of Takhiatash TPP on January 7th 2012

Name	Number of employees
Administrative and managerial staff	
Subtotal	39
Industrial and production personnel	
Managers	110
Specialist	65
Employees	6
Workers	754
Subtotal	935
Non-industry personnel	
Managers	6
Specialist	6
Employees	0
Workers	83
Home-based work	13
Subtotal	108
TOTAL	**1082**

Future Jobs

289. The project will promote industrial development projects envisaged for the region. Consequently, this will promote socio-economic development in the region and indirectly in whole Uzbekistan.

290. The construction phase will constitute the highest levels of activity with up to 1,000 construction workers concentrated onto the project site. For the demolishing of units I and II about 50 workers will be needed and for the decommissioining of units III and IV about 400 workers. During operation phase, about 110 people will be required for long term operation of the plant (81 production workers and 29 administrative-management staff) but they will be covered with current workers from the TPP.

291. IFC Performance Standard 2 “labor and working conditions” (January 2012) should be of application at hiring direct, contracted or supply chain workers.

B.5. The project’s environmental, health & safety management aspects

<u>Current management</u>

a) Health and safety:

292. 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». The document is revising every 5 years by “Uzgosenergonadzor” and re-approved every year by the Takhiatash TPP’s director and the department head of emergency situation of Takhiatash city.

293. The document consists of 13 chapters. These chapters provide data and describe the organizing of the following activities:

1. General regulations
2. Organizational requirements
3. Preparing for new positions (New Task Employee)
4. Probation period
5. Checking knowledge
6. Duplication
7. Permit to work
8. Orientation on work safety, technical operating and fire safety
9. Test anti-damage and anti-fire trainings
10. Special trainings
11. Professional development
12. Observation of personnel work places
13. Team work with personnel.

294. Occupational health and safety structure at the TPP presented at the following figure:

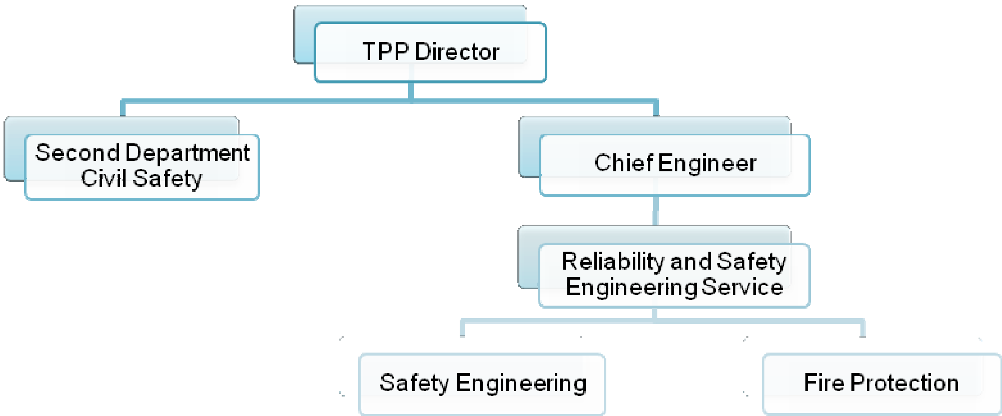


Figure 23. Occupational health and safety structure at the TPP

295. TPP's 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 activity at the TPP. The fire protection department is responsible for fire protection at the TPP. Civil safety department is responsible for the works related with activities in emergency situations. This department is responsible for personnel activity during anthropogenic and natural disaster (earthquakes, hurricanes, flooding). Every department prepares an action plan for the whole year. Usually these action plans cover the following topics:

- Number of planned trainings
- Planning number of people involved in trainings.
- Other planning activities – such as work safety days.

296. Safety engineering department submits reports on performed activity quarterly, civil safety department annually and fire protection department every two years.

297. Usually reports include information on the number of conducted trainings and the number of participants, results of conducted observations of work places, implementation of recommendations, provided by external checking organization or by the main office of Uzbekenergo, number and description of accidents occurred during reporting period

298. Takhiatash TPP has several health and safety procedures which are designed to fulfill national legislation.

299. Assessment of work places at Takhiatash TPP was done in 2010 and working conditions of 166 places have been evaluated. As result of the assessment performed, the following was confirmed:

- 308 workers have rights on favourable retirement;

- 568 workers have rights on additional nutrients (milk)
- 868 – on additional holidays

300. The last evaluation of working at Takhiatash TPP has been conducted in 2011 by Unitarian enterprises "Uzenrgosozlash" as entity having certificate on conducting evaluation. General & working places at Takhiatash TPP have been evaluated by this entity.

301. 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.

302. Measurements of vibration have been 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

303. 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).

304. 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/m^3 and allowed 20 mg/m^3) at the boilers drum and lime dust (36 mg/m^3 and 6 mg/m^3 accordingly) at the chemical reagents storage house. Exceeding on asbestos dust have been observed during turbine repairing (14 mg/m^3 and 6 mg/m^3 accordingly).

b) Environmental:

305. Environmental management of the TPP is implemented by an environmental engineer. The environmental engineer is within the TPP production and technical department. The environmental engineer is in charge of:

- ✓ Organization and coordination environmental performance of the TPP departments and workshops;
- ✓ Compilation and endorsement of annual and prospective work plans;
- ✓ Operational decisions of the present-day's environmental issues related with production process;
- ✓ Compilation and endorsement of environmental protection materials prepared for submission for superior organization;
- ✓ The timely preparation of environmental reports
- ✓ Supervise the work of treatment facilities on TPP and monitor emissions level.
- ✓ Development of proposals on reduction of industrial emissions, discharges and wastes
- ✓ Analysis of increasing emissions and discharges (if is the case), design and implementation of mitigation measures.

306. In order to undertake the above tasks, the environmental engineer interacts with the TPP Environmental Laboratory (EL) and some external state agencies. The EL is part of the Water treatment facility of the TPP and is in charge of conduct water quality monitoring.

307. Regarding the TPP environmental management performance, several penalties have been paid for the following evidences:

- 2004:
  - Exceeding of the water intake flow limit
- 2008:
  - Leaking in sewage pipe that discharge effluents to municipal waste water treatment plant;
  - Storage of salt (used for hardness removal from water) on the open site.
  - Exceeding level of exhaust gas from vehicles belonged to TPP
  - Storage of asbestos materials kept on an open site.

<u>Future management:</u>

308. For the future stage, an environmental health and safety plan and procedures based on international standards (World Bank, IFC EHS general guidelines, april 2007) should be updated and developed.

309. The Takhiatash TPP will strengthen its Health and Safety unit by adding environment management staff, which will take care the implementation of the EMP and EHS including measures to improve environmental performance of existing facilities

C. POLICY, LEGAL, AND ADMINISTRATIVE FRAMEWORK AND STANDARDS

310. This section provides an overview of the relevant national and international legislation and policies applicable to the Project.

C.1. Uzbek Legislation

C.1.1. Institutional Framework

C.1.1.1. National Institutional Framework

311. The Republic of Uzbekistan (RUz) is an independent democratic republic based upon 1992 Constitution (as amended on 28 December 1993, 24 April 2003, 11 April 2007, and 18 April 2011). The national environmental and social policy in Uzbekistan is based on the provisions of the country's Constitution. Under the 1992 Constitution all RUz citizens have equal rights and freedoms and are all equal under the law without distinction as to gender, ethnicity, nationality, language, religion, social background, convictions, personal and social status (Article 18). The Constitution also provides safeguards of human rights and freedoms proclaiming that the state secures rights and freedoms of its citizens (Article 43) and guarantees to everyone juridical protection of rights and freedoms (Article 44) when males and females enjoy equal rights (Article 46).

312. Uzbekistan is a presidential republic in which the President is the executive head of the state who secures efficient coordination of governmental authorities. The President issues decrees, resolutions and ordinances which shall be binding across Uzbekistan.

313. The bicameral Supreme Assembly, or 'Oliy Majlis' (OM), comprising the Legislative Chamber and the Parliament, is the legislature with a power to shape laws. In line with the Constitution any law has legal effect provided it is enacted by the Legislative Chamber, approved by the Parliament and signed by the President. OM defines the national environmental and social policies, approves national environmental programs, develops and adopts national environmental and social legislation, coordinates environmental compliance monitoring actions, defines the rates of environmental charges and establishes respective incentives, etc.

314. The Cabinet of Ministers (CM) is the executive. It comprises the Prime Minister, Deputy Prime Ministers, Ministers, State Committees Chairmen and the Government Executive of the Karakalpakstan Republic. CM exercises state control of environment protection and natural resources management along with the State Committee for Nature Protection of the Republic of Uzbekistan and the local governments. Based on its environmental and social mandate CM pursues the national environmental and social policy; regulates natural resources management; is responsible for natural resources inventory and evaluation; coordinates development and implementation of national socio-economic programs; develops mitigation measures; establishes procedures for collecting environmental charges, pollution and waste disposal fees; sets up limits for the use of natural resources and waste disposal; develops environmental education and awareness system; identifies zones of special environmental management, environmental protection and management regimes; develops international environmental relations .

315. The Councils of People’s Deputies, or ‘Kengashi’, led by governors known as ‘khokims’, are the representative bodies of government authority in regions, districts, cities and towns (except for towns under regional jurisdiction and city districts). Under the Constitution they address any issues within their mandate and responsibility based on the interests of the state and its citizens. The Kengashi are responsible for law and order; security and safety of citizens; issues of economic, social and cultural development; local budgets and taxes; local utilities; environment protection, civil registration; local standards and regulations, and enforcement. The term of office for both the Kengashi and the khokim is five years. The khokim is personally responsible for decisions and actions taken by Kengash while decisions of the khokim are binding to all ventures, institutions, organizations, associations as well as public officers and citizens across the respective territory.

316. The environmental responsibility of regional/local government authorities includes: identification of environmental priorities for the respective territory; approval of regional (local) environmental programs; inventory and evaluation of natural resources; inventory of environmentally hazardous facilities; logistical support to environmental actions; environmental permitting; waste management; collection of environmental charges; and environmental control .

317. The makhalla (community level organization) is an independent local form of self-government in Uzbekistan. Makhalla pursues general initiatives and actions locally, including environment-related ones. Makhalla is responsible for taking decisions on issues of local importance, including infrastructure improvement and development, arrangements for khashars (voluntary unpaid work on Sunday), provision of social aid to low-income families, etc.

318. Settlements, kishlaks (villages) and auls (mountain villages) are governed by aksakals (chairmen) and their advisors, who are elected by the gathering of citizens for a period of 2.5 years.

C.1.1.2. Regional Institutional Framework of the Karakalpakstan Republic

319. The RuZ Constitution defines Karakalpakstan as an independent republic constituting a part of the Republic of Uzbekistan. The law of the Republic of Uzbekistan is binding across Karakalpakstan. The Karakalpakstan Republic has its own Karakalpak Constitution (enacted on 9 April 1993) which may not contravene the provisions of the RUz Constitution. The relations between the Republic of Uzbekistan and the Karakalpakstan Republic shall be governed by treaties and agreements between the two parties.

320. The national institutional framework is mirrored all fundamental provisions of the ‘Jokargy Kenes’ (JK) of Karakalpakstan – the supreme body of power in Karakalpakstan – is the legislature ,who exercises its power through JK members who are elected for a period of 5 years. The Chairman of Jokargy Kenes is the highest official of the Republic of Karakalpakstan responsible for interaction between the legislature and the executive of the Republic of Karakalpakstan and elected by the JK members. The Presidium of Jokargy Kenes manages the work and operation of Jokargy Kenes and is composed of the Chairman of Jokargy Kenes, his deputies, chairmen of the committees and commissions, and the party leaders in JK of Karakalpakstan.

321. The Council of Ministers of Karakalpakstan – the Government of the Republic of Karakalpakstan - is the executive in Karakalpakstan. It is formed by the Jokargy Kenes of Karakalpakstan and has responsibility of securing effective functioning of the economy, social and community services, enforcing national and local laws and regulations. The Council of Ministers is headed by the Chairman who is appointed by JK (as advised by the JK Chairman and the President of the Republic of Uzbekistan) and who enters into the Cabinet of Ministers of the Republic of Uzbekistan.

C.1.1.3. Environmental Regulators

322. The State Committee for Nature Protection (SCNP) of the Republic of Uzbekistan ('Goskompriroda') is the primary environmental regulator. The Goskompriroda reports directly to the Parliament and is responsible at national, regional (oblast) and local (district) levels for the development and enforcement of the national environmental and conservation policy, overseeing environmental compliance, the integrated environmental management across various sectors, and securing healthy environment conditions across the country. The Goskompriroda mandate is set forth in the Regulation on the State Committee for Nature Protection of the Republic of Uzbekistan enacted by the Parliament in 1996.

323. The structure of Goskompriroda takes the form of a central body in Tashkent with regional branches and agencies providing scientific and technical support. Regional environmental authorities are structured similarly to the Goskompriroda. Karakalpakstan has its own State Committee for Nature Protection - Goskompriroda of the Karakalpakstan Republic, who is part of Goskompriroda of the Republic of Uzbekistan and reports to it. The Goskompriroda of the Karakalpakstan Republic will oversee the environmental compliance of the Project at construction and operation phases.

324. Other state bodies of the Republic of Uzbekistan dealing with environment related issues are:

- Ministry of Agriculture and Water Resources (MAWR)
- State Committee for Land Resources, Surveys, Cartography and the State Cadastre (or Goskomgeodezkadastr)
- State Committee for Geology and Mineral Resources (or Goskomgeologia)
- Centre of Hydro-meteorological Service (or Uzhydromet)
- Ministry of Health (or MHRUz)
- State Inspectorate for Exploration Supervision, Operations Safety Supervision of Industry, Mining and Utilities Sector (or Sanoatgeokontekhnazorat)
- Ministry of Internal Affairs (or MVD).

325. All national ministries, state committees, inspectorates and other national institutions have their respective branches or offices operating in the Republic of Karakalpakstan that report to the central body of the respective ministry, state committee, inspectorate, etc.

C.1.1.4. Social Regulators

326. Social laws are developed, adopted, revised or amended by ***Oliy Majlis***. Other national regulations are developed by the Cabinet of Ministers as advised by respective ministries and agencies responsible for social issues. These include:

- Ministry of Labour and Social Welfare (or MLSW);

- Regional (Oblast), municipal and local governments;
- State Inspectorate for Exploration Supervision, Operations Safety Supervision of Industry, Mining and Utilities (or ***Sanoatgeokontekhnazorat***)
- the Ministry of Health (or MHRUz)
- the State Committee for Nature Protection (or ***Goskompriroda***)
- the State Committee on Land Resources, Surveys, Cartography and State Cadastre (***Goskomgeodezcadastre***)
- the Trade Union Federation Council

327. The Ministry of Labor and Social Welfare of the Republic of Uzbekistan (MLSW) is the key regulator in the social sector responsible for labor-related issues, employment, pension benefits, social welfare and migration issues. The MLSW monitors compliance with the law and reports to the Cabinet of Ministers of the Republic of Uzbekistan. The MLSW mandate is set forth in the Regulations on the Ministry of Labor and Social Welfare enacted by the Cabinet of Ministers in 2007.[1]

328. The MLSW operates through its central body in Tashkent the network of its regional branches, local employment centres, social welfare departments and the MLSW of the Republic of Karakalpakstan. All report to the central MLSW body.

C.1.2. National EIA Procedure

329. The EIA procedure is regulated by Law on Environmental Expertise and The Regulation on State Environmental Expertise (SEE), approved by Decree No.491 of the Cabinet of Ministers on 31 December 2001 and amended in 2005 and 2009. The regulation defines the legal requirements for EIA in Uzbekistan. SEE is a review process conducted by the ***Goskompriroda*** Department for SEE (‘***Glavgosecoexpertiza’***) at either the national or regional level, depending on the project category.

330. State Committee of the Republic of Uzbekistan for Nature Protection (***Goskompriroda***) is specially authorized supreme and coordinating authority, implementing state control and intersectoral governance in Nature protection, using and reproducing nature resources. ***Goskompriroda*** of the Republic of Uzbekistan is under governance of and accountable to ***Oliy Majlis*** of the Republic of Uzbekistan. The SCNP is obliged to pursue the following objectives:

- Manage and monitor compliance with the State’s environmental impact assessment procedures
- Review and approve environmental impact assessments
- Monitor implementation of conditions specified in the environmental impact assessment approval

331. According to the Regulations on State Environmental Expertise in the Republic of Uzbekistan ***Goskompriroda*** on state environmental expertise is:

- Head of administration on state environment expertise of ***Goskompriroda*** (***Glavgosecoexpertise***)
- State environment expertise of the Karakalpakstan Republic state committee for nature protection

[1] Decree of the Cabinet of Ministers of Uzbekistan on measures to implement Decree of the President of the Republic of Uzbekistan No.PP-616 of 06.04.2007 on measures to increase employment and improve performance of the authorities responsible for labour and social welfare

- State environment expertise of Province and Tashkent city committee for nature protection (***Gosecoexpertise***)

332. ***Goskompriroda*** on state environmental expertise is a uniform system of State Environmental Expertise, methodological guidance of which implemented by ***Glavgosecoexpertise***. ***Glavgosecoexpertise*** undertakes the state environmental expertise on below objects:

- Pre-project and project documentations, operating enterprises and other objects effecting negative impact on environment and population health, objects with special legal status (on activities belonging to Category I and II)
- Materials of integrated monitoring of the territory for assigning the status of conserving nature territories, emergency environment situation zone, as well as environmental disaster; (Paragraph in the Cabinet Ministers' Decree of the RUz No.95 from 01.04.2005)
- Documentation on creation new types of technique, technology, materials, stuffs, productions
- Programs of State projects, concept, schemes of location and productive forces development in economic and social sectors;
- Town planning documents for object designing with a total population of 50 thousand people.
- Projects of standard technical, instructional and methodological documents (technical specifications, standards, environmental standards, rules, instructions...), regulating economic and other activities related to the use of nature resources

333. State environmental expertise of the Republic of Karakalpakstan, Provinces and Tashkent city implements state environmental expertise upon the below objects:

- Pre-project and project documentations, operating enterprises and other objects effecting negative impact on environment and population health, objects with special legal status (on activities belonging to Category III and IV)
- Town planning documents for object designing with total 50 thousand population and below
- Project on protected natural areas management plans

334. Pursuant to Section 10 of the Regulation on SEE, the developer must conduct the EIA assessment process ('OVOS' is the national acronym) in a staged approach, providing the ***Glavgosecoexpertiza***/***Gosecoexpertisa*** with OVOS documents for review at three distinct stages of the Project. Section 11 of the Regulation on SEE outlines the information that should be within the documentation at each of these stages. The three OVOS stages and their required deliverables are summarized as follows:

335. - Stage I: The 'Concept Statement on Environmental Impact' ('PZVOS' is the national acronym), to be conducted at the planning stage of the proposed project prior to development funds being allocated. The Concept Statement is required to provide details on environmental baseline conditions, land use, proposed construction methods, proposed technologies, plant and equipment, estimated discharges and emissions, waste management, considered alternative options, mitigation measures, health and safety risk assessment, environmental response planning and potential impacts.

336. - Stage II: The 'Statement on Environmental Impact' ('ZVOS' is the national acronym), to be completed where it was identified by the ***Glavgosecoexpertiza/Gosecoexpertise*** at Stage I that additional investigations or analyses were necessary. The Statement must be submitted to the ***Glavgosecoexpertiza/Gosecoexpertise*** before approval of the project's feasibility

study, and therefore before construction. The Statement is required to assess the environmental suitability of the project's sites based on the results of engineering and geological investigations, modelling or other required studies, environmental analysis of technology relating to revealed site problems, the results of public consultation (if required) and also to justify the selected mitigation measures.

337. - Stage III: The 'Statement on Environmental Consequences' ('ZEP' is the national acronym) represents the final stage in the SEE process and is to be conducted before the project is commissioned. The report details the modifications to the project design which have been made from the ***Glavgosecoexpertiza/Gosecoexpertise*** review at the first two stages of the EIA process, the comments received through the public consultation, the environmental norms applicable to the project and environmental monitoring requirements associated with the project and principal conclusions.

338. SEE approval (***Glavgosecoexpertiza/Gosecoexpertise*** opinion) is a mandatory document for project financing by Uzbek banks and other lenders (Section 18) at Stages I and II and for project commissioning at Stage III of the national EIA procedure.

339. An overview of the national EIA process is provided in Figure 26.

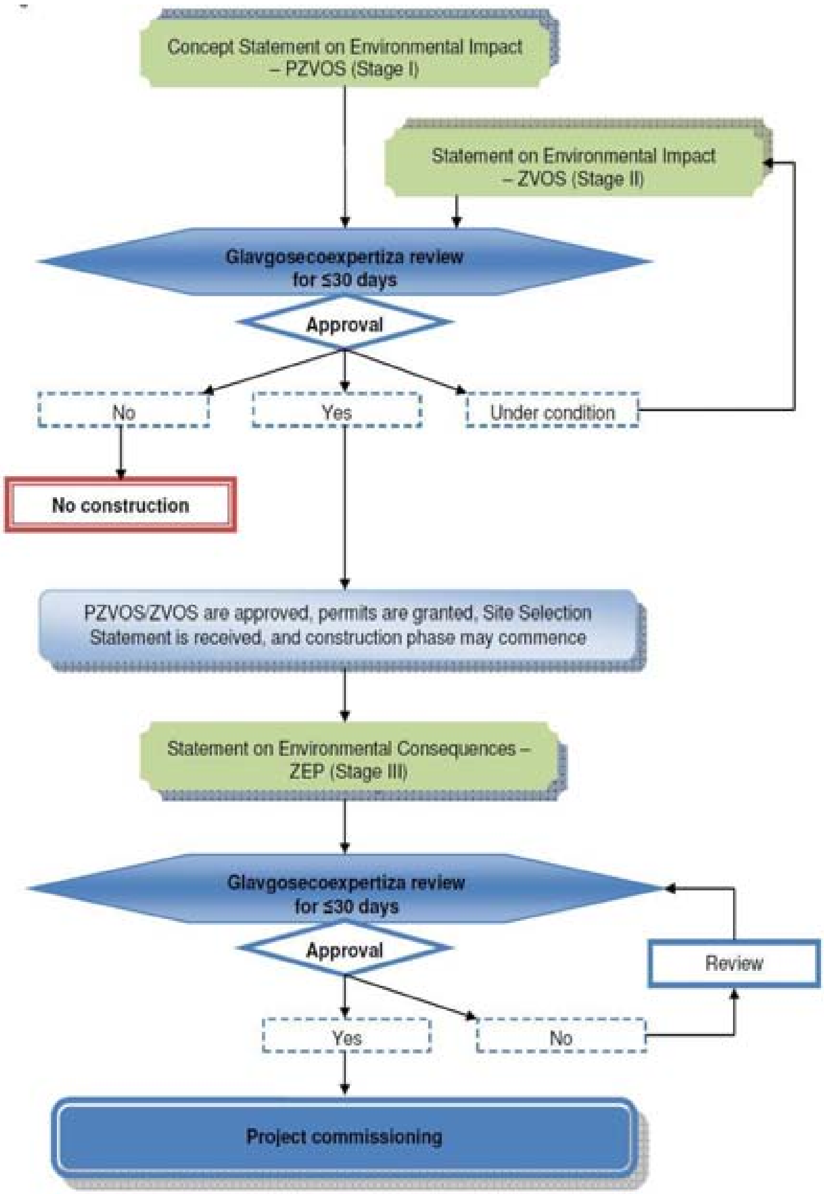


Figure 24. Uzbek EIA procedure [2]

340. All economic activities subject to SEE are classified into one of four categories:

- Categories I and II — "high and medium risks of environmental impact" (SEE is conducted by the national SCNP within 30 days, all EIA materials are required);

[2] (Source: Regulation on the State Environmental Expertise in the Republic of Uzbekistan No.491 of 31.12.2001, as amended on 05.06.2009)

- Category III — “low risk of impact” (SER is conducted by regional branches of SCNP within 20 days, all EIA materials are required); and
- Category IV – “low impact” (SEE is conducted by regional branches of SCNP within ten days, only a draft EIA is required).

C.1.3. Project permitting status

341. This section reflects the Project permitting status as at the date when this EIA document was submitted.

342. In compliance with Appendix 2 of the Cabinet Ministers’ Decree of the RUz No. 491, paragraph 37 (December 2001), the thermal power stations and other burning facilities with capacity 300 MW and more belong to Category 1 with respect to their environmental impact (high impact risk).

343. In compliance with national EIA requirements in the Republic of Uzbekistan, the ‘Concept Statement on Environmental Impact’ was developed as part of Takhiatash TPP pre-feasibility study and submitted to the State Environmental Expertise Appraisal. The approval for this first stage was received in November 2012 (#18/963).

344. The environmental appraisal of the documents 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 it was found advisable to proceed with the final stage of EIA, the Statement on Environmental Impact, for the purpose of establishing the limits to the emissions of pollutants and contaminants to the environment and to the production and disposal of wastes broken down for different years, according with the schedule for shutting down and decommissioning obsolete boiler equipment.

345. The State Environmental Appraisal of the State Nature Protection Committee of the Republic of Uzbekistan approved the draft environmental impact statement for the project of modernization of Takhiatash TPP considering one CCGT unit. Since the extension project with a second CCGT unit may involve a meaningful change in the evaluated impacts, a new EIA needs to be developed by the Design Institute and endorsed to the State Nature Protection Committee. The new EIA will be prepared as part of the Feasibility Study. At the time this report was written, the Design Institute had not started yet the development of their EIA.

C.1.4. Environmental regulatory framework

346. Since the country gained independence RUz has developed, revised and improved the national environmental legislation, enacted new environmental laws and regulations, developed programs and action plans to address environmental issues and promoted sustainable use of natural resources. Uzbekistan has enacted several supporting laws and statutes for environmental management, and is party to several international and regional environmental agreements and conventions. The key national environmental law is the Law on Nature Protection (1992).

347. A brief description of this law and the other supporting laws related to environmental protection is presented below.

C.1.4.1. Law on Nature Protection (1992)

348. The law “On nature protection” (Law No.754-XII, 1992) states legal, economic, and organizational bases for the conservation of the environment and the rational use of natural resources. Its purpose is to ensure balanced relations between man and nature, to protect the environmental system and to guarantee the rights of the population of a clean environment. According to the legislation of the Republic of Uzbekistan, the Cabinet of Ministries of Republic of Uzbekistan, the State Nature Protection Committee (SNPC) and the local government bodies are responsible for implementing state laws on environmental protection and management and the use of natural resources. Article 25 of this law states that State Environmental Expertise (SEE) is a mandatory measure for environmental protection, preceded to decision making process. In addition, article 25 says that the implementation of the project without a positive conclusion of SEE is prohibited. Table 29 outlines some key articles of the Law on Nature Protection, and their associated requirements.

Table 29. Main articles of the Law on Nature Protection (Law No.754-XII, 1992)

Article	Topic	Requirement
14	Environmental soil and standards	Environmental impacts shall be minimized by environmental norms and standards. Any project is subject to establishing maximum allowable norms of environmental load. This is undertaken at the detailed design phase of the Project by specialist Design Institutes.
19	Water and water bodies	The surface, underground and marine water resources of the Republic of Uzbekistan can be only used provided that there are sufficient water volumes in natural circulation; water purity is secured up to the standard, aquatic flora and fauna are under conservation, pollution of water bodies is avoided, ecological balance in water bodies is maintained and water bodies as landscape elements are not damaged.
20	Air	Changes in air quality, air pollution and air degradation shall be avoided to conform to established norms. In compliance with provisions of the international agreement all entities and individuals must phase out and at a later stage stop the production of ozone depleting substances.
20, 41, 45	Waste disposal; Environmental requirements to developments; Protection against contamination associated with waste	The owners of wastes have responsibility for safe disposal of waste in such a way that seeks to maximize opportunities for re-use or recycling and that is safe to the environment. Waste disposal shall logistically be arranged by local authorities. Key requirements include: • Ventures, organizations, establishments, and individuals should seek to implement waste-free and low waste technologies, reduce generation of production and consumption wastes, provide for their disposal and utilization and follow the procedures of their separation, storage, disposal and utilization. Commissioning of facilities that do not comply with these environmental requirements is forbidden.

Article	Topic	Requirement
		• It is forbidden to store and dispose of hazardous wastes on settlements lands, protected landscapes and recreational areas, historical sites, within water bodies, within water protection zones, in places where there is a risk to the life and health of citizens or in natural areas which are specially protected. • The disposal of wastes in the subsurface layer is permitted in exclusive cases, as justified through appropriate ground investigations. Requirements apply for the provision of health and safety of citizens and the protection of the environment. • The treatment of wastes and disposal or storage of wastes in landfills is authorised by the state bodies for nature protection.
33	Economic instruments to promote protection of the environment	The existing economic instruments include: • Resources user charges, pollution charges and other payments associated with environmental impact • Tax differentiation and financial incentives for introduction of low-waste and resource-recovery technologies • Taxes levied on environmentally hazardous technologies and operations • Licenses/permits to discharge and emit pollutants or to perform other environmentally hazardous activities • Allocation of responsibilities for the recovery of disturbed environment • Compensative payments for the damage to the environment • Deprivation of bonuses and awards for officers • Incentive prices and mark-ups for environmentally friendly products; • Economic sanctions against natural resources users for wasting natural resources and confronting with the established norms • Performance bonuses to groups and individual workers for promoting nature protection and manufacturing of environmentally friendly products • Other economic incentives as identified by the national legislation and local authorities.
34	Environmental changes	• Resources user charges and pollution charges include environmental taxes and other compulsory payments associated with the use of natural resources as well as compensative pollution charges associated with emissions, discharges and waste disposal, and

Article	Topic	Requirement
		conservation and renewal fees imposed on users of natural resources • Environmental tax rates and other payments associated with the use of natural resources are set in compliance with the legislation and depend on occurrence, quality, renewal capacity, accessibility, complexity, productivity, location, possibility of processing of natural resources and wastes re-use and recycling opportunities and other factors • Rates of pollution charges associated with emissions, discharges and waste disposal are subject for approval by the Cabinet of Ministers of Uzbekistan as advised by the Goskompriroda • Rates of conservation and renewal fees are subject for approval by the Cabinet of Ministers of Uzbekistan • Resources user charges constitute part of the primary cost of the product (works or services) • Compensative pollution charges and charges associated with exceeded norms and non-sustainable use of natural resources are collected by levy on the user profit • Collected resources user charges, conservation and renewal fees are transferred to the national budget • Collected compensative pollution charges associated with emissions, discharges and waste disposal are transferred to the relevant nature conservation funds • Paid resources user charges and compensative pollution charges does not exempt from the responsibility to undertake environmental activities and to repair the environmental damage.
35	Nature conservation funds	The Goskompriroda and its regional bodies may establish national and local nature conservation funds. The Regulation on the Nature Conservation Funds as approved by the Cabinet of Ministers of Uzbekistan details set-up and disbursement procedures. There are also Community Nature Conservation Funds that may be set up and operated as prescribed by law.
38	Emergency response and environmental hazards	Where accidents occur, an organisation should immediately initiate emergency response pursuant to the emergency response action plan with notification to respective governmental bodies, environmental authorities and emergency response organisations to mitigate environmental impacts associated with the accident.
46	Environmental certification	It is forbidden to use raw materials, implement technological processes and manufacture products without appropriate

Article	Topic	Requirement
		environmental or hygienic certificates or with deviation from established parameters.

C.1.4.2. Supporting national Legislation

349. State environmental control of issues related to the protection of soil and water, air, flora, fauna and specifically the environmental safety of the population is exercised through a range of national environmental laws and regulations. The main national and regional laws applicable to this project are explained in the following sections.

Air quality and air emissions

350. The key regulators dealing with air emissions and ambient air quality in Uzbekistan are:

- The State Committee on Nature Protection (Goskompriroda) who develops air quality standards to protect the environment, the climate and the ozone layer
- The Ministry of Health who develops air quality standards (sanitary norms) to protect human health and oversees the compliance with hygienic norms and standards associated with air quality.

351. The key legislation relating to air emissions and ambient air quality in Uzbekistan applicable to the Project includes the following:

Table 30. Key environmental legislation of the RUz on air quality and air emissions

National laws
Law of the Republic of Uzbekistan on Atmospheric Air Protection No.353-I of 27.12.1996 (as amended on 10.10.2006) It describes regulations on atmosphere protection and its objectives. It specifies standards, quality and deleterious effect norms, requirements on fuels and lubricants, production and operation of vehicles and other transport means and equipment, ozone layer protection requirements, obligations of enterprises, institutions and organizations toward atmospheric protection, and compensations for damages from atmospheric pollutions. The Cabinet of Ministries of the Republic of Uzbekistan, SNPC and local government bodies are responsible for implementing the law.
Law of the Republic of Uzbekistan on State Sanitary Control No.657-XII of 03.07.1992 (as amended on 03.09.2010) It regulates social relations on sanitary-epidemiological well-being and radiation safety, the right person to a healthy environment and other associated with it, the rights and guarantees of their implementation. Thus Article 9 of this law defines obligation to meet sanitarian norms, rules and hygiene regulation at the design, construction and commissioning projects.

Criminal Code, Section 4. Environmental Crimes approved on 22.09.1994 (as amended on 04.01.2011)- It is specifies the conception and defines punishment for violation of the norms and requirements of environmental safety, willful concealment or misrepresentation of environmental pollution, violation of flora and fauna, water, land, subsoil, protected areas use.
Law of the Republic of Uzbekistan on Environmental Expertise No.73-II of 25.05.2000 (as amended on 04.01.2011). It specifies the purposes, objectives and types of environmental expertise. The law defines the qualifications, duties and obligations of environmental experts. The State Nature Protection Committee (SNPC) has overall responsibility for implementing this legislation through The Departments of Environmental Expertise (Glavgosekoexpertiza and Gosecoexpertisa which are both under the SNPC) and the Provincial branches of SNPC.
Decrees
Decree of Oliy Majlis of Uzbekistan on **Enactment of the Law on Atmospheric Air Protection** No.354-I of 27.12.1996
Decree of the Cabinet of Ministers of Uzbekistan on **Approval of the Regulation on the State Environmental Expertise in the Republic of Uzbekistan** No.491 of 31.12.2001 (as amended on 05.06.2009)
Decree of the Cabinet of Ministers of the Republic of Uzbekistan on **Improving the System of Pollution and Waste Disposal Charges in Uzbekistan** No.199 of 01.05.2003 (as amended on 02.04.2010)
Decree of the Cabinet of Ministers of Uzbekistan on **The National Strategy for Reducing Greenhouse Gases Emissions (main provisions)** No.309 of 09.10.2000
Decree of the Cabinet of Ministers of Uzbekistan on **Measures to Implement the National Strategy for Reducing of Greenhouse Gases Emissions** No.389 of 09.10.2000
Regulations
Instructions on **Inventory of Pollution Sources and Rating Pollutant Emissions for Ventures in Uzbekistan** enacted by Order of the Chairman of the State Committee for Nature Protection of the Republic of Uzbekistan No.105 of 15.12.2005
Sanitarian Rules and Norms
Hygienic norms. List of Maximum Allowable Concentrations (MACs) of pollutants in ambient air of communities in the Republic of Uzbekistan including Annex 1. SanR&N RUz No.0179-04
Sanitary norms and requirements to protect ambient air in communities of the Republic of Uzbekistan SanR&N RUz No.0246-08

Hygienic Norms. List of Maximum allowed concentration (MAC) of pollutants into the atmosphere air of settlements in Uzbekistan SanR&N No 0293-11
Hygienic Norms. List of maximum permissible concentration (MPC)- microorganism-producers in the air of settlement areas SanR&N No 0147-04

352. Rating of pollutant emissions in the air applicable to projects under design is done by setting the maximum allowable emissions of those substances into the atmosphere (MAE) MAE is the mass of pollutant emissions per unit of time from the respective source from the perspective of its development and dispersion of hazardous substances in the atmosphere, creating ground-level concentrations not exceeding the maximum permissible concentrations fixed by Uzbek State Environmental Committee. According to the Guidelines for Inventory of Sources and Rating the Emissions into the Atmosphere for Uzbek Enterprises, registered by the Ministry of Justice on 3 January 2006, No 15-33, rated emissions by ingredients shall meet the following conditions:

$$C_m \leq MAC_{max} \times Quota \text{ , where}$$

C_m: The maximum pollutant concentration at the border of the facility is determined by calculation based on the characteristics of the emission source and the gas-air mixture by the method of CIS-86 Methodology for Calculation of Concentrations in the Air of Harmful Substances Contained in the Enterprises Emissions, 1987.

MAC_{max}: The maximum single maximum permissible concentration (MAC), mg/m^3, determined by Uzbek SanR&N No 0179-04 Hygienic Regulations List of Maximum Permitted Concentrations of Pollutants in the Air of Populated Areas in the territory of the Republic of Uzbekistan.

353. The quota for the pollutants release into the atmosphere is the ultimate magnitude of the impact of a particular substance/combination of substances established for each enterprise as a percentage of the total influence of all enterprises located in the territory. The quota for pollutants is determined by Table 31.

Table 31. Quota for pollutants

Enterprise Category*	**Hazard Class of Exhausted Substance****			
	1	2	3	4
1	0.2	0.3	0.4	0.5
2	0.2	0.35	0.5	0.65
3	0.2	0.4	0.6	0.8

* Enterprise category (based on level of impact) is determined in accordance with Uzbek Cabinet Decree No 491 from 2001.

** Hazard Class is determined under Uzbek SanR&N No 0015-94 List of Maximum Permitted Concentrations (MAC) of Pollutants in the Air of Populated Areas in the territory of the Republic of Uzbekistan (1 – high hazard, 4 – the lowest hazard).

354. The MAE standard is established based on the analysis of areas of ground-level concentrations created by all sources of the enterprise for each substance (in accordance with MAE are established for fully loaded process and gas-cleaning equipment and their normal operation). MAE shall not be exceeded in any 20-minute period of time.

355. Calculation of MAE values is done based on the results of the inventory of sources of exhausts in the atmosphere performed under the Guidelines for Inventory of Sources and Rating the Emissions into the Atmosphere for Uzbek Enterprises, Tashkent 2005 and the following documents:

- Uzbek Republic Law on Air Protection
- Uzbek Republic Law on Nature Conservation
- RD RU 34-567-2004 Guidelines. Calculation of annual MAE of pollutants in the atmosphere by equity contribution for TPP Uzbekenergo GJSC. Tashkent, 2004.

356. For this purpose inventory of all sources of pollutant exhausts shall be performed, data shall be collected by type and quantity composition of pollutants and sources shall be defined representing the greatest atmospheric air pollution hazard.

Water use and discharge

357. Water resources management, allocation and use in Uzbekistan are under the control of the Ministry of Agriculture and Water Resources (MAWR), which oversees national specialised associated, provincial and district departments of agriculture and water resources, and inter-provincial and inter-district canal management authorities.

358. Legislation related to water resources management, allocation and use within Uzbekistan is compiled in the next table:

Table 32. Key environmental legislation of the RUz on water use and discharge

National laws
Constitution of the Republic of Uzbekistan Article 55 "Land, depths, water, flora and fauna and other natural resources are national wealth, should be rationally used and are under state protection".
Law of the Republic of Uzbekistan on water and water use No.837-XII of 06.05.1993 It regulates the water relations, rational use of water by the population and economy. The law regulates the protection of waters from pollution and depletion, and prevention and liquidation of harmful effects of water, improvement of water bodies and the protection of the rights of enterprises and institutions, organizations and dehkan farms and individuals in the field of water relations. This

Law also authorizes the State (through authorized agencies) to carry out management and control of water use and protection. The following special state agencies are authorized to regulate water use: • Ministry of Agriculture and Water resources management (MAWR) (surface water); • State Committee for Geology and Mineral Resources (or Goskomgeologia) • State Inspectorate for Exploration Supervision, Operations Safety Supervision of Industry, Mining and Utilities Sector (or ***Sanoatgeokontekhnazorat***)
Land Code of the Republic of Uzbekistan Approved on 30.04.1998 It came into effect from July 1, 1998 and aims to regulate land relations in order to ensure that present and future generations have science-based, sustainable use and conservation of land, breeding and improvement of soil fertility, conservation and improvement of the environment and creating conditions for equitable development of all forms of management, the protection of individuals and legal entities' right for land, as well as strengthening the rule of law in this area. The law specifies that the system of land use management must be environmental, resource effective and provide for conservation of soil, limiting the impact on flora and fauna, geological resources and other components of the environment. Also, according to the Code, the estimate of negative impact of construction works or implementation of technologies to the state of lands and the effectiveness of measures envisaged for the use and protection of land is based on environmental impact assessment.
Decrees
Decree of the Cabinet of Ministers of the Ruepublic of Uzbekistan on **Rules of receiving industrial sewages and calculation of above standards pollutants discharges into the communal sewage system of the cities and other settlement areas of RUz** No.11 of 03.02.2010
Decree of the Cabinet of Ministers of the Republic of Uzbekistan on **Establishment of water protection and coastal zones at the Amudarya river in Surkhandarya, Khorezm province and Karakalpakstan** No. 27 of 07.02.2007
Decree of the Cabinet of Ministers of the Republic of Uzbekistan on **Limited water use in the Republic of Uzbekistan** No.385 of 03.08.1993
Decree of the Cabinet of Ministers of the Republic of Uzbekistan on **Confirming the regulations on water protection areas in water reservoirs and in other water bodies, rivers, main canals and collector, as well as drinking and domestic water supply sources, and for medical and recreation purposes in the Republic of Uzbekistan** No.174 of 07.04.1992
Resolution of Cabinet Ministries of RUz on **adoption of order of water use and water consumption in the Republic of Uzbekistan** No. 82 of 19 March 2013 The Regulation defines the followings: order of water use and consumption in the Republic of Uzbekistan; state management in water use. The document states that several Ministries are implementing control on water use: local governments entities, State nature protection committee,

State Inspection for geological study of subsoil, Safety in industry, mining and domestic sectors of the Cabinet of Ministers, the Ministry of Health of the Republic of Uzbekistan, the Ministry of Agriculture and Water Management of the Republic of Uzbekistan in the manner prescribed by law. Also the regulation regulates trans boundary water bodies uses.
Regulations
Regulation Document on **Regulations on rationing discharges of pollutants into water bodies and on the terrain, taking into account technically achievable performance of wastewater treatment** RH 84.3.6:2004
Regulation Document on **Order of endorsement and approval of projects of wastes disposal and limits for its disposal** RH 84.3.22:2006
Sanitarian Rules and Norms
Hygiene requirements for the protection of surface waters in RUz SanR&N No 0172-04
Main criteria for hygienic assessment of the level water bodies contamination for health risks population in Uzbekistan SanR&N No 0255-08
Sanitarian requirements for development and approval of maximum allowed discharges (MAD) of pollutants discharged into the water bodies with waste waters SanR&N No 0088-99
Others
Construction Norms and Rules on Guideline on content, endorsement and approval of design estimates for construction of enterprises, buildings (CNR) 1.03.01-96
Provision on the Ministry of Agriculture and Water Resources of the Republic of Uzbekistan, 2001

359. All interrelations in water resources within Uzbekistan are based on the above mentioned documents and corresponding contracts on water delivery. Water is delivered on a contractual basis to all water consumers including provincial and district water organizations and separate units. As a rule, the volume of water passing through the border of the neighboring states is specified in interstate agreements.

Waste Management

360. This section provides an overview of the key legislation concerning waste management and disposal in Uzbekistan. The Cabinet of Ministers of Uzbekistan sets and approves national policies, strategies, programmes and procedures relating to waste management including allocation of hazardous waste disposal sites and adjustment of waste disposal charge rates as set forth in Article 5 of the Law on Wastes. Local governments are responsible for waste management policies, strategies and procedures at the local level.

361. The normative documents shown in the following table are used for waste inventory and management at the Takhiatash TPP:

Table 33. Key environmental legislation of the RUz on waste management

National laws
Constitution of the Republic of Uzbekistan Article 55 “Land, depths, water, flora and fauna and other natural resources are national wealth, should be rationally used and are under state protection”.
Law on Wastes No.362-II of 05.04.2002 (as amended on 04.01.2011) It addresses waste management, exclusive of emissions and air and water pollution, and confers authority to the SCNP concerning inspections, coordination, ecological expertise and establishing certain parameters with regard to the locations where waste may be processed. The Law specifies that citizens have the right to a safe and healthy environment, to participate in the discussion of projects, and to compensation for damage to their lives, health or property. Dangerous waste that is transported domestically or internationally must pass ecological certification and be moved by special vehicles. The import of any radioactive waste for storage or burial is strictly forbidden. Although this is not specified in the Law, special privileges are given to persons and enterprises that develop and introduce technologies for reducing or recycling waste. Enterprises are responsible for their waste, but, if they recycle, they may be provided with assistance from the state budget, the National Fund for Nature Protection or voluntary payments. The principal objective of this law is to prevent negative effects of solid wastes on people’s lives and health, as well as on the environment, reduce wastes generations, and encourage rational use of waste reduction techniques in household activities. The law regulates the procedures for treating solid wastes and defines the authorities of various institutions involved in solid wastes management. The law also stipulates the rules for transporting solid wastes and provides market base incentives for efficient treatment of solid wastes. The Cabinet of Ministries of the Republic of Uzbekistan, SNPC, Ministry of Health, Uzbek Agency “***Uzkomunhizmat***”, Agency on supervision for safe operation in the industry and mines inspectorate (hereinafter Agency “***Sanoatkontekhnazorat***”) are responsible for implementing the law.
Decrees
Decree of the Cabinet of Ministers of the Republic of Uzbekistan on **Measures to streamlining of the collection, preparation and delivery of secondary processing of waste paper** No. 70 of 16.03.2009
Decree of the Cabinet of Ministers of the Republic of Uzbekistan on **Approval of the collection and disposal of used mercury-containing lamps** No. 266 of 21.09.2011
Decree of the Cabinet of Ministers of the Republic of Uzbekistan on **Improving the System of Pollution and Waste Disposal Charges in Uzbekistan** No.199 of 01.05.2003 (as amended on 02.04.2010)
Decree of Oliy Majlis of Uzbekistan on **Enactment of the Law of the Republic of Uzbekistan on Wastes issued** No.363-II of 05.04.2002

Decree of the Cabinet of Ministers of the Republic of Uzbekistan on **Enhancing the Use and Recycling of Mercury Lamps and Devices** No.405 of 23.10.2000
Orders
Order of **disposal of hazardous chemicals and hazardous materials on special landfills, their protection and maintenance**, approved by the State Nature Protection Committee, Ministry of emergency situations, Ministry of Finance, Ministry of Healthcare, No. 2438 of 20 March 2013. The regulation provides definitions of hazardous chemicals, toxic materials, special landfills and special transportation vehicles. State organization “Qishloqkimyo” (Agriculture chemicals) is responsible for transportation handling and disposal of hazardous materials. Transportation of such materials has to be conducted in accordance with Resolution of Cabinet Ministries of RUz No. 35 of 16 February 2011 on “Rules of hazardous materials transportation on the territory of RUz”. The Ministry of Healthcare and State Nature Committee are involved into the endorsement of proper completion of works. The following Ministries are responsible for conducting monitoring of the special landfills: • State Nature Protection Committee – reviewing on complying with environmental requirements; • Branches of Ministries of Health – reviewing on complying with sanitarian norms and rules during conducting works with hazardous chemical, toxic materials and their packages; • Ministry of Emergency Situation – conducting works to avoid emergency situations and handling with consequences. • Branches of State Committee on Geology and mineral resources – conducting permanent monitoring of ground water quality.
Regulations
Regulation Document on The waste inventory procedure RD Oz RH 84.3.15.2005
Regulation Document on Guidelines for setting waste disposal limits RD Oz RH 84.3.16.2005
Regulation Document on Production and consumption waste. Procedure for developing the Waste Disposal Limit Document RD Oz RH 84.3.17.2005
Regulation Document on Production and consumption waste. Waste Data Sheet RD Oz RH 84.3.18.2005
Regulation Document on Production and consumption waste management. Terms and definitions RD Oz RH 84.3.19.2005
Regulation Document on Guidelines for setting waste generation RD Oz RH 84.3.21.2005
Production and consumption waste. Waste inventory and waste disposal limits approval procedure (issued by the Goskompriroda of Uzbekistan, 2006) RD Oz RH 84.3.22.2006
Requirements for handling mercury and its compounds, mercury-based waste, and mercury containing devices

RD Oz RH 84.3.11.2004
Regulation on handling mercury-containing products in the Republic of Uzbekistan RD Oz RH 84.3.10.2004
Methodology for integrated waste hazard rating RD Oz RH 84.3.8.2004
Instruction for hazardous wastes generation, use and storage reporting as per Form No.3 – Hazardous Waste (half-year, annual reporting) (issued by the State Statistics Department of the Republic of Uzbekistan, 1997)
A Landfill for burial and land storage of industrial hazardous wastes KMK 201.12-96
Provisional waste norms for cities and regions of Uzbekistan approved by ***khokimyats***
Sanitarian Rules and Norms
Sanitarian Rules of inventory, classification, storage and disposal of industrial wastes SanR&N No. 0127-02
Hygienic classifier of toxic industrial wastes in the Republic of Uzbekistan SanR&N No. 0128-02
Sanitarian requirements on storage and disposal of solid waste in special landfills SanR&N No. 0157-04
Sanitarian Rules and Norms on collection, transportation and disposal of wastes contained asbestos in Uzbekistan SanR&N No. 0158-04
List of asbestos-cement materials and construction, allowed for using and field of its implementation SanR&N No. 0168-04
Sanitary regulations for collection, storage, transportation, disposal and recycling of municipal solid waste SanR&N No. 0068-96
Others
GOST 17.0.0.05-93 - Unified system of standards for environmental protection and rational use of resources. Waste Data Sheet. Composition, content, presentation and amendment procedures
GOST 30333-95 Material Safety Data Sheet. Basic principles. Information on safety during production, use, storage, transportation, and recycling (adopted as the interstate standard by Uzstandart letter _05/01-144 06.11.2003)
GOST 17.9.0.2-99 Environment protection. Waste management. Waste Data Sheet. Composition, content, presentation and amendment procedures
GOST 17.9.1.1-99 Environment protection. Waste management. Waste classification. Waste definition by the genetic principle and categorization
GOST 30774-2001 Resources saving. Waste management. Waste Hazard Data Sheet. Main provisions
GOST 30775-2001 Resources saving. Waste management. Identification and coding. Main provisions

362. The Uzbek Law on Wastes regulates waste management and requires entities to carry out rating and develop limits of waste disposal in order to ensure health and safety of both citizens and environment. The following provides an overview of key provisions of the Law applicable to the Project:

- The main objective is to ensure that waste management avoids any impact to life and health of citizens, and the environment. Any activity of any project may be restricted, suspended or terminated in case of non-compliance with waste legislation that entails damage to life and health of citizens, and the environment or when hazardous waste is generated without technical or other safety measures to protect life and health of citizens, and the environment (Article 17);
- The project shall comply with sanitary norms and standards, safety and environmental requirements to ensure efficient waste management (Article 22);
- Waste generated by the project shall be the property of the project (Article 4);
- The project shall comply with the respective waste management legislation of the Republic of Karakalpakstan (Article 3);
- Provided any international agreement signed by the Republic of Uzbekistan stipulates other requirements than those specified in the waste management legislation of the Republic of Uzbekistan, requirements of the international agreement shall govern (Article 3)
- It will be a responsibility of the Project (under Law on Wastes, Article 15) to:

    - keep records on generated waste and report to respective authorities (the Waste Inventory Document, the Waste Data Sheet, Waste Hazard Data Sheet, Form _ 3- Environment. Toxic Waste Generation, Handling and Storage Report);
    - rate the level of generated waste hazard (every five years);
    - develop, obtain approval of and comply with the Waste Generation Norms and Waste Disposal Limits;
    - collect, and properly store the waste in such a way as to prevent destruction and deterioration of waste of high resource value and subject to recycling;
    - take measures to develop and introduce waste recycling technologies;
    - prevent mixing of waste unless this is required by the applied technology;
    - avoid storage, treatment, recycling and disposal of waste at illegal sites;
    - monitor sanitary and environmental conditions at project owned waste disposal facilities;
    - reinstate land disturbed as a result of waste management;
    - maximize recycling and ensure environmentally safe disposal of non-recyclable waste;
    - report to authorities on illegal waste disposal sites and measures taken;
    - pay waste disposal charges;
    - recover damage caused to the life, health and property of citizens, the environment, or other companies as a result of waste management.

Municipal Solid Waste

363. SanR&N RUz - 0157-04 - Sanitary requirements for storage and disposal of municipal solid wastes (MSW) at landfills in Uzbekistan defines that MSW shall be collected through a unified system of specialized utilities and shall be disposed at MSW landfills.

364. MSW may include various items, goods, materials unsuitable for further use, and waste like paper, food waste, wood, metals, textiles, leather, rubber, glass, stones, charcoal and ash, house and street sweeps, fallen leaves, parts and screenings (particles of 15 mm or less).

Hazardous waste in Uzbekistan

365. Hazardous waste in Uzbekistan is defined as waste that contains substances with at least one of the defined hazardous properties (toxicity, infectivity, explosive hazard, fire hazard, high reactivity, radioactivity) and available in such amounts and in such a way as to pose an imminent or potential risk to human life and health, the environment, both in their current state or when exposed to other substances.

366. Hazardous waste is classified into four groups known as 'hazard classes'. Waste hazard is assessed based on the provisions of 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.

367. Waste hazard classes include:

- Class I – extremely hazardous waste;
- Class II – highly hazardous waste;
- Class III – moderately hazardous waste;
- Class IV – low-hazardous waste, and

368. Hazard classes, physical characteristics and chemical composition of toxic industrial waste are determined by designated process laboratories of companies or research institutes requiring involvement of specialists from Goskompriroda and the Sanitary Epidemiological Stations (SES).

369. The State Statistics Committee has generated a special statistics form to collect data on generated hazardous wastes: Form _ 3- Environment. Hazardous Waste Generation, Handling and Storage Report.

370. This report provides information on 15 streams of waste distinguished by pollutants (chrome, asbestos, mercury, etc.) and hazard classes.

Waste Transportation

371. Transportation of hazardous wastes shall be in specially designated types of vehicle with a waste transportation certificate and a permit. Responsibility for safe transportation of hazardous waste shall be with a transporting organization (Law on Wastes, Article 20).

372. Provided generated waste is subject to export and import operations, or hazardous waste is subject to transportation, an environmental certification procedure shall be completed by the project to confirm compliance with sanitary and environmental norms and standards associated with waste management (Law on Wastes, Article 19).

Waste Recycling and Re-use

MSW

373. MSW may be re-used as material for backfilling open pits and quarries provided food waste content is less than 15%.

Hazardous Waste

374. The national requirement for mercury-containing waste and materials (spent mercury lamps, devices, etc.) is to use only specialized contractors for recycling and treatment properly licensed by Goskompriroda of Uzbekistan. Currently mercury recycling facilities are available in Tashkent, Andijan, Fergana, Navoi, Zaravshan and Bukhara cities (Decree of the Cabinet of Ministers of the Republic of Uzbekistan on Enhancing the Use and Recycling of Mercury Lamps and Devices No.405 of 23.10.2000).

Waste Storage and Disposal

375. The Law on Wastes (Article 22) specifies general requirements for waste storage and disposal. Waste disposal of recyclable waste is prohibited in Uzbekistan. Storage and disposal of waste in the environment including in nature conservation and protected areas, settlements, health and recreational areas or historical and cultural facilities is prohibited. Waste disposal in subsoil is allowed in exceptional cases provided special investigations prove it is safe for health, the environment, and natural resources.

376. Hazardous waste disposal facility of the project is subject to national approval.

377. All wastes (hazardous and non-hazardous) generated and landfilled by the Project will be subject to waste disposal charges used in Uzbekistan as an economic instrument to promote waste recycling and re-use.

MSW

378. MSW landfills in Uzbekistan are accommodated in such a way as to ensure that landfill operations comply with sanitary and epidemiological requirements and are safe to both human health and the environment. A MSW landfill may service one settlement or a group of settlements.

379. MSW landfills may be used to dispose of construction waste and some types of industrial waste rated at Hazard Class III and IV however this will require a special approval from a respective Centre for Sanitary and Epidemiological Supervision (CSES).

Hazardous Waste

380. Decontamination and disposal of toxic industrial wastes shall be carried out at special engineering facilities - landfills - taking into account their class of hazard, by incineration, neutralization or dumping.

381. Industrial hazardous waste shall be disposed at hazardous waste landfills as specified in SanR&N RUz - 0127-02 29.07.02 – Sanitary procedures for industrial waste inventory, classification, storage and disposal.

382. When dumping industrial waste rated under Hazard Class I, additional measures shall be taken to prevent migration of those substances from the waste into the environment.

383. When dumping solid and dust waste under Hazar Class II and III, sealing the bottom and side walls of those trenches is mandatory.

384. Industrial waste rated under Hazard Class III and IV may be disposed of at MSW landfills provided their share is 30% maximum and concentrations of toxic substances in aqueous leachate is similar to concentrations in MSW leachate (BODtotal and COD is 3400-5000 mg/l O_2 (SanR&N RUz - 0157-04)).

385. Industrial waste rated under Hazard Class IV may be disposed at MSW landfills as an insulating material provided concentrations of toxic substances in aqueous extract are similar to concentrations in MSW leachate, with BOD_{total} and COD being less than 300 mg/l O_2, and waste homogeneous structure being made of minimum 250 mm fractions (SanPiN RUz _0157-04 - Sanitary requirements for storage and disposal of municipal solid waste at MSW landfills in Uzbekistan).

386. Liquid industrial waste under Hazard Class IV shall be evenly spilled at the landfill. Liquid waste under Hazard Class I, II and III, prior to transportation to landfills shall be dehydrated to a pasty consistency at the enterprises. Hazard Class I shall be placed in hermetically closed steel containers after dehydration also.

387. Combustible waste as well as scrap, impregnated with varnishes, thinners, and enamels shall be burned in a special furnace at the landfill.

388. Related to the disposal of wasted asbestos, SanR&N No 0158-04 regulates a procedure of wasted asbestos handling. Chapter 4 describes the procedure of collecting wasted asbestos. Wastes contained asbestos have to be disposed by the method avoided dust generating. In case of manually collection wastes the personnel protection equipment for respiratory organs (respirators) should be used. Bulk materials collected by other methods should be placed into the impermeable bags (containers). Replacement of the bags (containers) should be conducted by mechanized methods.

389. Solid wastes which contain asbestos should be storage into places where they will not be destroyed during period of storage. Bags (or other containers) used for storage of wastes should be disposal by grinding and packing into the dense transportable piles in the special indicated places. These bags could not be reused as a waste paper or package. It could be reused as secondary materials for production of asbestos – cement and other goods.

390. All containers with asbestos wastes should have appropriate inscriptions and labelling. 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; transportation should avoid spilling of wastes and prevent pollution of environment. Transportation of unpacked asbestos in open trucks and railway platforms is prohibited.

391. Asbestos wastes belonged to Hazard Class IV could be disposed on MSW without limitations (quantity). Disposal of asbestos wastes under Hazard Class III is limited and amount of such wastes should not exceed 30% of general amount of solid wastes. Asbestos wastes should be disposed on landfills with impervious layers with soil interlayer between them. This legislation also provides specification of landfills location and its organization (arrangement/structure).

392. Permits for combined landfill of industrial and municipal waste are granted by local CSES based on results of analyses completed by accredited laboratories (SanR&N RUz - 0157-04).

393. Landfill owners are responsible for safe storage and disposal of waste to avoid potential impacts to human health and the environment (SanR&N RUz _0157-04).

Soil

394. Issues related to protection of geology, soils and groundwater in Uzbekistan are regulated by relevant national legislation including:

Table 34. Key environmental legislation of the RUz on soil, subsoil and groundwater

National laws
Law of the Republic of Uzbekistan on Subsoil No.2018-XII of 23.09.1994 This law aims to ensure sustainable and integrated use of mineral resources to meet the needs of the mineral raw materials and other needs, protection of mineral resources, environment, safety of operations in subsoil use and protection of subsoil users, protecting the interests of individuals, society and state. According to the Law, the monitoring of subsoil, which represents a system of observations of the subsoil to timely detect changes, assess, prevent and redress the negative processes, is established (Article 18). Geological studies are permitted only after obtaining a positive opinion of the state environmental assessment (Article 25). Licenses for construction and operation of underground facilities for the storage and disposal of waste shall be issued by the State Nature Protection Committee of the Republic of Uzbekistan as a result of direct negotiations

Decrees
Decree of the Cabinet of Ministers of the Republic of Uzbekistan on **Approval of Regulatory Documents in Conformity with the Law of Uzbekistan on Subsoil** No.19 of 13.01.1997 (as amended on 17.12.2010) Annex No. 2, Regulations on state control and supervision for usage and protection of subsoil, geological survey of subsoil and rational usage of mineral resources
Decree of the Cabinet of Ministers of Uzbekistan on **Improving the System of Pollution and Waste Disposal Charges in Uzbekistan** No.199 of 01.05.2003 (as amended on 02.04.2010)
Decree of the Cabinet of Ministries of the Republic of Uzbekistan on **Regulation on Measures for Ground Water Management, Enhancement of Ground Water Protection against Pollution and Depletion** No.179 of 08.04.1992
Sanitarian Rules and Norms
Sanitary rules and Norms on Development of hygiene studies to schemes of soil pollution in Uzbekistan SanR&N No 0272-09
Sanitary rules and Norms on Hygienic assessment of the contamination level of soils of different land use types in the specific conditions of Uzbekistan SanR&N No 0212-06
Hygienic requirements for the quality of the soil in settlements areas in specific natural-climatic conditions of Uzbekistan SanR&N No 0183-05

Biodiversity

395. The national biodiversity policy in Uzbekistan is based on the provisions of the National Constitution of 1992. Article 55 defines that flora and fauna as well as other natural resources are protected by the state and considered to be resources of national wealth subject to sustainable use. Biodiversity management and conservation in Uzbekistan are regulated through a range of national laws and regulations, gathered in Table 35 below.

Table 35. Key environmental legislation of the RUz on biodiversity

National laws
Law of the Republic of Uzbekistan on Protected natural areas No.710-II of 03.12.2004 It regulates relations in organization, protection and use of conserved territories, and management of protected nature reserved or territories. In the law are given the categories and

management of conserved territories such as integrated (landscape) wildlife preserves, nature parks, state natural objects, areas for protection, conversion and restoration of certain natural and manmade objects and complexes. SNPC and local government bodies are responsible for implementing state control and protection of nature conserved territory and its usage.
Law of the Republic of Uzbekistan on Protection and use of flora No.543-I of 26.12.1997 It regulates protection and usage of flora growing in natural condition, as well as in cultivation and its reproduction and conservation of gene pool of wild plants. The Cabinet of Ministries of the Republic of Uzbekistan, local government bodies and special authorized agencies implement the law. SNPC and Head Department of Forestry under Ministry for Agricultural and Water Resources Management are the special authorized agencies in flora protection and its usage. The Cabinet of Ministries of Republic of Uzbekistan, local government bodies, SNPC and Head Department of Forestry are responsible for implementing on the national level the administration of the law.
Law of the Republic of Uzbekistan on Protection and use of fauna No.545-I of 26.12.1997 It defines the legal relationship aimed at regulating relations in the protection, use, restoration and reproduction of fauna in order to ensure the conditions of its existence, preservation of species diversity, the integrity of natural communities and habitat. The choice of sites for all types of construction, pre-planning, design and project documentation, implementation of which may have impact on the wildlife or its habitat and projects unit hunting and fishing, projects, work on acclimatization and hybridization of animal protection plants, dangerous to wildlife and its habitat is subject to the state environmental assessment.
Law of the Republic of Uzbekistan on Forestry No.770-I of 14.04.1999 It describes main objectives of forest regulations and state forest fund and gives mechanism of state regulations and controls in the field of forest protection, conservation, use, and reproduction. The law stipulates the order of forest management, its types and cutting conditions of tree and bush plantations. The Cabinet of Ministries of the Republic of Uzbekistan, local government bodies, SNPC and Head Department of Forestry under Ministry for Agricultural and Water Resources Management are responsible for implementing the law.
Decrees
Decree of the Cabinet of Ministers of the Republic of Uzbekistan on **Confirmation of tax for calculation of damage recovery caused on flora of the RUz** No.293 of 27.07.1995
Decree of the Cabinet of Ministers of the Republic of Uzbekistan on **National strategy and measures of the RUz on conservation of biological diversity** No.139 of 01.04.1998

Decree of the Cabinet of Ministers of Uzbekistan on **the Red Book of the Republic of Uzbekistan** No.109 of 09.03.1992
Decree of the Supreme Council of Uzbekistan on **Reinforcement of the Protection of Valuable and Endangered Species of Flora and Fauna and Harmonisation of their Use** No.937- XII of 03.09.1993
Appendix of the Decree of the Cabinet of Ministers of the Republic of Uzbekistan on **Classification of technogenetic, natural and environmental emergencies** No 455 from 27.10.1998

C.1.4.3. Supporting regional legislation

396. The Republic of Karakalpakstan has developed a series of laws specific to the region. Where Karakalpakstan legislation is in force this should be considered in parallel with national legislation. The key regional environmental laws applicable to this Project are:

- Law on Nature Protection (03.03.06)
- Law on Atmospheric Air Protection (16.08.97)
- Law on Protected Natural Areas (29.08.05)
- Law on Water and Water Management (24.12.93)
- Law on Subsurface Resources (29.08.06)
- Law on Environmental Expertise (05.10.07)
- Land Code (29.08.06)

C.1.4.4. Economic Instruments in Environmental Management

397. Economic instruments are used as supplements to the regulatory tools in Uzbekistan. The system of environmental charges and payments for the use of natural resources has been developing gradually. It plays a dual role: revenue-raising to finance public environmental spending and behaviour changing through creating incentives for reducing emissions, discharges and waste. First introduced in 1992, the system was revised in 1995 with the introduction of pollution charges based on gross emissions/discharges and values of disposed waste. In 2003 new changes have been introduced. Compensative pollution charges are now collected by the Goskompriroda and Nature Protection Funds, and distributed between the state budget - 60%, and Nature Protection Funds – 40%. The next step was the introduction of user charges levied on those who use water, land, forests, subsoil and other resources.

398. Since 1998, Uzbekistan launched a new tax system. Existing resource payments were transferred to the rank of taxes: water tax, land tax and subsoil tax. Proceeds raised are transferred to the state budget. Some non-compliance penalties like those associated with protected flora and fauna are collected by local Nature Protection Funds while few are shared between the state budget and the Nature Protection Funds at 50% by 50%.

399. Rates of pollution charges and environmental taxes are set by the Cabinet of Ministers. These will be applied to the project at the operational stage.

C.1.5. Social regulatory framework

C.1.5.1. Key Social Legislation

400. Social legislation in Uzbekistan covers the whole spectrum of social related issues, including employment, health and safety, education, health care, social protection, migration and consumer rights. Table 36 provides a summary of the key social legislation of the Republic of Uzbekistan.

Table 36. Key social laws of the Republic of Uzbekistan

Employment and Occupational H&S
Law of the Republic of Uzbekistan on **State Sanitary Supervision** No.657-II of 03.07.1992 (as amended on 03.09.2010)
Labour Code of the Republic of Uzbekistan of 01.04.1996 (as amended on 22.12.2010)
Law of the Republic of Uzbekistan on **Occupational Health and Safety** No.839-XII of 06.05.1993 (as amended on 07.12.2001) It establishes a general order of organization of work safety regardless of the types of production, ownership and aims to ensure health and safety of citizens.
Law of the Republic of Uzbekistan on Protecting Health of Citizens No.265-I of 29.08.1996 (as amended on 19.05.2010) In order to protect the health of citizens, the Project will have an emergency preparedness and

Employment and Occupational H&S
response plan, HIV/AIDS awareness initiatives, TB testing for employees, a gas rescue squad and a fire fighting service.
Law of the Republic of Uzbekistan on **Occupational Safety at Hazardous Industrial Facilities** No.ZRU-57 of 25.08.2006
Law of the Republic of Uzbekistan on **Mandatory State Social Insurance against Occupational Accidents and Diseases** No.ZRU-174 of 10.09.2008
Law of the Republic of Uzbekistan on **Compulsory Civil Liability Insurance of the Employer** No.ZRU-210 of 16.04.2009
Methodology of conducting assessment of labor conditions and work places attestation Approved by Ministry of Labor and Ministry of Health, 1996
Rules of work with personnel at energy production enterprises. Endorsement by Uzenergonadzor (under UE), 2002
Rules of fire safety regulations for power plants Approved by Uzenergonadzor and Main Department of Fire Safety, 2004
Rules of safety regulations for maintenance electrical Installations Approved by Uzenergonadzor, 2004
Standardized provision on organizing of labor safety works Approved by Labor Ministry and Professional Unions Federation of RUz, 1996
Sanitarian-hygienic norms of working area SanR&N No 0203-06
Sanitarian norms for noise level at the working places SanR&N No 0120-01
Sanitarian norms of allowed levels of electrostatic fields at the working places SanR&N No 0121-01
Sanitarian norms of general and local vibration at the working places SanR&N No 0122-01
Hygienic classification of work conditions by harmful and dangerous indicators of industrial environment, heaving and intensity of production SanR&N No 0141-03
Community H&S
Law of the Republic of Uzbekistan on the **Appeal of Citizens** No.1064-XII of 06.05.1994 (as amended on 13.12.2002)
Law of the Republic of Uzbekistan on the **Prevention of the Disease Caused by Human Immunodeficiency Virus (HIV)** No.816-I of 19.08.1999
Law of the Republic of Uzbekistan on **Protecting the Population against Tuberculosis** No.215-II of 11.05.2001
Women's rights

Employment and Occupational H&S
Family Code of the Republic of Uzbekistan of 01.09.1998
Social Protection and Welfare
Law of the Republic of Uzbekistan on Social Protection of Disabled Persons No.422-XII of 18.11.1991 (as amended on 11.07.2008)
Law of the Republic of Uzbekistan on Employment No.616-I of 01.05.1998 (as amended on 22.12.2009)
Indigenous peoples
1992 Constitution of the Republic of Uzbekistan (as amended on 18.04.2011)
Resolution of Oliy Majlis of Uzbekistan on Approval of the Declaration on the Elimination of All Forms of Intolerance and of Discrimination Based on Religion or Belief No.505-I of 30.08.1997
Resolution of Oliy Majlis of Uzbekistan on ratification of the Convention Concerning Discrimination in Respect of Employment and Occupation No.499-I of 30.08.1997
Land allocation and use
Civil Code of the Republic of Uzbekistan of 01.03.1997 (as amended 22.09.2010)
Land Code, approved on 30.04.1998 (as amended on 04.01.2011) All land allocation for the Project has been and will be conducted in accordance with the Land Code of the Republic of Uzbekistan. The law specifies that the system of land use management must be environmental, resource effective and provide for conservation of soil, limiting the impact on flora and fauna, geological resources and other components of the environment.
Law of the Republic of Uzbekistan on **State Land Cadastre** No.666-I of 28.08.1998 (as amended on 03.12.2004)

C.2. International Requirements

C.2.1. Asian Development Bank's (ADB) Environmental Procedures

401. The ADB Safeguards Policy Statement (SPS) 2009 sets out policy principles and outlines the delivery process for ADB's safeguard policy in relation to environmental safeguards. The ADB has adopted a set of specific safeguard requirements that borrowers/clients are required to meet in addressing environmental and social impacts and risks. ADB staff will ensure that borrowers/clients comply with these requirements during project preparation and implementation.

402. The safeguard requirements (SR) are operational policies that seek to avoid, minimize or mitigate the adverse environmental and social impacts of projects. ADB's safeguard policy framework consists of three operational safeguard requirements, which are identified in Table 37.

403. Projects are categorized, A, B or C based on the magnitude of their potential environmental and social effects. With reference to ADB's Safeguard Policy Statement SR1 on Environment, this

Project is considered to be a 'Category A' project for the purpose of this assessment. ADB defines a 'Category A' project as one that is likely to have significant adverse environmental impacts that are irreversible, diverse, or unprecedented.

404. An environment and social assessment for a Category A project is required to examine the project's potential positive and negative impacts, compare them with those of feasible alternatives (including the "without project" scenario) and recommend any measures needed to prevent, minimize, mitigate, or compensate for adverse impacts and to improve performance. This report constitutes the EIA on behalf of the Project sponsor. The above considerations have defined the rigor of this EIA, the scope of the EMP and the disclosure and consultation requirements for the Project.

405. A summary about category and how these safeguard requirements have been incorporated into this environmental and social assessment is included.

Table 37. ADB's safeguard policy

Safeguard	Scope and triggers	Category	Action in EIA
SR1 Environmental Safeguard requirement	Environmental safeguards are triggered if a project is likely to have potential environmental risks and impacts. The ADB requires the ESIA Report to be produced in line with their defined scope; to include explanation of meaningful consultation and grievance redress and include an EMP in line with their scope.	A	This report constitutes the EIA, and sets out the proposed management and mitigation actions for the significant environmental impacts. It also provides an explanation of meaningful consultation and includes an Environmental Management Plan for the management of environmental impacts.
SR2 Involuntary resettlement safeguard requirement	The involuntary resettlement safeguards covers physical displacement (relocation, loss of residential land, or loss of shelter) and economic displacement (loss of land, assets, access to assets, income sources, or means of livelihoods) as a result of (i) involuntary acquisition of land, or (ii) involuntary restrictions on land use or on access to legally designated parks and protected areas. It covers them whether such losses and involuntary restrictions are full or partial, permanent or temporary.	B	The Project will require additional land next to the existing facilities which will lead to involuntary resettlement of population. A land acquisition and resettlement plan (LARP) which considers compensation measures was prepared in close consultation with affected people. LARP is an independent document from the EIA.
SR3 Indigenous peoples	The Indigenous Peoples safeguards are triggered if a project directly or indirectly affects the dignity, human	C	Ethnic Karakalpak people are not considered to meet all four of the ADB defining characteristics of

Safeguard	Scope and triggers	Category	Action in EIA
safeguard requirement	rights, livelihood systems, or culture of Indigenous Peoples or affects the territories or natural or cultural resources that Indigenous Peoples own, use, occupy, or claim as an ancestral domain or asset. The term Indigenous Peoples is used in a generic sense to refer to a distinct, vulnerable, social and cultural group		Indigenous Peoples. In the project area, there is not community or group that maintains any particular culture, language or properties. They are all Uzbek. No further study is needed.

406. The need for detailed gender analysis has not been identified in relation to this Project. However, efforts will be made to encourage women's involvement in the Project and the realization of benefits to women. In this respect, a specific Poverty, Social and Gender Analysis has been undertaken as an independent document to the EIA.

407. A consolidated Operations Manual specifies ADB's internal review procedures for due diligence and for supervision throughout the project cycle in relation to each safeguard policy area. In addition to the three safeguard policies, several sector policies have environmental safeguard elements, for example, those pertaining to water, energy, and forestry.

C.2.1.1. World Bank IFC Environmental, Health and Safety Guidelines

408. ADB Safeguard Policy Statement indicates that during the design, construction and operation promoter must apply pollution prevention and control technologies and practices consistent with international good practice, as reflected in internationally recognized standards such as the World Bank Group´s Environment, Health and Safety Guidelines.

409. In this project, general and thermal power plants EHS IFC (World Bank Group) guidelines have been taken into account to:

- Establish specific standards for the project.
- Provide prevention and control measures for each source of pollution applicable to this type of industry Environmental Monitoring programs
- Provide occupational health and safety sources of threats, prevention and control measures and monitoring

C.2.2. International conventions

410. Under international cooperation in the field of environment protection, Republic of Uzbekistan signed number of International Conventions, which should be undertaken by State Committee for Nature protection of the RUz. Those potentially applicable to the Project, and for which Uzbekistan is signatory, are outlined in Table 38.

Table 38. Key applicable international conventions and protocols

Convention or protocol	Overview	Relevance to project
Vienna Convention on Ozone Layer Protection (1985), ratified in 1993 Montreal Protocol on Substances that Deplete the Ozone layer 1987), ratified in 1993 London (1990) and Copenhagen Amendments to the Montreal Protocol (1992), ratified in 1998	The Montreal Protocol (a Protocol to the Vienna Convention on Ozone Layer Protection) is designed to protect the ozone layer by phasing out the production of numerous ozone depleting substances.	Through limitation of the release of chloride and bromide containing ozone depleting substances, the Project will support Uzbekistan's contribution toward the anticipated recovery of the ozone layer by approximately 2050.
UN Framework Convention on Climate Change (2007). Kyoto Protocol (1997), ratified in 1999	The Kyoto Protocol (a Protocol to the UN Framework Convention on Climate Change (UNFCCC)) aims to stabilize greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system.	The Project will comply with all national standards for GHG emissions in order to contribute to Uzbek targets set in line with the adoption of the Kyoto Protocol.
Convention Concerning the Protection of World Cultural and Natural Heritage (2004).	The Convention Concerning the Protection of World Cultural and Natural Heritage is the precursor to the establishment of UNESCO World Heritage Sites as a place (i.e. natural or built environment) that is listed by the UNESCO as of special cultural or physical significance.	Uzbekistan has four UNESCO World Heritage Sites. However, the Project will have no interaction with these. As such, requirements under the convention will not be triggered.
Convention on Biodiversity (1992), ratified in 1995	The Convention on Biological Diversity (CBD) is an international legally binding treaty with three principal goals: - conservation of biological diversity (or biodiversity) - sustainable use of its components - fair and equitable sharing of benefits arising from genetic resources.	Issues pertaining to biodiversity conservation and sustainable natural resource management are fully applicable to the Project and undergo assessment within EIA.
UN Convention to Combat Desertification (1994), ratified in 1995	The United Nations Convention to Combat Desertification is intended to combat desertification and mitigate the effects of drought through national action programs. The Convention is based on the	The Project will not result in accelerated desertification. Revenues from the Project within Uzbekistan can contribute to aspects of national action programs thereby

Convention or protocol	Overview	Relevance to project
	principles of participation, partnership and decentralization; the backbone of Good Governance and Sustainable Development.	supporting Uzbekistan's commitments.
Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (1989), ratified in 1996	The Basel Convention was designed to reduce the movements of hazardous waste between nations, and specifically to prevent transfer of hazardous waste from developed to less developed countries. It does not, however, address the movement of radioactive waste. 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, and to assist LDCs in environmentally sound management of the hazardous and other wastes they generate.	The Project will comply with all national and international standards for hazardous waste generation and management. Issues pertaining to hazardous waste generation are applicable to the Project and undergo assessment within EIA.
Bonn Convention on Conservation of Migrating Species of Wild Animals (1998), ratified in 1998	The Convention on the Conservation of Migratory Species of Wild Animals (also known as CMS or the Bonn Convention) aims to conserve terrestrial, marine and avian migratory species throughout their range.	Issues pertaining to Project interactions with migratory species are not significant.
Convention on International Trade of Endangered Species of Flora and Fauna (1973); ratified in 2000	The aim of Convention on International Trade of Endangered Species of Flora and Fauna ('CITES') is to ensure that international trade in specimens of wild animals and plants does not threaten their survival.	Issues pertaining to biodiversity conservation are fully applicable to the Project and undergo assessment within EIA.

C.3. The project´s commitments

411. As mentioned previously, EHS IFC guidelines have been considered to establish the project standards. These standards contain performance levels and measures that are normally acceptable and applicable to projects. When Uzbek regulations differ from these levels and measures, the project will achieve whichever is more stringent.

412. The national legislation of Uzbekistan place a priority on provisions stipulated in international agreements as opposed to national law. Specifically, the Law on Nature Protection specifies

(Article 53) that if the international agreement, which the Republic of Uzbekistan is signatory of, sets requirements other than those specified in the existing national environmental laws or regulations, the provisions of the international agreement shall prevail except where national legislation sets more stringent requirements.

413. If less constraining levels than those in the EHS IFC guidelines are selected for special reasons in the project's context, full detailed justification for every one of the alternatives shall be presented under the framework of the present EIA of the Project. The justification shall show that the proposed performance levels will protect the health of local human populations as well as the environment.

414. 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. For planned activities that are subjected to an SEE, official approval received from SCNP for the national EIA and signed by the chairman is the equivalent of an environmental permit.

415. 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 project of categories I and II and by the territorial committees for nature protection of a region, the Republic of Karakalpakstan or Tashkent City for categories III and IV. Waste disposal limits are approved for five years, and the standards of emission limit values for enterprises of categories I, II, III and discharge limit values for substances emitted into water bodies for any enterprise are approved for three years.

416. Emission permits are not based on an integrated approach to pollution prevention and control. Calculations of the standards of emissions discharge into air, water bodies and disposable wastes are based on different approaches. Standards are approved for different terms, 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).

417. Details of the specific international standards (EHS IFC guidelines) as well as national and specific site's limits in relation to ambient air quality, air emissions, effluents, noise and health and safety procedures are provided below.

C.3.1. Takhiatash TPP's Standards on Ambient Air Quality

418. The General EHS Guidelines advise that 'relevant standards' with respect to ambient air quality are national legislated standards or, in their absence, the current World Health Organization (WHO) Air Quality Guidelines or other internationally recognized sources. Where a host country's legislated standards are less stringent than either the WHO or other internationally recognized sources, the IFC acknowledge that it is acceptable to use the national legislated standards as the principal standards that the Project is assessed against.

C.3.1.1. Uzbek standards

419. In accordance with “SanR&N No 0293-11 Hygienic requirements, the list of MAC for pollutants in atmosphere in the territory of Populated areas in the Republic of Uzbekistan” above mentioned pollutants have to comply with following limits:

Table 39. Summary of the relevant Ambient Air Quality Standards for Protection of Human Health (mg/m^3) at Takhiatash TP

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

C.3.1.2. International Standards

420. The legal reference limits pertaining to air quality for each of the pollutants are those corresponding to World Bank reference values. It should be pointed out that point 1.1. (Air Emissions and Ambient Air Quality) in the "Environmental, Health, and Safety General Guidelines" document (April 2007) states that emissions must not generate levels of pollutants equal to or greater than those set out in national legislation, or failing national legislation, reference values for air quality given by the WHO (Air Quality Guidelines Global Update, 2005), which are shown in Table 40.

Table 40. WHO Ambient Air Quality Guidelines (General IFC Guidelines, 2007)

Pollutant	Average Period	Guideline value in µg/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

C.3.2. Takhiatash TPP's Standards on Air Emissions

421. Currently, for future new CCGT, Maximum Allowed Emissions (MAE), have not been determined. The limits will be calculated and should be approved during the project construction phase before the project commission. MAE for the new CCGT units will be calculated based on national legislation and international standards, whichever is more stringent. In this respect, IFC standards are based on concentration measured at an oxygen percentage and MAE are based in a mass flue which could allow dilution of pollutants. Future emission standard should be established in concentration units.

C.3.2.1. Takhiatash TPP current emission standards

422. For existing units of the Takhiatash TPP, Maximum Allowed Emissions (MAE) are calculated by unitary enterprises "Uzenergosozlash" and were passed to State Nature Protection Committee for approval in 2009. Table 41 shows the MAE calculated for the Takhiatash TPP and Table 42 includes the calculation procedure of these MAE.

Table 41. Pollutants maximum allowed emissions for Takhiatash TPP

Pollutant	MAE	
	g/s	t/y
Nitrogen dioxide	441,8480	3126,2838
Nitrogen oxide	71,80000	508,02715
Carbone oxide	9,722000	164,16310

Table 42. Calculation of MAE for Takhiatash TPP

№	Name of value	Formula, source	Value for stack №1	Value for stack №2	Sum	Notes
1	Annual consumption of natural fuel B_{gas}, thousand.nm^3 B_{mazut}, t	Inventory Data	140233 0	841882 0	982115 0	
2	Annual consumption of conditional fuel, ton of conditional fuel (tcf) Gas (Bg)c Mazut (Bм)c Total, Bc	$B_c \times Q^p_{nG}$ $B_c \times Q^p_{nM}$				$Q^p_{nG} = 8146 \frac{kcal}{m^3}$ $Q^p_{nM} = 10915.5 \frac{kcal}{m^3}$ $Q_c = 7000 \frac{kcal}{m^3}$
3	Annual consumption of heat, Qyear , G kal/year	$B \times Q_c \times 10^{-9}$	1,142	6,858		
4	Hourly nominal consumption of conditional fuel into boiler room Bb, tcf /hour	$n \times B_c \times Q^p_{nM}$	78,8	165,1	243,8	
5	Hourly nominal consumption of fuel heat in boiler rooms, Q hour, G kal/hour	$B_b \times Q_c \times 10^{-3}$	551,32128	1155,4286	1706,7499 2	
6	Working hours, hour	Inventory Data	2839	6942		
7	Average annual boiler capacity, b, portion from nominal	$Q_{year} \div Q_{hour} \times \tau$	0,730	0,855		
8	Secondly emission of pollutants from stacks with nominal capacity, g/s	Inventory Data				

№	Name of value	Formula, source	Value for stack №1	Value for stack №2	Sum	Notes
	MNO_2 MNO MSO_2 Mazut ash MCO		 158,464 25,75 0 0 3,142	 283,384 46,05 0 0 6,58		
9	Maximum ground concentration of pollutants from stacks with nominal boiler capacity, quotas from maximum allowed concentration (MAC) $qnNO_2$ qnNO $qnSO_2$ qn3M qnCO	Analyze of scatter band (dispersion of pollutants)	0,077122 0,001769 0 0 0,00042	0,024109 0,000561 0 0 0,00021	0,101231 0,00233 0 0 0,00063	
10	Temperature of exhausted gases at the rated (nominal) and average annual capacity degree C T_{nom} $T_{average}$	Inventory Data	135 135	191 191		
11	Temperature of ambient air, T_{at}, ºC	Inventory Data	35	35		
12	Difference in temperature $T_{nom}-T_{at}$	Inventory Data	100	156		

№	Name of value	Formula, source	Value for stack №1	Value for stack №2	Sum	Notes
	T_{av}-T_{at}		100	156		
	Quota of source in ground concentration NO_2 NO SO_2 Mazut ash CO	Calculation of dispersion, input of source (maximum concentration)	0,7618417 0,7592275 0 0 0,6666667	0,2381583 0,2407725 0 0 0,3333333	1 1 0 0 1	
13	Approved quota in MAC NO_2 NO SO_2 Mazut ash CO	($q_{source\ (source\ input)}$ x $q_{app\ (quota)}$)	0,2514078 0,3796137 0 0 0,6666667 0,1939834	0,0785922 0,1203863 0 0 0,3333333 0,0560166	0,33 0,5 0 0 1 0,25	
14	Maximum ground concentration from stuck at the average annual capacity MAC quote qav NO_2 qav NO qav SO_2	$q_{NO_2} \times b \times \sqrt{T_{nom}} \div b \times T_{av}$ $q_{SO_2} \times b \times \sqrt{T_{nom}} \div b \times T_{av}$ $q_{SO_2} \times b \times \sqrt{T_{nom}}$	0,0456219 0,0010465 0	0,0185682 0,0004321 0	0,0641901 1 0,0014785 3 0	Stack №1 K=2.2 Stack №2 K=2.36

№	Name of value	Formula, source	Value for stack №1	Value for stack №2	Sum	Notes
		$\div b \times T_{av}$				
15	Emission of NO_2 from boiler rooms at the nominal capacity (at the condition of the not exceed ground concentration 0,33 MAC) Mn NO_2, g/s	(q_{NO2}(ap) / q_{NO2}) x M_n x NO_2 Inventory Data	516,572 158,464	923,795 283,384	1440,3674 8 441,848	
16	Secondly emission of nitrogen oxide from stacks with nominal capacity, g/s (at the condition of the not exceed ground concentration 0,5 MAC) MNO, g/s	Inventory Data	25,750	46,050	71,800	
17	Secondly emission of CO from stacks with nominal capacity, g/s (at the condition of the not exceed ground concentration 1,0 MAC) MCO, g/s	Inventory Data	3,142	6,58	9,722	
19	Secondly emission of nitrogen dioxide from stacks with average annual load (at the condition of the not exceed ground concentration 0,33 MAC) $M_{cp}NO_2$, g/s	(q_{NO2}(ap) / q_{NO2}) x M_n x NO_2 x b^2 Inventory Data	465,141 35,054	876,841 110,76	1341,9825 145,814	
20	Secondly emission of nitrogen dioxide from stacks with average annual load (at the condition of the not exceed ground concentration 0,5 MAC) M_{av} NO, g/s	Inventory Data	5,696	17,998	23,694	
21	Secondly emission of carbon oxide from stacks with average annual load (at the condition of the not exceed	Inventory Data	2,2929	5,63	7,9229	

№	Name of value	Formula, source	Value for stack №1	Value for stack №2	Sum	Notes
	ground concentration 1,0 MAC) M_{av} CO, g/s					
23	Annual maximum allowed emission (MAE) of NO_2 , at the condition of the not exceed ground concentration 0,33 MAC for average annual capacity of boiler room, MAE NO_2 , t/year	Inventory Data	358,27	2768,02	3126,29	
24	Annual maximum allowed emission (MAE) of NO, at the condition of the not exceed ground concentration 0,5 MAC for average annual capacity of boiler room, MAE NO , t/year	Inventory Data	58,22	449,8	508,02	
25	Annual maximum allowed emission (MAE) CO , at the condition of the not exceed ground concentration 1,0 MAC for average annual capacity of boiler room, MAE CO , t/year	Inventory Data	23,435	140,701	164,136	

C.3.2.2. International Standards

423. Relevant IFC standards applicable to combustion facilities rated over 50 MWth are presented in the IFC Guidelines for Thermal Power Plants. The only pollutant limited by these Guidelines for the technologies presented on the project is NO_X. Table 43 presents the relevant emission limits for NO_X specified within the EHS Guidelines for both natural gas boilers and turbines.

Table 43. Pollutant Emissions Limit Values in the "Environmental Health and Safety Guidelines" document for thermal power plants, December 2008, for natural gas boilers and natural gas turbines rated >50MWth (Tables 6-B and 6-C)

Combustion technology /fuel	NO_X concentration level (mg/Nm^3), Dry basis	Excess O_2 content (%)
Existing units: Natural Gas Boilers (Table 6-C)	240	3
Future CCGT: Natural Gas Turbines > 50 MW_{th} (Table 6-B)	51 (25 ppm)	15

C.3.3. Takhiatash TPP's effluent standards

424. Currently, for future new CCGT, Maximum Allowed Discharge (MAD), have not been determined. They will be calculated at the same stage as MAE for new unit. MAD for the new CCGT will be calculated based on national legislation and international standards, whichever is more stringent. In this respect, IFC standards are based on concentration and MAD are based in a mass flue which could allow dilution of pollutants. Future discharge standards should be established in concentration units. When ambient water characteristics already exceed standards, effluent characteristics should not increase ambient values.

C.3.3.1. Current Takhiatash TPP effluent standards

Control of pollutants discharge into the surface water

425. The impact of the activity of commercial entities on surface and ground water is determined by the following factors:

- Water consumption and water management determining changes in the natural material balance of the aquatic environment
- Discharge of pollutants with service water directly into water bodies

426. Discharge of all categories of waste water is regulated by hygienic requirement and quality norms for surface water in accordance with SanR&N No 0172-04 Hygiene requirements for the protection of surface waters in RUz and Attachment to Construction Norms and Rules (CNR) 1.03.01-96 "Guidelines on content, order, approval and endoresement of design estimate for enterpises, building construction";.

427. Table 44 below presents the general effluent standards into the water bodies classified by type of use.

Table 44. General water standards

Indicators	**Purpose of water use**			
	Domestic use	**Cultural and service**	**Fishery needs**	
			Highest and first category	**Second category**
Suspended solids	Compared with the natural conditions the content of suspended solids at wastewater discharge shall not be increased by more than			
	0.25 mg/dm^3	0.75 mg/dm^3	0.25 mg/dm^3	0.75 mg/dm^3
	For reservoirs and watercourses containing at low water above 30 mg/dm^3 suspended solids, there may be an increase to 5%. Suspensions with fallout rate of more than 0.4 mm/s for watercourses and more than 0.2 mm/s for discharge reservoirs are prohibited			
Floating matter	There shall not be a film of oil products and concentrations of other contaminants on the water surface			
Color	Shall not be detected in the column of height		There shall be no foreign colour	
	20 sm	10 sm		
Smell and test	Intensity of more than 1 point is not permitted		Water must not give extraneous odours and flavours to fish meat	
Temperature	Temperature of water at the discharge point must not exceed 3ºC in comparing with average monthly temperature of the hottest month		Temperature of water at the discharge point must not exceed 5ºC in comparing average monthly temperature of the hottest month. Increasing of temperature more than 28 ºC in summer and till 8ºC in winter is not allowed	
Hydrogen exponent (pH)	Shall not beyond 6.5...8.5 pH		Shall not beyond 6.5...8.5 pH	
Mineralization	Shall not exceed by dry residue 1000 mg/dm^3, including chlorides - 350mg/dm^3 and sulphates - 500 mg/dm^3		Rated according to water bodies intoxications	
Dissolved oxygen	No less than 4 mg/dm^3 in any period of the year in a sample taken by 12 a.m. on the same day		In winter shall be no less than	
			6 mg/dm^3	
			No less than 6 mg/dm^3 in any period of the year in a sample taken by 12 a.m. on the same day	

<table>
<tr><th rowspan="3">Indicators</th><th colspan="4">Purpose of water use</th></tr>
<tr><th rowspan="2">Domestic use</th><th rowspan="2">Cultural and service</th><th colspan="2">Fishery needs</th></tr>
<tr><th>Highest and first category</th><th>Second category</th></tr>
<tr><td rowspan="2">BOD</td><td colspan="2">At 20ºC must not exceed</td><td colspan="2" rowspan="2">At 20 º C shall not exceed 3.0 mg/dm³ if in winter the dissolved oxygen content in the water of the first* category fishing water bodies fell to 6.0 mg/dm³, and in the second** – to 4 mg/dm³, then discharge in them is only permitted to wastewater that does not change the BOD</td></tr>
<tr><td>3.0 mg/dm³</td><td>6.0 mg/dm³</td></tr>
<tr><td rowspan="2">COD</td><td colspan="2">Shall not exceed</td><td></td><td></td></tr>
<tr><td>15.0 mg/dm³</td><td>30.0 mg/dm³</td><td></td><td></td></tr>
<tr><td>Causative agent (of a disease)</td><td colspan="4">Not allowed</td></tr>
<tr><td>Chemicals (pollutants)**</td><td colspan="4">Shall not be contained in concentrations exceeding the MAC</td></tr>
</table>

*- The first category includes water bodies, where valuable fish species highly sensitive to oxygen are kept and reproduced in.

** - The second group includes water bodies used for other aquatic economy needs.

428. Maximum allowed concentration of most spread pollutants are presented in Table 45.

Table 45. Maximum permissible concentration of pollutants in the water of surface water bodies by usage categories (mg/m^3)

Pollutants	Water usage categories (Handbook of environmentalist, Tashkent 2010)			
	Fishery	Communal	Drinking water	Irrigation
COD	15	40	30	40
BOD_{20}, mg_{O2}/L	3	3-6	3-7	10
pH	6.5-8.5	6.5-8.5	6.5-8.5	6.5-8.5
Mineralization	1000	1000	1000-1500	1000
Including: sulphates	100	500	400-500	
Chlorides	300	350	250-350	
Ammonium nitrogen (ammonium salt) (NH_4^+)	0.5	2	0.5	1.5

Pollutants	Water usage categories (Handbook of environmentalist, Tashkent 2010)			
	Fishery	**Communal**	**Drinking water**	**Irrigation**
Nitrogen	9.1	25	45	25
Nitrogen nitrite	0.02	0.5	3	0.5
Nitrite	0.08	3.3	3	
Nitrate	40	45	45	
Phosphate (PO_4^{3-})	0.3	1	3.5	1
Ether soluble	0.05	0.8	0.8	0.8
Oil products	0.05	0.3	0.1	0.3
SAS	0.1	0.5	0.5	0.5
Phenol	0.001	0.001	0.001-0.1	0.001
Fluorine (F)	0.05	1.5	0.7	1
Arsenic (As)	0.05	0.05	0.05	0.1
Iron (Fe)	0.05	0.5	0.3-3	5
Chromium (Cr^{6+})	0.001	0.1	0.05	0.1
Copper (Cu)	0.001	1	1	1
Zinc (Zn)	0.01	1	3	5
Cyanides	0.05	0.1		
Lead (Pb)	0.03	0.1	0.03	0.2
Nickel (Ni)	0.01	0.1	0.1	
Cadmium (Cd)	0.005	0.01		
Cobalt (Co)	0.1	1		
Molybdenum (Mo)	0.0012	0.5	0.25	
Strontium (Sr^{2+})		2	7	
Selenium (Se)	0.001		0.01	
Mercury (Hg)		0.005	0.0005	

Control of pollutants discharges into the water bodies

429. According to current practice in the country, quality standards for surface waters or their natural composition and properties shall be maintained in waterways in where discharge of sewage or other economic activities affect the conditions of ***water bodies used for domestic and municipal purposes***. The area in where the characteristic should be maintained is located one kilometer downstream the discharge point to the body of water .In water bodies (lakes) the requirements shall be maintained in the area within a radius of one kilometer from the discharge point.

430. Within sewages discharges or other types of economic activities affecting the conditions of ***water bodies used for fishery***, surface water quality standards or their natural composition must be respected throughout the area of water use, starting with a baseline alignment, determined in each case by the SCNP, but no more than 500 m from the point of discharge of sewage or the location of other sources of pollution of surface waters. According to data provided into the "Permission on maximum allowed discharge of pollutants into the water body (Takhiatash TPP)", Suenly canal is receiver of discharging from TPP waste water, belonged to category of water bodies used for fishery purposes.

431. Rating of discharges of pollutants is carried out by establishing the maximum allowed discharges (MAD) of these substances in wastewater into water bodies. MAD is the maximum mass of matter in wastewater allowable for discharge under the established regime at a given point of the water body, to ensure water quality standards at the points of water use. MAD is calculating based on requirements indicating into SanR&N No 0088-99 «Sanitarian requirements for development and coordinating of projected MAD of pollutants, discharged into the water bodies with waste water» and Uz RH 84.36.2004"Regulations on discharge of pollutants into water bodies and on the terrain, taking into account technically achievable performance of wastewater treatment." In according with these documents, MAD is derived from the maximum allowed concentration (MAC) of substances in the water at the points of water use, the assimilative capacity of the water body and the optimal mass distribution of substances between water users, discharging wastewater.

432. The value of the MAD is defined as the product of average daily flue of wastewater q (m^3/h) to the allowable concentration of the discharge of contaminants C (g/m^3).

$$MAD\ (g / h) = q \times C$$

Norms of MAD developed considering:

- categories of water object receiving drainage waters;
- quality of water in river, water reservoir;
- stream assimilation properties of water object;
- possibility of dilution by water receiving bodies
- MAC of pollutants in water
- General requirements for content and properties of water bodies

433. If the ambient contamination of the water body for some indicators cannot provide standard quality of water in the checkpoint, then the MAD for these indicators are calculated on the basis of allocation of regulatory requirements for the composition and properties of water bodies. If the ambient contamination of the water body exceeds norms, MAD could be developed with

consideration ambient water quality. Control of discharges of pollutants into water bodies could be done for 20 parameters that characterize the top 20 industrial pollutions in Uzbekistan.

434. In calculating the norms of MAD diluted and assimilative capacity of water bodies, justification rules are specific hydrologic data, hydro biological and other observations by organizations that have a license to conduct such operations. The initial water quality data can be based on natural background values for unpolluted areas of water bodies within the reserves with similar geological and geographical conditions and stock research materials of the past.

435. Control of discharges of pollutants on the terrain is based on the type, permeability and filterability of soils forming a natural bottom of water body data, the amount of information about the natural decrease in areas receiving wastewater, groundwater levels and their qualitative composition.

436. The norms determine the type of ***sewage*** discharge treatment facilities that produce clean municipal wastewater. Since the vast majority of sewage treatment plants (STP) in the country are based on biological treatment, then a mixture of domestic and industrial wastewater sent to biological treatment should meet the following requirements[3]:*

- pH should not be below 6.5 and above to be 8.5;
- temperature must not be lower 6℃ and above 30 ℃;
- The total concentration of dissolved salts are not higher of MAD;
- BODfull should not exceed 250-500 mg/l;
- must not contain any un dissolved tar and oil;
- Must not contain surfactants.

<u>Current Takhiatash TPP effluent standards</u>

437. **There are two types of approved limits** for discharging waste water on the TPP. One of them are limits for discharging water into the water body (canal Suenly) and the other one are limits for discharging water into the municipal sewage system.

438. Limits on going 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 (till 2015). Conclusion of State Environmental Expertise from 2012 officially endorses these limits.

439. The document of the TPP “***Limits on maximum allowed discharges into the water courses”*** contains information on TPP as a subject of water use and source of waste water. This document includes general information on Takhiatash TPP, water use situation on the plant and describes sources of using water and waste water discharge and disposal. The document also provides calculation of maximum allowed discharges into the water courses based on national regulations.

a) Limits for discharging waste water into Suenly canal:

[3] Construction norms, Sewage norms and regulations 2.04.03-96, Tashkent 1997

440. As it is mentioned, MAD should be designed with consideration of water quality of water in water body – wastewater receiver. 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 Table 45. Based on national water quality standards and ambient concentration of pollutants into the canal Suenly, State Nature protection Committee defines norms of pollutants (MAC_T) for Takhiatash TPP.

441. Calculation of limits for maximum allowed waste water discharges (MAD) is done based on the formula provided above:

$$MAD_e = q_e \times C_e$$

here q_e – established flue for TPP

and C_e – established concentration for pollutants (for Takhiatash TPP) (Table 46)

442. 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 q_e and have been using for calculation of MAD (Table 46).

Table 46. Water quality in Suenly canal, national norms for pollutants and norms for TPP (Book "Permission on maximum allowed discharge of pollutan

	Indicator	Unit	anal Suenly verage 2009	anal Suenly verage 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
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 (Table 44), in case if during the low water period mineralization of water course (body) exceeds 30 mg/l, it is allowed exceeding of suspended solids of 5 % relative to the existing (ambient) concentration in river Table 44, section A). 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 following pollutants: suspended solids, sulphates, iron and oil products. MAD for these pollutants shouldn't exceed ambient pollution of canal Suenly."

443. Discharge of pollutants not included into the Table 46 is prohibited.

b) Limits for discharging waste water into municipal sewage system:

444. Two types of sewage water are discharging into the municipal sewage system:

- Industrial waste water after comprehensive waste water treatment plants (on the TPP) go through outlet #1. Flow is 103.43 thousand m^3/year or 283.37 m^3/day or 11.807 m^3/hour.
- Communal and sanitarian discharges from TPP go through outlet #2. Flow is 66.328 thousand m^3/year or 181.72 m^3/day or 7.571 m^3/hour.

445. Communal waste water is discharging through outlet #2 without any treatment. Communal sewage is treated at the Takhiatash city municipal waste water treatment plant WWTP. Concentration of pollutants into the discharging water does not exceed permissible concentration.

446. 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". Principle of calculation of MAD into the municipal sewage system is the same as for MAD into the water courses.

$$MAD= C_e \times q_p$$

Where C_e – established concentration for TPP, mg/dm^3;
q_p – projected flue, m^3/day

Table 47. 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	NO_3^-	0.158	45.0	12751.65
5	NO_2^-	0.043	3.3	935.121
6	NH_4^+	0.255	2.5	708.425
7	Fe	0.106	5.0	1416.85
8	Oil products	Abs	1.0	283.37
9	BOD_5	Abs	22.6	6404.162
10	Phosphates	-	2.5	708.425
11	pH		6.5-8.5	
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	NO_3^-	0.204	45.0	8177.4
5	NO_2^-	0.203	3.3	599.676
6	NH_4^+	0.068	2.5	454.3
7	Fe	0.255	5.0	908.6
8	Oil products	Abs	1.0	181.72
9	BOD_5	Abs	22.6	4106.87
10	Phosphates	-	2.5	454.3
11	pH		6.5-8.5	

C.3.3.2. International Standards

447. EHS IFC standards for thermal power plants are shown in Table 48.

Table 48. Effluent guidelines applicable for direct discharges of treated effluents to surface waters for general use*

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
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℃ 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.

* IFC EHS guidelines for thermal power stations of December 2008, Table 5

C.3.4. Takhiatash TPP noise standards

C.3.4.1. Uzbek Standards

448. To ensure acceptable levels of sound pressure and sound levels in rooms, workplaces, industrial sites, in residential and public buildings, living areas of cities and other settlements the project must comply with a couple of Uzbek legislations.

449. The Uzbek national construction noise norms that are relevant to all stages of the construction phase are provided by law KMK 2.01.08-96 “Protection from noise” and detailed in Table 49 below.

Table 49. Uzbek construction noise norms (KMK 2.01.08-96 “Protection from noise”)

Premises and territories	**Equivalent sound pressure levels, Leq (dB)**									**Level of sound, (dBA)**
	31.5	**63**	**125**	**250**	**500**	**1 kHz**	**2 kHz**	**4 kHz**	**8 kHz**	
1. Hospital and sanatorium wards, operating hospitals	68	51	39	31	24	20	17	14	13	25
2. Living rooms in apartments, living premises in rest/care homes, sleeping rooms in children boarding-schools	72	55	44	35	29	25	22	20	18	30
3. Doctor’s offices in hospitals, sanatoriums, polyclinics, audience halls of concert-halls, rooms in hotel, living rooms in campus	78	59	48	40	34	30	27	25	23	35
4. Hospital and sanatorium territories adjacent to the buildings	78	59	48	40	34	30	27	25	23	35
5. Territories adjacent to living houses (in 2 m from cladding structures), residential areas of neighbourhoods and housing estates, grounds of schools and pre-school institutions, school territories	84	67	57	49	44	40	37	35	33	45
6. Class premises, exercise rooms, auditoriums of schools and other educational facilities, conference halls, audience halls of theatres, clubs, cinemas, halls for court sessions and meetings.	82	63	52	45	39	35	32	30	28	40
7. Administration working premises, working premises of design and engineering organisations, scientific	86	71	61	54	49	45	42	40	38	50

Premises and territories	Equivalent sound pressure levels, Leq (dB)									Level of sound, (dBA)
	31.5	63	125	250	500	1 kHz	2 kHz	4 kHz	8 kHz	
and research institutes										
8. Café, restaurant, canteen halls, lobby of theatres and cinemas	89	75	66	59	54	50	47	45	43	55
9. Trading halls of shops, sport halls, waiting halls of airports and transport stations, reception centers of housekeeping/ municipal services	93	79	70	63	58	55	52	50	49	60

450. The "Sanitarian Rules and Norms on providing allowed noise level into the living building, public building 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 Table 50 shows.

Table 50. Admissible noise level into the living area, 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

451. Uzbek Sanitary Protection Zone. The Sanitary-Protection Zone (SPZ) is defined as the minimum exclusion zone around a given industrial facility in order to protect sensitive receptors from noise emissions, amongst other contaminants. The SPZ aims to provide the required level of protection from site emissions under normal operational conditions.

452. The extent of the SPZ is fixed by the nature of the site and can be estimated according to the industrial categorization of land use. The dimensions of the SPZ are defined by way of calculation and establishing permissible emission limits.

453. The following land uses are typically prohibited within an SPZ:

- Residential properties;
- Public or individual country houses;
- Production and storage of drinking water; and,
- Parks, sports, educational and medical facilities.

454. The following land uses are allowed within an SPZ:

- Non-living areas for standby emergency personnel, premises for rotational personnel, trade and meal facilities hotels;
- Administration buildings, design bureaus and research labs; and,
- Sport and recreational facilities of the closed type, public baths and laundries, garages, transport parking places, fire stations, communications, oil and gas pipelines, transmission lines, facilities for technical water supply, cooling water facilities, pump canalisation stations, recycling water supply installations, gas stations and transport service stations.

455. Discussions with the relevant environmental authorities, in combination with air emissions and noise campaign results will confirm the eventual size of the SPZ.

C.3.4.2. International standards

456. The project must observe World Bank Directives ("Environmental, Health and Safety General Directives, 2007 ") based on those of the WHO. As for the impact of noise beyond the perimeter, 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.

457. The respective limit values in the IFC Environmental, Health and Safety (EHS) Guidelines that apply to new and existing thermal power plants are detailed in Table 51.

Table 51. Maximum Allowable Noise Levels (General IFC 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

C.3.5. Takhiatash TPP Waste management and standards

458. Hazardous and non-hazardous wastes will be managed separately and in an environmentally sound manner. For the future waste management of Takhiatash TPP (construction, operation and decommissioning phases) hazardous classification will be based on national or international (Basel Convention) definitions, whichever is more stringent, as Uzbekistan is a signatory part of this Convention.

C.3.5.1. Uzbek standards

459. It will be a responsibility of the Project (under Law on Wastes, Article 15) to develop, obtain approval of and comply with the Waste Generation Norms and Waste Disposal Limits.

Wastes Inventory

460. At the design phase the Project shall complete a waste inventory procedure as specified in Goskompriroda's Guideline O'z RH 84.3.15:2005 - The waste inventory procedure is required in order to identify all types of actually generated waste (both domestic and industrial), their physical, chemical, mechanical and hygienic characteristics and consumer properties.

461. The waste inventory shall be undertaken once and be updated in case of major repairs, upgrades or process modifications. This document will also serve as a basis for Waste Data Sheets (WDS) and the Waste Disposal Limit Document to be developed by the Project at the design phase. The Waste Inventory Document is subject to approval by Goskompriroda.

462. A WDS is a document to confirm the point of origin, amounts, properties and potential hazards of waste.

463. The WDS aims at assessing risks associated with waste management and obtaining information on waste as a recoverable resource.

464. The WDS should be developed for each type of generated waste and shall include the following information:

- waste description, location, company information
- general data of generated waste including generation rate (t/year), total amount accumulated, type, aggregative state, code (local + international)
- waste specific characteristics like density, mass, humidity, composition, hazard class, etc

Waste Generation Norms and Waste Disposal Limits

465. The Law on Wastes specifies (Article 18) the general requirement for any project to set and comply with waste generation norms and waste disposal limits. The procedures for setting waste generation norms and waste disposal limits were developed and approved by Goskompriroda in 2005 (O'z RH 84.3.21:2005 - Guidelines for setting waste generation norms and O'z RH 84.3.16:2005 - Guidelines for setting the waste disposal limit, respectively).

466. Waste Generation Norm (WGN) is a fixed amount of a particular type of waste generated per unit of the manufactured product or per unit of crude material. WGN aims at minimizing waste generation and improving waste management.

467. Waste Disposal Limit (WDLs) is maximum amount of waste permitted for temporary storage for a fixed period of time. WDLs aim at reducing environmental impact associated with generated waste. Limits are set based on actually available storage areas, production capacity, crude material consumption, preventive measures and waste management planning. Limits should be summarised in the WDL Document to be developed by the Project at the design phase based on waste inventory and provisions of Goskompriroda's Guideline O'z RH 84.3.17:2005 – Order of organization and development of limits for production and consumption wastes.

C.3.5.2. International Standards

468. The project will comply with the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (1989), ratified in 1996. Hazardous wastes generated by the project (construction, operation and decommissioning phases) 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, and to assist LDCs in environmentally sound management of the hazardous and other wastes they generate.

469. Waste management of the project (construction, operation and decommissioning phases) will be based also on chapter 1.6. of general EHS IFC guidelines (April, 2007).

C.3.6. Takhiatash TPP Health and safety standards

C.3.6.1. Uzbek standard

470. In accordance with provision # 18 of Law on Labor Protection of RUz "Administration is obliged to implement sanitarian-hygienic working conditions, preventing on-the-job injury rate and industrial diseases". Attachment # 2 to Resolution of Cabinet Ministries of RUz # 267 dated 2000, defines "Order of development and coordinating works on labor protection". Chapter #3 of this regulation states about necessity of providing proper and safety working conditions. Every enterprise, regardless of form of property, has to conduct assessment of working conditions. Assessment of working conditions is based on results of evaluation of working places. Evaluation of working places is conducted in accordance with "Methodology of working places", approved by Ministries on Labor and Health (1996). Timing of conducting "Evaluation of working places" is established by enterprise, but shouldn't be less than one time per 5 years. In accordance with Methodology, every type working places should be evaluated, and the evaluation includes data on the following factors:

1. Chemical,
2. Physical,
3. Microclimate,
4. Brightness

5. Burden of labor
6. Intensity of works

471. The level of burden of labor is defining based on this data. Favourable penssion, additional holydays and specified food provision have to be provided for the staff working in the high level of burden labor working conditions.

Noise standards

472. Noise impact from the industry is characterized by:
- Frequency (Hz);
- The frequency and duration of noise% in daytime and at night;
- Sound pressure level (dB);
- the character of noise (a constant level and variability (intermittent))

473. To ensure acceptable levels of sound pressure and sound levels in rooms, workplaces, industrial sites, in residential and public buildings, living areas of cities and other settlements requirements are provided in the following regulations:

- SanR&N No 0120-01 “Sanitarian norms for noise level at the working places”
- KMK 2.01.08-96 “Protection from noise”

474. Calculated noise levels are based on passport data of more noisy equipment. Sound pressure levels at the boundary of industrial enterprises, the level of sound in the design point in the object to be protected from noise, are determined in accordance with above-mentioned regulations.

Table 52. Admissible noise level at the working places (SanR&N No 0120-01)

	Type of activities, working place	**Level of sound pressure, dB, octave bands with average geometric mean frequencies (Hz)**									**Level of sound, dB (A)**
		31.5	**63**	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**	
1	Creative activity, management with high requirements, scientific activity, design activity, teaching, medical treatment, administration rooms and etc.	86	71	61	54	49	45	42	40	38	50

	Type of activities, working place	Level of sound pressure, dB, octave bands with average geometric mean frequencies (Hz)									Level of sound, dB (A)
		31.5	63	125	250	500	1000	2000	4000	8000	
2	High qualified activity required concentration, management activity, measurements and analytical activities at the laboratories, management rooms at the technical departments, laboratories	93	79	70	63	58	55	52	50	49	60
3	Works related with other receiving instructions and acoustic signs, works required auditory control, controller, dispatcher, room foreman	96	83	74	68	63	60	58	56	54	65
4	Works required concentration, works related with conducting monitoring and remote management of technological cycles: work places at the control panel at the monitoring rooms without noise connection through phone; at the laboratory with noisy equipment	103	91	83	77	73	70	68	66	64	75
5	Execution of all types of work with the exception of works mentioned at parag 1-4 and similar to them) at the permanent work places at the workrooms.	107	95	87	82	78	75	73	71	69	80

475. For assessment of noise level at the Takhiatash TPP three types of working places have been observed: analytical laboratories (row 2); controller rooms (row 3); workrooms (row 5).

Vibration standards

476. Level of vibration is defined in accordance with SanR&N No 0122-01 Sanitarian norms of general and local vibration at the working places.

477. As defined in this document hygienic vibration, impacted at the human, implementing by following methods:

- Frequency (spectral) analysis of rationing parameters
- Integral assessment based on frequency of rationing parameters
- Vibration dose

478. General vibration is divided into 3 categories depending of generating sources:

Table 53. Categories of vibration depending on generating sources

Category	Description	Generating sources
Category 1	Transportation vibration	• Agricultural and industrial tractors, combines • Trucks • Snowplough
Category 2	Transportation-technological vibration	• Excavators, industrial and construction cranes • Track machine, concrete placers
Category 3	Technological vibration, impacted at the human at the working places in stationary machines	• Machine tool • Woodworking machine • Electrical machine • Stationary electrical installations • Pump and ventilation units

479. Category 3 also divides on the three 3 technological types:

a) At the permanent working places in workrooms
b) At the working places in storehouses, dining rooms, communal and other facilities without machinery generating vibration;
c) At the working places of administrative buildings, laboratories, medical entities and workrooms for intellectual workers

Table 54. Sanitarian norms of general vibration category 3 – technological types "a"

Average gemetrical frequency of octane band (Hz)	**Allowed values for vibro acceleration and vibro speed by axes X Yo, Zo**			
	Vibro acceleration		**Vibro speed**	
	m/s^2	**dB**	**m/s^2**	**dB**
2.0	0.14	53	1.3	108
4.0	0.1	50	0.45	99
8.0	0.1	50	0.22	93
16.0	0.20	56	0.20	92
31.5	0.40	62	0.20	92
63.0	0.80	68	0.20	92
Corrected and eqvivalent corrected values, their levels	0.1	50	0.2	92

Table 55. Sanitarian norms of general vibration category 3 – technological types "b"

Average gemetrical frequency of octane band (Hz)	**Allowed values for vibro acceleration and vibro speed by axes Xo, Yo, Zo**			
	Vibro acceleration		**Vibro speed**	
	m/s^2	**dB**	**$m/s^2 \cdot 10^{-2}$**	**dB**
2.0	0.056	45	0.50	100
4.0	0.04	42	0.18	91
8.0	0.04	42	0.089	85
16.0	0.08	48	0.079	84
31.5	0.16	54	0.079	84
63.0	0.32	60	0.079	84
Corrected and eqvivalent corrected values, their levels	0.04	42	0.079	84

Table 56. Sanitarian norms of general vibration category 3 – technological types "c"

Average gemetrical frequency of octane band (Hz)	Allowed values for vibro acceleration and vibro speed by axes Xo, Yo, Zo			
	Vibro acceleration		Vibro speed	
	m/s^2	dB	$m/s^2 \cdot 10^{-2}$	dB
2.0	0.02	36	0.18	91
4.0	0.014	33	0.063	82
8.0	0.014	33	0.032	76
16.0	0.028	39	0.028	75
31.5	0.056	45	0.028	75
63.0	0.112	51	0.028	75
Corrected and equivalent corrected values, their levels	0.014	33	0.028	75

Micro climate standards

480. Indicators, characterized metereological conditios in close work rooms (microclimate) are:

A) – air temperature;
B) – air relative humidity;
C) – air moving speed;
D) – intensity of heat radition.

481. Optimal microclimate conditions are active for all working zone in working wooms without dividing on permnent and temporary. Optimal and allowed indicators of temperature relative humidity and speed of air movement in worknig zone of working rooms have to comply with values, indicated into Table 57.

Table 57. Optimal and allowed norms of temperature relative humidity and speed of air movement in working zone of working rooms

Season	Work category	Temperature (℃) Optimal	Allowed – Upper limit – At the working places – Permanent	Allowed – Upper limit – At the working places – Non-permanent	Allowed – Lower limit – At the working places – Permanent	Allowed – Lower limit – At the working places – Non-permanent	Humidity (%) Optimal	Humidity (%) Allowed At the working place – permanent and non-permanent no more than	Speed of movement (m/s) Optimal	Speed of movement (m/s) Allowed At the working place – permanent and non-permanent no more than
Cold season	Light - 1a	22-24	25	26	21	18	40-60	75	0.1	No more than 0.1
	Light - 1б	21-23	24	25	20	17	40-60	75	0.1	No more than 0.2
	Middle weight – Iia	18-20	23	24	17	15	40-60	75	0.2	No more than 0.3
	Middle weight – Iiб	17-19	21	23	15	13	40-60	75	0.2	No more than 0.4
	Heavy - III	16-18	19	20	13	12	40-60	75	0.3	No more than 5
Warm season	Light - 1a	25-27	31	32	24	23	40-60	30 (at 32℃)	0.1	0.3-0.5
	Light - 1б	24-26	31	32	23	22	40-60	35 (at 31℃)	0.2	0.3-0.6
	Middle weight - IIa	23-25	30	31	22	21	40-60	40 (at 30℃)	0.3	0.3-0.7
	Middle weight – IIб	22-24	29	30	21	20	40-60	45 (at 29℃)	0.3	0.4-0.7
	Heavy - III	21-23	27	29	20	19	40-60	50 (at 28℃)	0.4	0.4-0.7

Air at the workplace

482. Air quality at the work places is regulated by SanR&N No 0046-95 Hygienic Norms. List of Maximum allowed concentration (MAC) of pollutants into the air of work area.

C.3.6.2. International standards

483. In the construction and decommissioning phases, chapter 4.2 of the general EHS IFC guidelines (April 2007) must be fulfilled.

484. In the operation phase, chapter 2 of the general EHS IFC guidelines (April 2007) and chapter 1.2 of the thermal power plants EHS IFC guidelines (December 2008) must be fulfilled.

D. ALTERNATIVE SOLUTIONS EXAMINED AND JUSTIFICATION FOR THE SELECTED SOLUTION

485. This section will explain why and how certain decisions were made. To do so, the alternatives for the situation with and without the project as well as within the alternative with the project are analyzed.

486. The alternatives considered are focused mainly on three aspects: site location, fuel selection, combustion technology used for electricity production and cooling system.

487. The different alternatives to the proposed project do not offer the same opportunities to capitalize on existing infrastructure and other related resources available for the proposed project so that the different selected solutions are justified within this chapter.

D.1. "No project" alternative

488. The main goals of the Takhiatash TPP's CCGT project are to cut operational expenses, to increase the efficiency and the reliability of the energy supply to consumers, as well as to improve the environmental quality within its area of influence.

489. The "No project" alternative means that Uzbekenergo decides not to construct the CCGT units at Takhiatash TPP and continues operating the technically obsolete and physically worn-out equipment of III and IV units.

490. As a result, the reliability and technical conditions of the equipment would decrease and this option would result in even lower technical and economic indicators. Furthermore, accidental risks with potential negative consequences for the environment would increase.

491. The power demand outlook in Karakalpakstan region is strong and, furthermore, Takhiatash TPP not only provides the North-West region of the country with electricity but also heats water for consumers supply in Takhiatash town and for covering its own needs.

492. Operational lifetime of Takhiatash TPP's equipment ranges from 22 to 43 years, which is the main reason for the equipment reliability degradation and increases the probability of accidental risks with potential negative consequences for the environment.

493. Not carrying out the project would mean potentially reducing the planned coverage of the energy demand in Uzbekistan in case of failure of the worn-out equipment, with the resulting parallel reduction in both economic development (delay in the development or investment in Takhiatash area and the supplied cities due to a lack of infrastructure, etc.) as well as the quality of life of its inhabitants (limited access to electricity and poor environmental conditions).

494. Given the consequences indicated and the social impact produced if the "no project" alternative is considered, the most appropriate alternative is believed to be going ahead with the construction of the CCGT units at Takhiatash TPP as long as this Environmental Impact Assessment demonstrates that it will produce an overall impact that is compatible with, controllable by and fits perfectly into the sustainable development policy framework maintained by the Uzbek authorities and the ADB on the condition that the preventive and corrective measures as well as the environmental monitoring program are observed.

D.2. "With project" alternative

495. The implementation of the Takhiatash CCGT units is a priority project within the development program in Uzbekistan. The "with project" alternative will result in a quantitative improvement of the environmental quality in the area of the TPP and an increased economic development in the region and country. If this Environmental Impact Assessment demonstrates that the project will produce an overall impact that will be compatible with, controllable by and fits perfectly into the sustainable development policy framework maintained by the ADB and Uzbek authorities on the condition that the preventive and corrective measures as well as the environmental monitoring program are observed, this alternative would be selected.

D.2.1. Justification for sites selection

496. The site of the 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, located in north-western Uzbekistan.

497. One of the main objectives of the project is to supply the strong power demand outlook in Karakalpakstan. In this context, the locations for installation must be limited to the area to be served. Locations outside this range are too far from the consumers.

498. Apart from the above, there were several weighty reasons justifying the choice of Takhiatash as a site for the new CCGT units. Among these reasons, the following may be noted:

- Location of the new CCGT units within the terrains of the Takhiatash TPP, so the area has been previously developed for industrial use. This avoids certain issues that may arise if the plant is located in a new site in natural areas not previously impacted, such an increase of the impact on the landscape, the vegetation and wildlife.
- Existing distribution and transport structure, so, the project will not require for this purpose either further investments or soil use changes:
  - Interconnection with the national electricity network due to the already existing transmission line.
  - Gas supply to the new CCGT units through gas pipeline with a Gas Distribution Plant at just two kilometers from the power plant area (current supply point).
- Proximity of water supply in sufficient quantities for the power plant (Suenly canal)
- Good communication infrastructure (roads)
- Minimal impact on populated areas in the neighbourhood.

- Proximity of large consumption conglomerations, such as Takhiatash and Nukus.

D.2.2. Choosing combustion technology

499. An important aspect to choose an appropriate combustion technology is the amount of atmospherics emissions associated with the same.

500. The primary emissions to air from the combustion of fossil fuels or biomass are sulfur dioxide (SO_2), nitrogen oxides (NO_X), particulate matter (PM), carbon monoxide (CO), and greenhouse gases, such as carbon dioxide (CO_2). Depending on the fuel type and quality, mainly waste fuels or solid fuels, other substances such as heavy metals (i.e., mercury, arsenic, cadmium, vanadium, nickel, etc), halide compounds (including hydrogen fluoride), unburned hydrocarbons and other volatile organic compounds (VOCs) may be emitted in smaller quantities, but may have a significant influence on the environment due to their toxicity and/or persistence.

501. The amount and nature of air emissions depends on factors such as the fuel (e.g., coal, fuel oil, natural gas, or biomass), the type and design of the combustion unit related to the thermal efficiency (e.g., reciprocating engines, combustion turbines, or boilers), operating practices, emission control measures (e.g., primary combustion control, secondary flue gas treatment), and the overall system efficiency.

Table 58. Contributions of emissions from different LCP categories to the total air emissions from IPPC installations operating in EU-15 in 2001 according to the European Pollutant Emission Register 2001 (EPER) [193, EC, 2001]

LCP category	Contribution to total emissions from IPPC installations (%)										
	SO_2	NO_X	NH_3	CO_2	N_2O	CH_4	PM_{10}	Hg_{tot}	Dioxins+ furans	NMVOC	CO
LCPs over 300 MW	64.6	53.4	0.5	54.4	7.6	0.2	38.1	28.8	19.0	0.7	4.4
LCPs 50 – 300 MW	3.6	6.0	N1	5.0	21.0	0.2	2.1	2.6	0.2	0.7	2.8
Gas turbines	0.9	3.6	0.03	5.5	0.4	0.3	0.1	N1	0.3	0.1	0.3
Stationary engines	0.3	1.2	N1	0.1	N1	0.05	0.2	0.3	N1	0.1	0.03
All LCPs	69.4	64.2	0.5	65.0	29.0	0.8	40.5	31.7	19.5	1.6	7.5
Notes: N1 No emissions reported for this category.											

CO_2 emissions

502. Carbon dioxide is the main reaction product from the combustion of all fossils fuels. These emissions are directly related to the carbon content of fuels, where gaseous fuels have significantly lower CO_2 emissions than other fossil fuels. The content of carbon varies for coal and lignite (hard and brown coal) between 61 and 87 wt-%, for wood it is about 50 wt%, and for gasoil and heavy fuel oil about 85 wt-%

Table 59. Specific CO_2 emission factors for the main fuels burned in large combustion plants (192, TWG, 2003)

Fuel	Specific CO_2 emission factors as a range. (t CO_2/ TJ (g/kWh))
Natural gas	55 (198)
Heavy fuel oil (HFO)	80 (288)
Light fuel oil (LFO)	77 (277)
Hard coal	95 (342)
Lignite	110 (396)

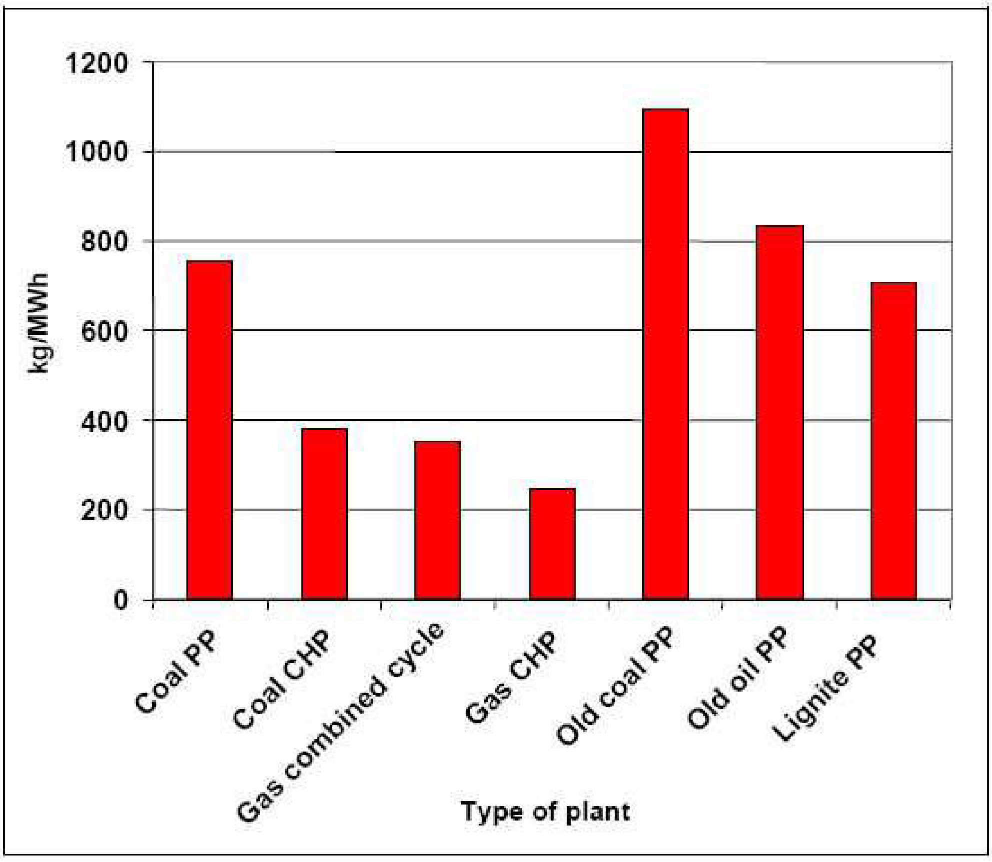


Figure 25. Examples of CO_2 releases for different types of combustion plants

Particulate matter (dust) emissions

503. Particulate matter (dust) emitted during the combustion of solid or liquid fuels arise almost entirely from their mineral fraction. By combustion of liquid fuels, poor combustion conditions lead to the formation of soot. Combustion of natural gas is not a significant source of dust emissions. The emission levels of dust, in this case, are normally well below 5 mg/Nm^3 without any additional technical measures being applied.

504. In the following table can be seen the Best Available Technologies (BATs) for the reduction of particulate emissions from some combustion plants.

Table 60. BAT for the reduction of particulate emissions from some combustion plants

Capacity (MW_{th})	Dust emission level (mg/Nm^3)						BAT to reach these levels
	Coal and lignite		Biomass and peat		Liquid fuels for boilers		
	New plants	Existing plants	New plants	Existing plants	New plants	Existing plants	
50 – 100	5 – 20*	5 – 30*	5 – 20	5 – 30	5 – 20*	5 – 30*	ESP or FF
100 – 300	5 – 20*	5 – 25*	5 – 20	5 – 20	5 – 20*	5 – 25*	ESP or FF in combination FGD (wet, sd or dsi) for PC ESP or FF for FBC
>300	5 – 10*	5 – 20*	5 – 20	5 – 20	5 – 10*	5 – 20*	

Notes:
ESP: Electrostatic precipitator) **FF**: Fabric filter **FGD(wet)**: Wet flue-gas desulphurisation
FBC: Fluidised bed combustion) **sd**: semi dry **dsi**: dry sorbent injection
* Some split views appeared in these values and are reported in Sections 4.5.6 and 6.5.3.2 of the main document.

SO_2 emissions

505. Sulphur oxides emissions mainly result from the presence of sulphur in the fuel. Natural gas, for example, is generally considered free from sulphur, and for this reason no additional technical measures are needed. For the rest of fuels, that need more emission reduction measures, the Beste Available Technologies (BATs) for the reduction of SO_2 emissions from some combustion plants are summarised in the following table.

Table 61. BAT for the reduction of SO_2 emissions from some combustion plants

Capacity (MW_{th})	SO_2 emission level (mg/Nm^3)						BAT to reach these levels
	Coal and lignite		Peat		Liquid fuels for boilers		
	New plants	Existing plants	New plants	Existing plants	New plants	Existing plants	
50 – 100	200 – 400* 150 – 400* (FBC)	200 – 400* 150 – 400* (FBC)	200 – 300	200 – 300	100 – 350*	100 – 350*	Low sulphur fuel or/and FGD (dsi) or FGD (sds) or FGD (wet) (depending on the plant size). Seawater scrubbing. Combined techniques for the reduction of NO_x and SO_2. Limestone injection (FBC).
100 – 300	100 – 200	100 – 250*	200 – 300 150 – 250 (FBC)	200 – 300 150 -300 (FBC)	100 – 200*	100 – 250*	
>300	20 – 150* 100 – 200 (CFBC/ PFBC)	20 – 200* 100 – 200* (CFBC/ PFBC)	50 – 150 50 – 200 (FBC)	50 – 200	50 – 150*	50 – 200*	

Notes:
FBC: Fluidised bed combustion
CFBC: Circulating fluidised bed combustion
PFBC: Pressurised fluidised bed combustion
FGD(wet): Wet flue-gas desulphurisation
FGD(sds): Flue-gas desulphurisation by using a spray dryer
FGD(dsi): Flue-gas desulphurisation by dry sorbent injection
* Some split views appeared in these values and are reported in Sections 4.5.8 and 6.5.3.3 of the main document.

NO_X emissions

506. NO_X emissions are emitted in any combustion process due to the N_2 natural content in the combustion air. The principal oxides of nitrogen emitted during the combustion are nitric oxide (NO) and nitrogen dioxide (NO_2), referred as NO_X.

507. The Best Available Technologies (BATs) for coal, lignite, peat, biomass, liquid fuel and gas fired combustion plants are summarised in the following tables:

Table 62. BAT for the reduction of NO_X from coal-and lignite-fired combustion plants

Capacity (MW_{th})	Combustion technique	NO_X emission level associated with BAT (mg/Nm^3)			BAT options to reach these levels
		New plants	Existing plants	Fuel	
50 – 100	Grate-firing	200 – 300*	200 – 300*	Coal and lignite	Pm and/or SNCR
	PC	90 – 300*	90 – 300*	Coal	Combination of Pm and SNCR or SCR
	CFBC and PFBC	200 – 300	200 – 300	Coal and lignite	Combination of Pm
	PC	200 – 450	200 – 450*	Lignite	
100 – 300	PC	90* – 200	90 – 200*	Coal	Combination of Pm in combination with SCR or combined techniques
	PC	100 – 200	100 – 200*	Lignite	Combination of Pm
	BFBC, CFBC and PFBC	100 – 200	100 – 200*	Coal and Lignite	Combination of Pm together with SNCR
>300	PC	90 – 150	90 – 200	Coal	Combination of Pm in combination with SCR or combined techniques
	PC	50 – 200*	50 – 200*	Lignite	Combination of Pm
	BFBC,CFBC and PFBC	50 – 150	50 – 200	Coal and Lignite	Combination of Pm

Notes:
PC: Pulverised combustion
BFBC: Bubbling fluidised bed combustion
CFBC: Circulating fluidised bed combustion
PFBC: Pressurised fluidised bed combustion
Pm: Primary measures to reduce NO_x
SCR: Selective catalytic reduction of NO_x
SNCR: Selective non catalytic reduction of NO_x
The use of anthracite hard coal may lead to higher emission levels of NO_X because of the high combustion temperatures
* Some split views appeared in these values and are reported in Section 4.5.9 of the main document.

Table 63. BAT for the reduction of NO_X from peat, biomass and liquid fuel-fired combustion plants

Capacity (MW_{th})	NO_X -emission level (mg/Nm^3)				BAT to reach these levels
	Biomass and Peat		Liquid fuels		
	New plants	Existing plants	New plants	Existing plants	
50 – 100	150 – 250	150 – 300	150 – 300*	150 – 450	Combination of Pm SNCR/ SCR or combined techniques
100 – 300	150 – 200	150 – 250	50 – 150*	50 – 200*	
>300	50 – 150	50 – 200	50 – 100*	50 – 150*	

Notes:
Pm: Primary measures to reduce NO_x
SCR: Selective catalytic reduction of NO_x
* Some split views appeared in these values and are reported in Section 6.5.3.4 of the main document

Table 64. BAT for the reduction of NO_X and CO emissions from gas-fired combustion plants

Plant type	Emission level associated with BAT (mg/Nm^3)		O_2 level (%)	BAT options to reach these levels
	NO_x	CO		
Gas turbines				
New gas turbines	20 – 50	5 – 100	15	Dry low NO_x premix burners or SCR
DLN for existing gas turbines	20 – 75	5 – 100	15	Dry low NO_x premix burners as retrofitting packages if available
Existing gas turbines	50 – 90*	30 – 100	15	Water and steam injection or SCR
Gas engines				
New gas engines	20 – 75*	30 – 100*	15	Lean-burn concept or SCR and oxidation catalyst for CO
New gas engine with HRSG in CHP mode	20 – 75*	30 – 100*	15	Lean-burn concept or SCR and oxidation catalyst for CO
Existing gas engines	20 – 100*	30 – 100	15	Low NO_x tuned
Gas-fired boilers				
New gas-fired boilers	50 – 100*	30 – 100	3	Low NO_x burners or SCR or SNCR
Existing gas-fired boile	50 – 100*	30 – 100	3	
CCGT				
New CCGT without supplementary firing (HRSG)	20 – 50	5 – 100	15	Dry low NO_x premix burners or SCR
Existing CCGT without supplementary firing (HRSG)	20 – 90*	5 – 100	15	Dry low NO_x premix burners or water and steam injection or SCR
New CCGT with supplementary firing	20 – 50	30 – 100	Plant spec.	Dry low NO_x premix burners and low NO_x burners for the boiler part or SCR or SNCR
Existing CCGT with supplementary firing	20 – 90*	30 – 100	Plant spec.	Dry low NO_x premix burners or water and steam injection and low NO_x burners for the boiler part or SCR or SNCR

SCR: Selective catalytic reduction of NO_x **SNCR:** Selective non catalytic reduction of NO_x
DLN: dry low NO_X **HRSG:** heat recovery steam generator **CHP:** Cogeneration
CCGT: combined cycle gas turbine
* Some split views appeared on these values and are reported in Section 7.5.4 of the main document..

508. For new gas turbines, dry low NO_X premix burners (DLN) are considered a Best Available Technology.

Thermal efficiency

509. The efficiency with which energy can be generated is an important indicator of the emission of the climate relevant gas CO_2. One way to reduce the emission of CO_2 per unit of energy generated is the optimisation of the energy utilisation and the energy generating process. Increasing the thermal efficiency has implications on load conditions, cooling system, emissions, use of type of fuel and so on.

510. The Best Available Technology conclusion to increase efficiency and the Best Available Technology associated levels are summarized in the following tables.

Table 65. Levels of thermal efficiency associated with the application of BAT measures for coal and lignite fired combustion plants

Fuel	Combined technique	Unit thermal efficiency (net) (%)	
		New plants	Existing plants
Coal and lignite	Cogeneration (CHP)	75 – 90	75 – 90
Coal	PC (DBB and WBB)	43 – 47	The achievable improvement of thermal efficiency depends on the specific plant, but as an indication, a level of 36* – 40 % or an incremental improvement of more than 3 % points can be seen as associated with the use of BAT for existing plants
	FBC	>41	
	PFBC	>42	
Lignite	PC (DBB)	42 – 45	
	FBC	>40	
	PFBC	>42	

PC: pulverised combustion **DBB**: dry bottom boiler **WBB**: wet bottom boiler
FBC: fluidised bed combustion **PFBC**: pressurised fluidised bed combustion
* Some split views appeared in this value and are reported in Section 4.5.5 of the main document

Table 66. Thermal efficiency levels associated with the application of BAT measures for peat and biomass fired combustion plants

Fuel	Combined technique	Unit thermal efficiency (net) (%)	
		Electric efficiency	Fuel utilisation (CHP)
Biomass	Grate-firing	Around 20	75 – 90 Depending on the specific plant application and the heat and electricity demand
	Spreader-stoker	>23	
	FBC (CFBC)	>28 – 30	
Peat	FBC (BFBC and CFBC)	>28 – 30	

FBC: fluidised bed combustion **CFBC**: circulating fluidised bed combustion
BFBC: bubbling fluidised bed combustion **CHP**: Cogeneration

Table 67. Efficiency of gas-fired combustion plants associated to the use of BAT

Plant type	Electrical efficiency (%)		Fuel utilisation(%)
	New plants	Existing plants	New and existing plants
Gas turbine			
Gas turbine	36 – 40	32 – 35	-
Gas engine			
Gas engine	38 – 45		-
Gas engine with HRSG in CHP mode	>38	>35	75 – 85
Gas-fired boiler			
Gas-fired boiler	40 – 42	38 – 40	
CCGT			
Combined cycle with or without supplementary firing (HRSG) for electricity generation only	54 – 58	50 – 54	-
Combined cycle without supplementary firing (HRSG) in CHP mode	<38	<35	75 – 85
Combined cycle with supplementary firing in CHP mode	<40	<35	75 – 85
HRSG: heat recovery steam generator **CHP**: Congeneration			

511. The following alternative technologies for power generation from fossil fuels will be discussed and compared, particularly in order to increase efficiency and thereby effectiveness of the plant and to reduce environmental impact:

- Generation of 510 MW by an oil-fired conventional plant
- Generation of 510 MW by a coal-fired conventional plant
- Generation of 510 MW by a combined cycle power plant CCGT

Generation of 510 MW by an oil-fired conventional plant

512. The oil-fired conventional power plant uses fuel oil is a fraction obtained from petroleum distillation, either as a distillate or a residue and is burnt in a furnace or boiler for the generation of heat or used in an engine for the generation of power.

513. The combustion of fuel oil is not complete in comparison with natural gas and will produce CO_2, NO_X, SO_2 and particulate emissions. In order to control the atmospheric emissions till standards, the oil-fired conventional plant would need facilities to reduce the NO_X, SO_2 and particulate emissions.

514. The oil-fired conventional plants will need additional expenditure due to the choice of fuel and the need to control the pollutants emissions till standards:

- Construction of facilities for the control of NO_X, SO_2 emissions.
- Water and additional chemical products consumption from the facilities to control emissions.
- Gypsum treatment and disposal.

- Appropiated fuel oil storage and handling.

Generation of 510 MW by a coal-fired conventional plant

515. Coal is one of the largest source of energy for the generation of electricity worldwide, as well as one of the largest worldwide anthropogenic sources of carbon dioxide releases. The atmospheric emissions due to coal combustion, even with desulfurization treatment, are much higher in comparison with other fossil fuels. Gross carbon dioxide emissions from coal usage are about double the amount from natural gas and will produce more NO_X, SO_2 and particulate emissions than fuel oil.

516. The coal-fired conventional plants will need additional expenditure due to the choice of fuel and the need to control the pollutants emissions till standards:

- Construction of facilities for the control of NO_X, SO_2 emissions and particulate matter.
- Water and additional chemical products consumption from the facilities to control emissions.
- Gypsum treatment and disposal.
- Bottom and fly ash handling and disposal
- Coal yard
- Coal unloading, transportation, storage and grinding.

Generation of 510 MW by a combined cycle power plant

517. Natural gas is the cleanest fossil fuel for producing energy and is composed mainly by methane CH_4. Before natural gas can be used as fuel, it must undergo processing to remove almost all materials other than methane, so the emission of SO_2 are not significant as well as the emission of particulate matter and CO_2 , due to its higher molecular weight Hydrogen/Carbon (H/C). The combustion of natural gas only will produce NO_X and CO_2 emissions.

518. The Combined Cycle technology takes advantage of the thermal energy of the exhausted gas from the gas cycle to generate water steam to be reused at the steam cycle. Due to that fact, the efficiency of the Combined Cycle technology is highly superior in comparison with other conventional thermal technology.

519. Combined Cycle technology can provide 57% of electrical efficiency that means electricity generation on the basis of more competitive prices in comparison with other technologies. Moreover, natural gas produces energy with the lowest rate emissions per produced kWh and the CCGT power plant does not need additional expenditure for emissions control and fuel storage in comparison with fuel and coal.

<u>Findings</u>

520. The best combustion technology chosen for the new power generation units, from the environmental point of view, is the combined cycle option, which offers a high number of advantages over the other existing conventional steam power units at Takhiatash TPP:

- Decrease in relative fuel consumption
- Decrease in NO_x emissions due to design features of gas turbine combustors and effective combustion mode
- Decrease in gross discharge to atmosphere (no SO_2 and particulate emissions, lower CO_2 and NO_x emissions than coal and fuel-oil)
- Lower percentage of COVs and unburned fuel.
- Decrease in the level of atmospheric pollution by CCGT units' discharges compared to the decommissioned boilers No.1-6
- Decrease in the level of atmospheric pollution by CCGT units' discharges after modernization compared to current environmental conditions
- Decrease in the emission the main greenhouse gas (CO_2 emissions are 60% less than in a conventional technique). This opens the possibility of securing a contribution to the cost of installation under the Clean Development Mechanism of the United Nations Framework convention on Climate Change (UNFCC). This mechanism allows improvement of the emission performance to be reflected in carbon credits, which can then be sold.
- No need of flue gas desulphurization plant (FGD), SCR plant for NO_X reduction and particle collector devices. Neither additional consumables nor residue from facilities to reduce atmospheric emissions.
- Decrease of accidental risk by means of using ACS system controlling CCGT units' operation
- Very competitive energy prices in comparison with other technologies: moderate investment values, short period of execution and high efficiency
- Lower risks of fire and soil pollution
- No additional land occupation due to storage and disposal needs

521. In summary:

Table 68. Table Comparison of technologies

ASPECTS		COAL-FIRED CONVENTIONAL	OIL-FIRED CONVENTIONAL	COMBINED CYCLE
EMISSIONS	SO_2	xxx	xx	-
	NO_X	xxx	xx	x
	PARTICLES	xxx	xx	-
	CO_2	xxx	xxx	x
Operation of flue gas desulphurization plant (FGD)	To reduce SO_2	xxx	xxx	-
Operation of SCR plant for NO_X reduction and particle collector	To reduce NO_X	xxx	-	-

ASPECTS		COAL-FIRED CONVENTIONAL	OIL-FIRED CONVENTIONAL	COMBINED CYCLE
Operation of low NO_X burner	To reduce NO_X	xxx	xxx	x
Operation of particle collector devices.	To reduce particulate matter	xxx	-	-
Gypsum disposal & treatment	From desulfurization process	xxx	xx	-
Fly ash and fly bottom disposal	From combustion process	xxx	-	-
Coal yard	Coal storage	xxx	-	-
Risks of fire and soil pollution	Due to fuel storage	xxx	xxx	-
Cooling demand	Steam cycle	xxx	xxx	x
Land occupation	Plant &disposal facilities	xxx	xx	x
Energy demand	Plant Operation	xxx	xx	x
Fuel demand	Plant Operation	xxx	xx	x

522. On top of that, Takhiatash CCGT units will use NO_X burner systems to control NO_X emissions till standards. The basic principle is the staged injection of the fuel gas without affecting the boiler efficiency.

D.2.3. Cooling system

523. Cooling is required in order to maintain the operational state of the fluid carrying energy from the boilers to the turbines (steam). After having been used for driving the generator, the steam becomes "dead" steam, and needs to be transformed back into a high density fluid (liquid water) so that it may once more be able to transfer heat from the thermal boiler. For this purpose, there are several alternatives, being the most common the open circuit and the closed circuit cooling towers.

524. Although the water consumption of Combined Cycle technology is lower than a conventional power plant, the choice of adequate refrigeration system minimizes the water consumption.

a) Open circuit:

525. It uses water from the sea, from a river, from a lake or from a dam in a single pass (i.e. once) and then returns the water to the same source at a temperature higher than 10℃, but with the same characteristics and without lowering salinity.

526. This type of cooling requires large volumes of water; therefore it can only be used on sites close to the sea or to large dams. This ensures better diffusion of the thermal gradient.

527. The big advantage is that no water is consumed. The disadvantage is the increase of the temperature in the discharge which causes an impact on the fauna and flora of the receptor water body.

b) Closed circuit:

528. Closed-circuit requires rather smaller volumes of water. Steam first goes through a wet cooling tower in which it passes through a fine-mesh system which then transfers the heat to the atmosphere.

529. Part of the water is lost as steam. Another part condenses into water and flows into the tank located at the bottom of the tower, from where it is returned into the steam circuit.

530. The circuit is not completely closed, since part of the water is lost through evaporation into the atmosphere. It is necessary to resupply the circuit with additional fresh water from a water source (river, dam, sea etc). Moreover, the water flowing to the tank at the bottom of the cooling tower contains concentrated levels of salts resulting from evaporation; therefore some of it is purged back to the original water source to relieve the circuit and avoid salt accumulation

531. This type of cooling system requires continuous water supply to compensate for evaporation and purging.

532. Wet cooling towers fall into two main categories: natural draft and mechanical draft.

- **Natural draft towers** use very large concrete chimneys to introduce air through the media. Due to the large size of these towers, they are generally used for very large water flow rates.
- **Mechanical draft towers** use large fans to force or suck air through circulated water. The water falls downward over fill surfaces, which help increase the contact time between the water and the air, what helps to maximize the heat transfer between the two. Cooling rates of mechanical draft towers depend upon their fan diameter and speed of operation.

Findings

533. Closed circuit solution has been selected in order to avoid increasing the water intake from Suenly canal as well as not significantly increasing the temperature of the channel's water, issues that may occur with an open circuit cooling system.

534. Natural draft tower option has been discarded because of their huge shape, construction difficulties and cost, therefore the cooling alternative selected for the Takhiatash new CCGT units corresponds to the aforementioned closed circuit scheme using 5 wet mechanical draft towers per each CCGT unit. This system consists of passing cold water through the condenser tubes. The steam going out of the steam turbine flows around these tubes and condenses by transferring its heat to the water flowing through the pipes. Circulating water is returned to the towers with an increase in temperature of approximately 8 °C, from which, once cooled, it is collected in the tanks

at the bottom and pumped back into the circuit. Figure 26 shows a diagram explaining the operation of a mechanical draft cooling tower.

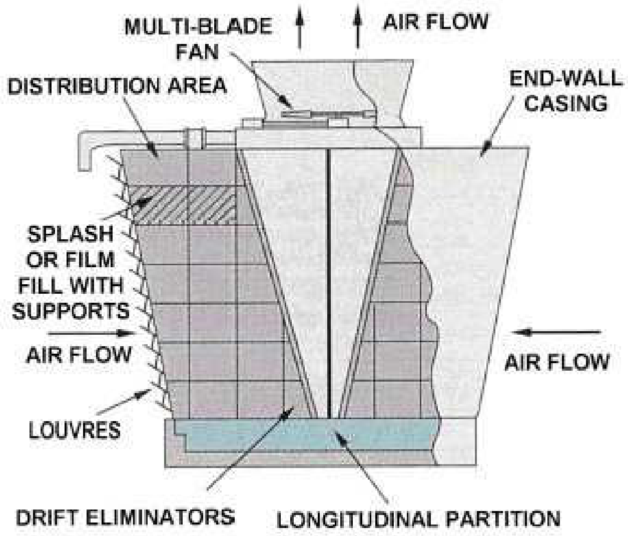


Figure 26. Mechanical draft cooling tower

535. The impacts of the cooling system are discussed in the relevant sections of this Environmental Impact Assessment.

CONCLUSION:

536. As described in the Project Description chapter, alternatives chosen for the project are the best option on location and technology, both combustion and cooling system. As locate the project in an existing industrial area with part of the existing facilities to be used for the new CCGT units (transmission line, water intake and discharge canals and gas supply) the environmental potential impacts are going to be minimized. By other hand, combined cycle technology based on natural gas and refrigerated with a closed cooling water systems gather the most environmental friendly power generation among those fuel combustion technologies. This technology achieves the highest rate of power generation with the lowest rate of air emission pollutants. The closed refrigeration system has the advantage to decrease the amount of water intake and discharge reducing the temperature increase of the effluent compared to those open system

E. ENVIRONMENTAL BASELINE

537. The Environmental Baseline provides a general overview of the existing environmental and social conditions prevailing in the Study Area. In particular, this study sheds the light on key environmental sensitivities that may influence the project plans. It also serves as an environmental management tool that enables the identification and assessment of the impacts resulting from the proposed project.

538. The data presented in the environmental baseline study was mainly collected through two inter-dependant means: (i) a desk study of existing data records, review of previous studies and publications on the area, and (ii) Field survey of the Study Area consisting of a site visit and visual documentation.

539. Regarding existing data records, monitoring information gathered by the TPP environmental team has been analyzed: water, groundwater and soil quality analysis. As this primary information was considered not to be sufficient it has been completed with site surveys (noise campaign, water quality analysis including World Bank parameters regarding effluent standards, soil analysis of the new area where the future CCGT units are going to be located).

540. Nevertheless, time period coverage of the primary data was not enough in some cases as the ideal data collection period exceeded the environmental assessment period. Therefore, data collection is advised to continue in the EMP for some of the environmental factors in order to provide a more complete baseline previously to the commissioning of the project.

E.1. Physical environment

541. Takhiatash TPP is located in Takhiatash city, in Khodjeyliy region of the Republic of Karakalpakstan (3 km to the South-West of the city centre). The surface area is relatively flat with no significant deviation in either direction and is characterized by an altitude of 76.30-76.70 m.

E.1.3. Climate and meteorology

542. In terms of climatic conditions, the area belongs to the Central Asia zone of deserts and semi-deserts with sharp continental climate meaning hot, dry summer and cold, wet winter period. The average air temperature according to the observations of the meteorological stations located on the territory of the republic is +13.7ºC and the average for the growing season is +22.6ºC. The absolute maximum temperature registered is +36ºC. In winter, there are temperatures as low as -16.0ºC, but they are short in duration not exceeding a period of 30 days.

543. In long-term data, precipitation is in the amount of 80-100 mm per year and in terms of timing, it falls in the autumn-winter period. The average humidity in the Republic of Karakalpakstan is 56%. Winds blow constantly throughout the year mainly from the northeast at a speed of 10.5 m/s, at times – 7.12m/s, and in the spring and summer months turn into dust whirls.

544. The area of the left bank of the Amudarya river is under large amplitude fluctuations of the air temperature (daily and annual) at pronounced contrasts of precipitation periods:

- The maximum precipitation rate falls on winter and spring;
- Rapid increase of the temperature during the spring to summer transition period create unique thermal conditions and provide important for biota phases of wet and warm spring and hot and dry summer.

545. According to a number of environmental features, Takhiatash is located in the zone of relatively favorable environmental conditions in relation to the areas of irrigated lands of Khorezm region.

546. Analysis of climate conditions of the Takhiatash TPP region was conducted on the base of meteorological station data (Figure 29 and Figure 30).

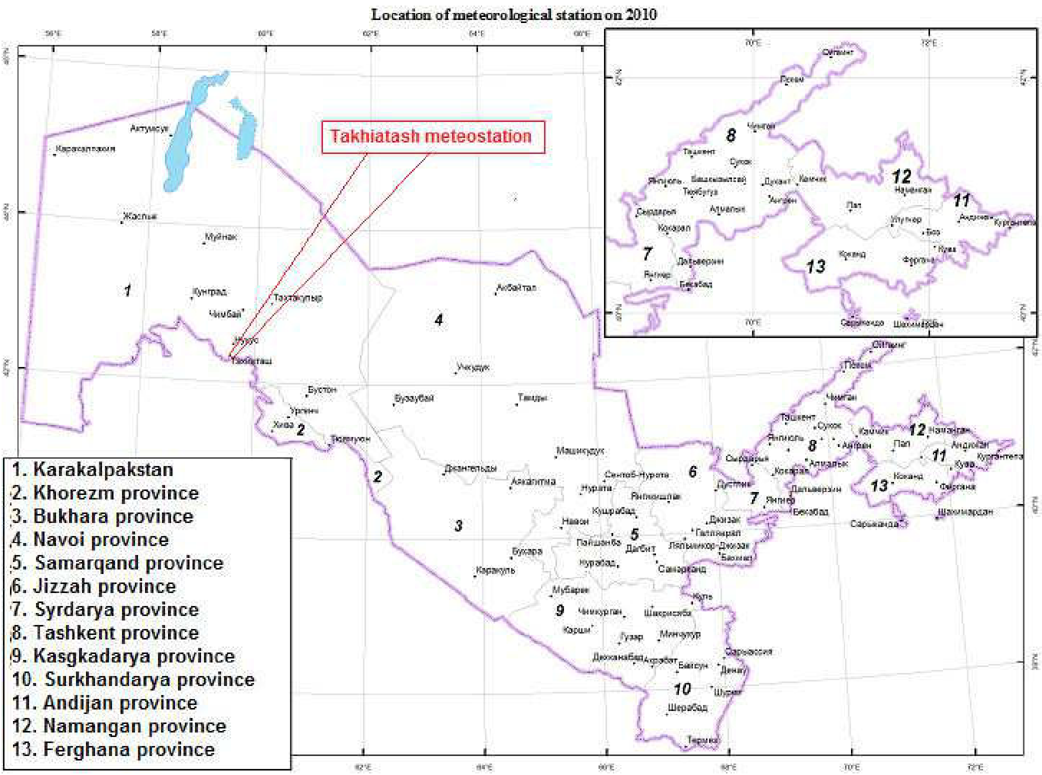


Figure 27. Location of meteo-station

547. In the following table climate conditions related to temperature, precipitation and wind are shown:

Table 69. Climate characteristics, m/s Takhiatash

Characteristic	Measurement units	Value
A coefficient, depending on the atmosphere thermal stratification and defining conditions of horizontal and vertical dispersion of air contaminants	-	200
Average annual air temperature	°C	13.64
Maximal temperature	°C	45.00
Minimal temperature	°C	-26.80
Average minimal air temperature	°C	-8.59
Average maximal air temperature	°C	35.75
Average air temperature in January	°C	-3.42
Average air temperature in July	°C	28.54
Maximal ground surface temperature	°C	62.00
Minimal ground surface temperature	°C	-30.00
Average ground surface temperature	°C	15.83
Average annual precipitation	mm	110.60
Annual frequency of wind direction for 16 rhumbs		
N	%	16.64
NNE	%	5.69
NE	%	18.68
ENE	%	2.68
E	%	12.58
ESE	%	5.31
SE	%	17.87
SSE	%	0.68
S	%	3.53
SSW	%	0.95
SW	%	6.57
WSW	%	1.50
W	%	7.14
WNW	%	1.69
NW	%	11.13
NNW	%	2.98
Calm	%	15.06
Number of cases with relate to gradations		
0-1	m/s	38.28
2-3	m/s	44.29
4-5	m/s	12.78
6-7	m/s	1.77
8-9	m/s	0.83
10-11	m/s	1.83
12-15	m/s	0.63
15	m/s	0.10
The highest speed of the wind, exceeding of which is 5%, U*	m/s	5.45

548. Climate in the Takhiatash TPP region – sharp continental is characterized by wide annual and daily temperature fluctuation range. Annual air temperature is 13.64 ºC. Maximal temperature 45.00 ºC, minimal -26.80 ºC.

549. Annual precipitation level is 110.60 mm. Small amount of precipitation and high temperature causes heating of the ground, which conditions the dryness of underlying terrain. Maximal ground temperature is up to +62 ºC, minimal values are down to –30.0 ºC.

550. Winds of north-east (18.68 %), north (16.64 %) and east (12.58 %) directions prevail in Takhiatash city. Annual wind speed is 2.26 m/s, maximal wind speed is 25.0 m/s. Most often, winds with speed of 2-3 m/s (44.29 %) and 0-1 m/s (38.28 %) are indicated. From February to May strengthening of winds is indicated.

551. Winds with the speed of 12-15 m/s are indicated in 0.63 % of cases. On rare occasions (in 0.10 % of cases) the speed of winds reaches 15 m/s and higher, because of the proximity of desert and dryness of underlying terrain is accompanied by significant dust transfer.

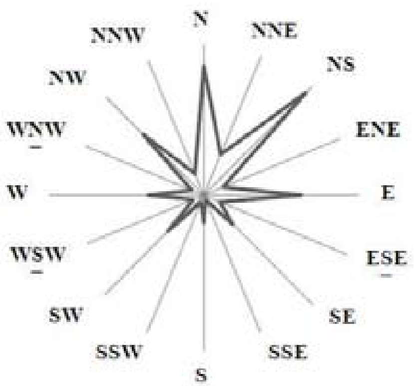


Figure 28. Takhiatash city wind rose.

552. Thus, high air and ground temperature in summer time, small amount of precipitation lead to the increase of natural dust level of the region. High frequency of winds with the speed of 2-3 m/s and higher facilitates distribution to the long distances of contaminants coming from high, hot sources of emission and dissemination of low unorganized discharges.

E.1.2. Air quality

553. 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.

554. 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.

555. City boiler-houses, which mainly operate on the base of the fuel oil emit into the air the oxides of nitrogen, sulphur, carbon, benzopyrene, 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.

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

557. 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 80 t/km^2 of dry fallouts precipitate in Takhiatash city region.

558. 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.

559. 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%

560. 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.

561. 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 Nukus and Kizketken settlement area was analyzed:

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

Figure 29. Location of the air quality monitoring stations.

Table 70. 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, SO_2, NO_2, NO, Phenol
# 7	42°23'24.74"N 59°38'29.88"E	Dust, SO_2, NO_2, CO Phenol

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

Table 71. 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

563. Maximal one-time and average concentrations of dust, SO_2, NO_X, CO during 2011-2012 are presented in the tables underneath

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

- NO_2:

Table 72. World Bank values recorded for NO_2 ($\mu g/m^3$)

VALUES RECORDED FOR NO_2 ($\mu g/m^3$). 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 73. National Standards for Air Pollutants values recorded for NO_2 ($\mu g/m^3$)

VALUES RECORDED FOR NO_2 ($\mu g/m^3$). NATIONAL STANDARDS FOR AIR POLLUTANTS				
Measuring points	Year	Annual mean value (Limit value: 40 $\mu g/m^3$)	Monthly value (Limit value: 50 $\mu g/m^3$)	Daily value (Limit value: 60 $\mu g/m^3$)
# 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

565. As can be observed in the above tables neither national nor international NO_2 standards are exceeded

- NO:

Table 74. National Standards for Air Pollutants values recorded for NO ($\mu g/m^3$)

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

566. No national or international standards are exceeded for NO.

- CO:

Table 75. National Standards for Air Pollutants values recorded for CO ($\mu g/m^3$)

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

567. As for NO_2 and NO, no national or international standards are exceeded for CO.

Table 76. Average and maximum concentration (mg/m^3), Nukus (#5) and Takhiatash (#7) in 2012

Pollutant	№ check points	Months																							
		01		02		03		04		05		06		07		08		09		10		11		12	
		Average	Max	Average	Max	Average	Max	Average	Max	Average	Max	Average	Max	Average	Max	Average	Max	Average	Max	Average	Max	Average	Max	Average	Max
Dust	№5	**0,2**	0,4	**0,3**	0,5	**0,4**	**0,6**	**0,5**	**0,8**	**0,5**	**0,8**	**0,5**	**1,4**	**0,5**	**0,7**	**0,3**	**0,7**	**0,3**	**0,7**	**0,3**	**0,9**	**0,3**	**0,6**	**0,3**	**0,6**
	№7	**0,2**	**0,7**	**0,4**	**0,8**	**0,4**	**0,6**	**0,5**	**0,8**	**0,5**	**0,7**	**0,5**	**1,6**	**0,5**	**0,8**	**0,3**	**0,6**	**0,3**	**0,6**	**0,3**	0,5	**0,3**	**0,7**	**0,2**	0,4
SO_2	№5	0,012	0,017	0,012	0,017	0,013	0,018	0,013	0,019	0,014	0,019	0,013	0,018	0,014	0,019	0,013	0,018	0,013	0,018	0,010	0,019	0,005	0,002	0,004	0,012
	№7	0,012	0,017	0,012	0,017	0,012	0,017	0,013	0,018	0,014	0,019	0,013	0,018	0,014	0,019	0,013	0,019	0,013	0,020	0,010	0,022	0,004	0,013	0,005	0,011
CO	№7	2	4	2	4	2	4	2	4	2	4	2	4	2	4	2	4	2	4	2	4	3	4	2	4
NO_2	№5	0,03	0,04	0,03	0,03	0,03	0,04	0,03	0,04	0,03	0,04	0,03	0,04	0,03	0,04	0,03	0,04	0,03	0,04	0,02	0,04	0,01	0,03	0,02	0,03
	№7	0,02	0,04	0,03	0,04	0,03	0,04	0,03	0,04	0,03	0,04	0,03	0,04	0,03	0,04	0,03	0,04	0,03	0,04	0,02	0,05	0,01	0,03	0,02	0,03
NO	№5	0,01	0,02	0,01	0,02	0,01	0,02	0,01	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,02	0,01	0,02	0,01	0,02	0,01	0,01	0,01	0,02
Phenol	№5	0,002	0,004	0,002	0,004	0,002	0,004	0,002	0,005	0,003	0,005	0,002	0,005	0,003	0,005	0,002	0,005	0,002	0,004	0,002	0,005	0,001	0,004	0,001	0,004
	№7	0,002	0,004	0,002	0,005	0,002	0,004	0,002	0,005	0,003	0,005	0,002	0,004	0,003	0,005	0,002	0,005	0,002	0,004	0,002	0,005	0,001	0,004	0,001	0,004

Pollutant	№ check points	Month																							
		01		02		03		04		05		06		07		08		09		10		11		12	
		Average	Max	Average	Max	Average	Max	Average	Max	Average	Max	Average	Max	Average	Max	Average	Max	Average	Max	Average	Max	Average	Max	Average	Max
Dust	№5	**0,3**	**0,9**	**0,4**	**1,0**	**0,3**	**0,6**	**0,4**	**0,7**	**0,4**	**1,1**	**0,4**	**0,7**	**0,3**	**0,6**	**0,3**	**0,6**	**0,4**	**0,8**	**0,4**	**0,6**	**0,4**	**0,8**	**0,3**	**0,9**
	№7	**0,2**	**0,8**	**0,4**	**0,9**	**0,3**	**0,6**	**0,4**	**0,8**	**0,3**	**0,8**	**0,3**	**0,6**	**0,3**	**0,6**	**0,2**	**0,6**	**0,4**	**0,8**	**0,4**	0,8	**0,4**	**1,0**	**0,4**	0,8
SO_2	№5	0,006	0,012	0,008	0,015	0,010	0,017	0,010	0,017	0,011	0,017	0,011	0,020	0,010	0,018	0,010	0,019	0,009	0,017	0,009	0,017	0,008	0,017	0,009	0,015
	№7	0,006	0,013	0,007	0,016	0,010	0,017	0,010	0,017	0,012	0,019	0,012	0,019	0,010	0,022	0,010	0,019	0,010	0,017	0,010	0,017	0,009	0,017	0,009	0,017
CO	№7	3	4	2	4	2	4	2	4	2	4	2	4	2	4	2	4	2	4	2	4	2	4	2	4
NO_2	№5	0,01	0,03	0,02	0,03	0,02	0,03	0,02	0,04	0,02	0,04	0,02	0,04	0,02	0,04	0,02	0,04	0,02	0,04	0,02	0,05	0,02	0,03	0,02	0,03
	№7	0,01	0,03	0,02	0,03	0,02	0,04	0,02	0,04	0,02	0,04	0,02	0,04	0,01	0,02	0,02	0,04	0,02	0,04	0,02	0,04	0,02	0,04	0,02	0,04
NO	№5	0,01	0,01	0,01	0,02	0,01	0,02	0,01	0,02	0,01	0,02	0,01	0,02	0,02	0,04	0,01	0,02	0,01	0,02	0,01	0,03	0,01	0,02	0,01	0,02
Phenol	№5	0,002	0,003	0,001	0,004	0,001	0,004	0,002	0,004	0,002	0,004	0,002	0,004	0,002	0,005	0,002	0,005	0,002	0,005	0,002	0,006	0,002	0,005	0,001	0,006
	№7	0,002	0,003	0,001	0,003	0,001	0,004	0,002	0,005	0,001	0,004	0,002	0,004	0,002	0,005	0,001	0,004	0,002	0,005	0,002	0,005	0,001	0,005	0,001	0,004

E.1.3. Noise

568. 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.

569. 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).

570. These measuring points are included in the image below.

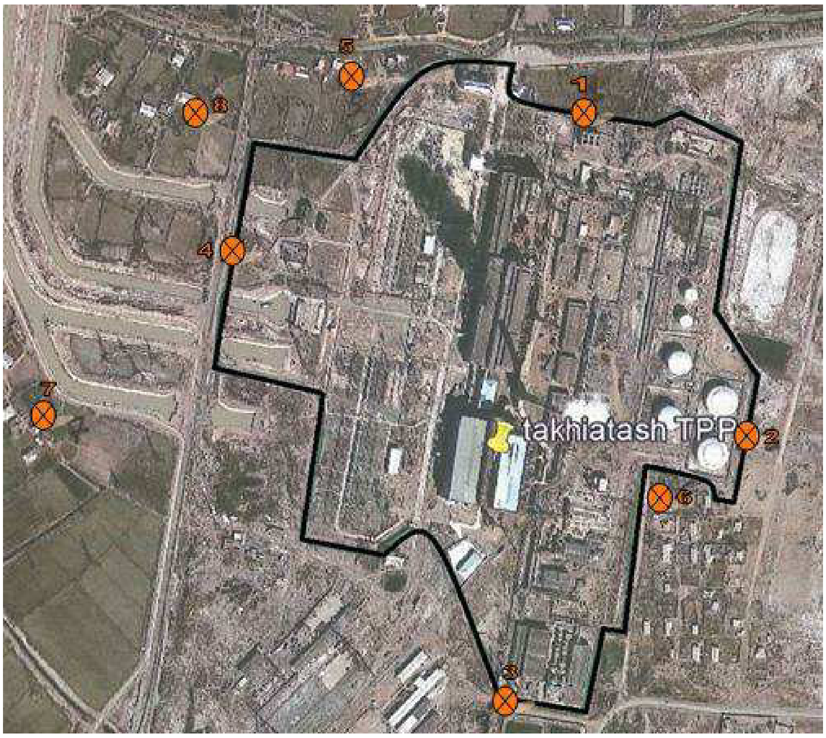


Figure 30. Location of monitoring points for noise measurements

571. For sound level measuring a noise meter -003-M2_No 2431 was used, tested on 9th September 2012 with number of certificate 786/05.

572. Regarding applicable legislation, it has been considered international and national requirements. The will be applicable depending on the existence of national legislation as well as the location of the different measuring points.

573. 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 (see chapter 3).

574. 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 77 . 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		

575. As noticeable in the table above, noise levels measures go over 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.

576. 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.

577. Apart from the points mentioned, measurements carried out in all the other points show that the background noise levels comply with what requirements of the standards.

E.1.4. Geology

578. The territory of the Republic of Karakalpakstan is a plain with shallow closed depressions, crossed by many dry ancient creeks and riverbeds as well as abandoned and existing irrigation canals. The relief is relatively smooth with a general slope of 0.0001 to the north and northwest.

579. The low Sultan-Uizdag mountain range is located in the southern part of the Republic in the Amudarya district and the small Kuskanatau and Beltau hills are located in the northern part in the Kegeyli and Takhtakupyr regions.

580. Kyzylkum desert areas are covered with ridged and hilly quicksand. The Amudarya River flows across the country from north to south for more than 500km and divides the territory into two regions – the Right Bank and the Left Bank region

581. The geological structure of the Amudarya Delta on the territory of Karakalpakstan is composed of many kinds and types of sediments of the Cretaceous Tertiary and Quaternary periods. Cretaceous sediments occur on the right bank of the Amudarya River.

582. Tertiary sediments are noticeable in the Tuya-Muyun, Kyzylkum, Ustyurt and other areas in the form of red and red-yellow clay sediments.

583. Quaternary sediments are widely spread throughout the territory of the present and emerging Amudarya Delta and are composed of sand, sandy loam and clay loam brought by the water. These sediments have a relatively good permeability, loose structure and are unstable to erosion processes. The quaternary sediments are subject to reclamation and groundwater and its regime are formed there.

584. The complexity of the geological structure of the Amudarya River delta and the availability and aquicultural use of irrigated land determine the characteristics of its geological conditions and the formation of the groundwater regime.

585. The alluvial plains of the delta composed of sand, sandy loam, loam, clay layers and other solid sediments in the form of separate strata, lenses and mounds obstruct the movement of groundwater from the outside and restrain the outflow of seepage and surface water.

586. The territory of Takhiatash TPP is confined to the left bank of the Amu Darya delta plain. It is composed of quaternary sediments, which are sandy loam, clay loam, clay and sand.

587. Lithologic description of rocks:

- Made ground – light brown, stiff, macroporous clay loam (depth of 1,2m).
- Grayish brown, stiff clay loam with sandy layers (depth of 3,6m).
- Dark grayish brown, plastic sandy loam (depth of 5m).
- Dark grayish brown, stiff clay loam with sandy layers (depth of 7,8m).
- Dark gray, fine, watered sand (depth of 8,7m).
- Dark grayish brown plastic sandy loam with clay layers (depth of 10,0m).

588. Non-collapsible soil. According to the results of laboratory data and hydrochloric acid extracts the sands are considered saline, as the freely and medium soluble salt content is over 0,5%. Sandy loam, clay loam and clay are non-saline. Content of freely and medium soluble salts is less 5%. Seismicity of the area is 7 points; the estimated seismicity is 8 points.

E.1.5. Soil

589. The study area is characterized by meadow oasis soils of the desert zone. Desert climate and irrigation moisture regimes impact on salinization susceptibility of the soil. Irrigated agriculture significantly changed the soil. It completely lost the gray soil profile structure.

590. Soil is affected by salinization and continues to undergo the precipitation of salts from the Aral sea. As a result, the chloride-sulfate type of salinity was formed on the area. The reaction of soil solution is slightly alkaline: soil and ground have 8-9 pH.

591. Urban environment where an agricultural use of lands is limited causes an increased soil salinity, as there is almost no system of seasonal irrigation of soil cover. It causes to the increased content of alkaline chlorides, sulfates, carbonates, etc in the soil.

592. Local pollution processes are caused by the peculiarities of urban agglomeration. Generally, the soil is affected by salinity, as well as by weak (1-1.5 MAC), but occurring contamination by heavy metals (chromium, molybdenum). To the north of the city along the flow of groundwater the water is polluted (lower MAC) by listed toxic elements, as well as the soil has an increased salinity.

593. Soil texture is an important indicator of physical properties. Their composition is characterized by mineral particles of different size in destroyed aggregate complexes of minerals. The particles have different mineral composition: large particles mostly consist of quartz, silt particles consist of fine-grained quartz and feldspar, fine-dispersed particles consist of authigenic and terrigenous clay minerals. Mineral particles' spreading has stratified structure and is characterized by frequent vertical and lateral changes of different texture layers. It reflected on the soil cover of the area, extending to the power within 1m. No regularities in lithological horizon changes in soils were observed.

594. Horizontal distribution of the top 30sm (arable) horizon clearly shows the reduction of the lithological composition. It is related with the impact of channel and riverine sediments of the Amu Darya river as well as with the eolian transport of desert sand.

595. Humus content is important for the soil. Its concentration impacts on buffer and absorptive capacity of toxic components. For the region, the soil has low the humus content in the topsoil (less than 0.9%). The humus content decreases by several grades in the following underlying layer. Therefore, in general, the screen buffer role of soils for man-made penetration of toxic elements from the surface to the groundwater and accumulation on the surface is low. The scattering and removal of elements dominates.

596. Clear connection of toxic agent halos 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 the mild chromium, molybdenum, arsenic and selenium contamination. 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 increases in the region. It is typical for the metallogeny of the territory.

597. Pollution halos are more extensive on irrigated lands to the north of Takhiatash. This contamination process is related with the use of fertilizers, herbicides, etc.

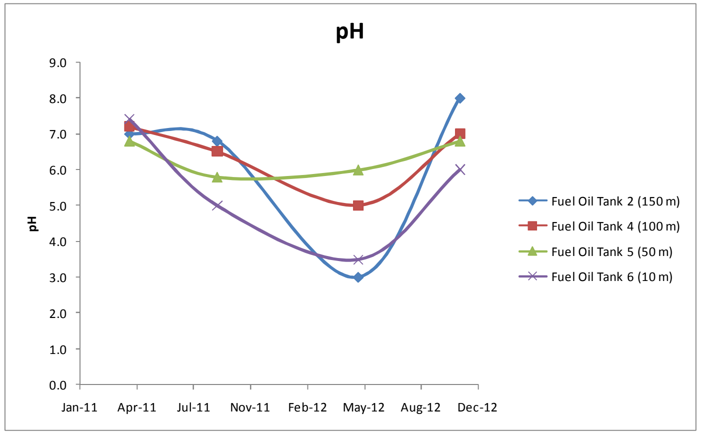
598. Prosperous situation in ground and surface toxic contamination in Takhiatash town is caused by poor infrastructure development of industrial facilities. The city has only a few local industries. Moreover, salinity and plastering have great impact on soil contamination.

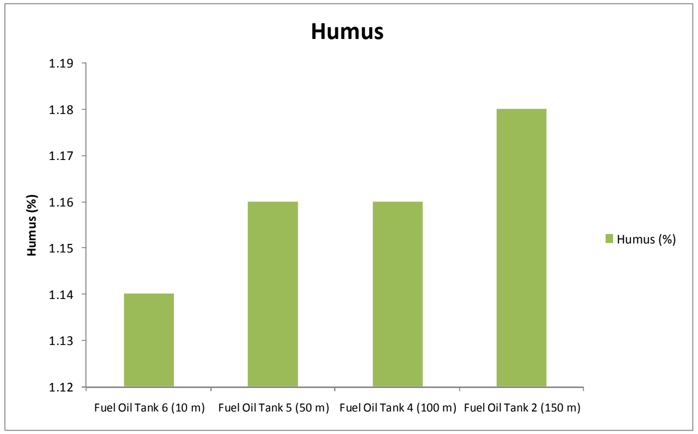
599. As for the whole zone of deserts with irrigated lands in terms of hydromorphic regime, they have a high carbonate content (5-10% CO_2) with a quite significant distribution from the surface to depth. Ca dominates in the composition of carbonates, exceeding Mg content 7-10 times.

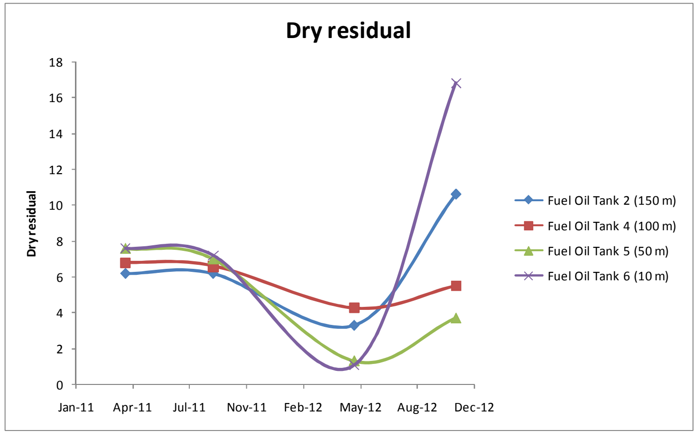
600. The soil is everywhere plastered; the gypsum content of about 1% and increases to the upper horizons of the soil. Soil salinity and plastering process in the city increases due to the limited technology of regular seasonal flushing typical for irrigated land.

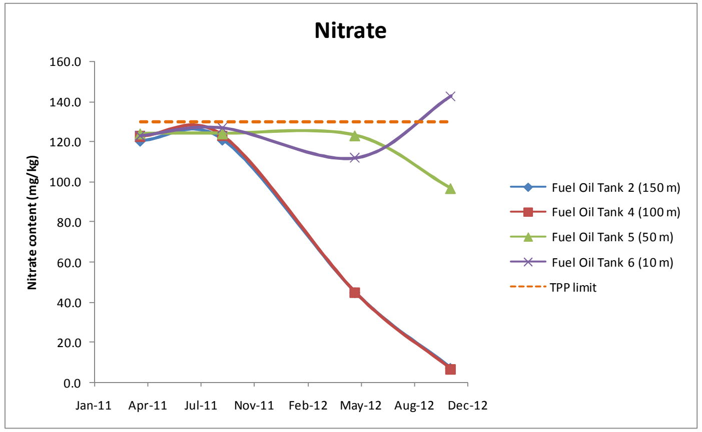
601. Low discharge of groundwater (500-1500 m^3/ha) and arid climate leads to the salt accumulation. The evaporation is 10-12 times greater than rainfall rate (the evaporation rate is 2000-2500 mm/year). Salt, brought by ground water, accumulates in the soil horizon. In Takhiatash, which has the high groundwater level (1-2 m or less from the surface), the capillary rise of water to the surface and evaporative concentration of salts is very high.

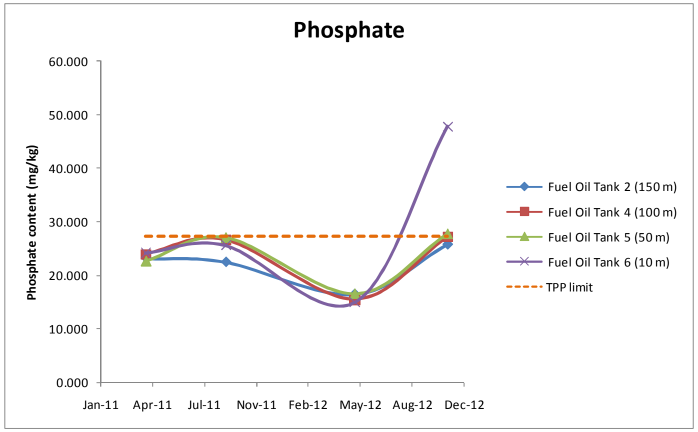
602. At the Takhiatash TPP site, samples from four different points were analyzed in a twice-a-year basis. These points are located in the vicinities of the fuel tanks, at 10, 50, 100 and 150 m of distance from the tanks. The sampling depth ranges from 0 to 30 m. The analyzed parameters were the content of humus, the pH, dry residual and the content of nitrates, phosphates, oil products and three metals: copper, zinc and manganese. In the following charts, measurements of years 2011 and 2012 can be observed.


pH
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
pH
Jan-11
Apr-11
Jul-11
Nov-11
Feb-12
May-12
Aug-12
Dec-12
Fuel Oil Tank 2 (150 m)
Fuel Oil Tank 4 (100 m)
Fuel Oil Tank 5 (50 m)
Fuel Oil Tank 6 (10 m)

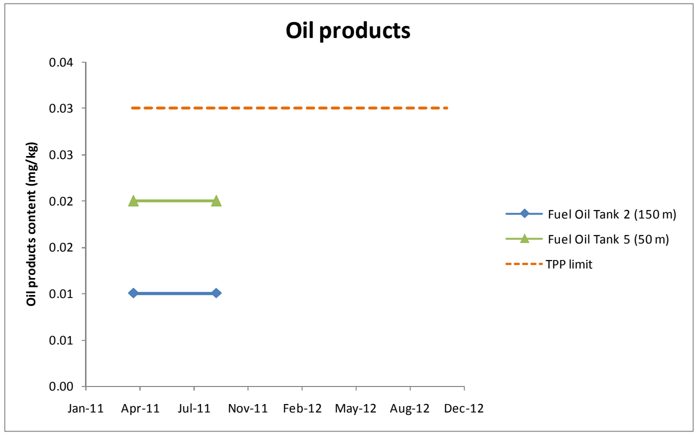

Humus
1.19
1.18
1.17
1.16
1.15
1.14
1.13
1.12
Humus (%)
Fuel Oil Tank 6 (10 m)
Fuel Oil Tank 5 (50 m)
Fuel Oil Tank 4 (100 m)
Fuel Oil Tank 2 (150 m)
Humus (%)


Dry residual
18
16
14
12
10
8
6
4
2
0
Dry residual
Jan-11
Apr-11
Jul-11
Nov-11
Feb-12
May-12
Aug-12
Dec-12
Fuel Oil Tank 2 (150 m)
Fuel Oil Tank 4 (100 m)
Fuel Oil Tank 5 (50 m)
Fuel Oil Tank 6 (10 m)

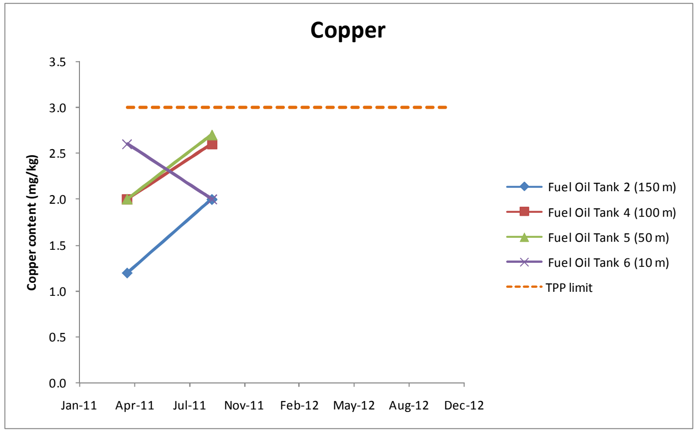

Nitrate
160.0
140.0
120.0
100.0
80.0
60.0
40.0
20.0
0.0
Nitrate content (mg/kg)
Jan-11
Apr-11
Jul-11
Nov-11
Feb-12
May-12
Aug-12
Dec-12
Fuel Oil Tank 2 (150 m)
Fuel Oil Tank 4 (100 m)
Fuel Oil Tank 5 (50 m)
Fuel Oil Tank 6 (10 m)
TPP limit



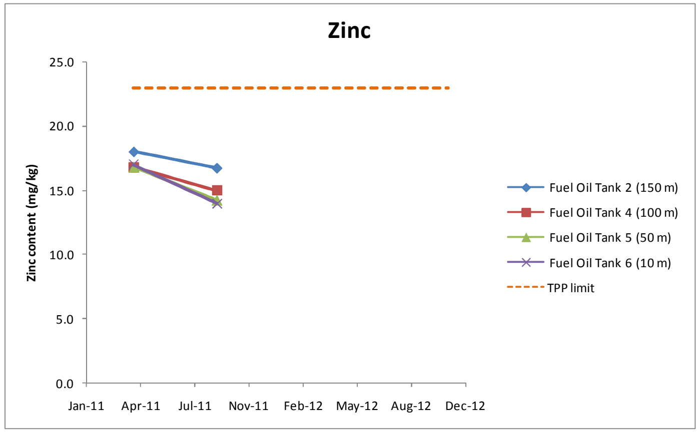
Phosphate
Phosphate content (mg/kg)
60.000
50.000
40.000
30.000
20.000
10.000
0.000
Jan-11
Apr-11
Jul-11
Nov-11
Feb-12
May-12
Aug-12
Dec-12
Fuel Oil Tank 2 (150 m)
Fuel Oil Tank 4 (100 m)
Fuel Oil Tank 5 (50 m)
Fuel Oil Tank 6 (10 m)
TPP limit



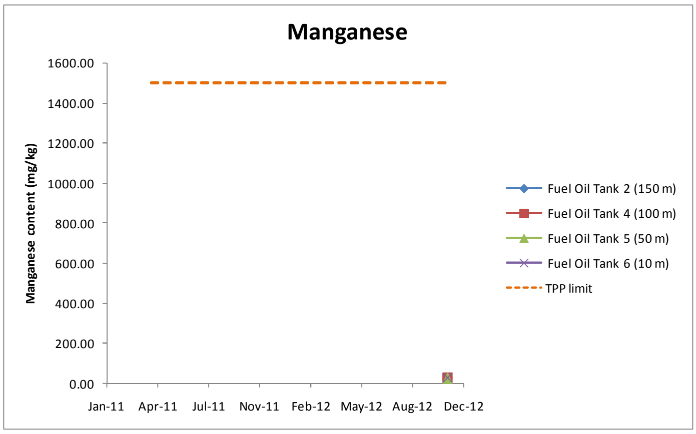
Oil products
Oil products content (mg/kg)
0.04
0.03
0.03
0.02
0.02
0.01
0.01
0.00
Jan-11
Apr-11
Jul-11
Nov-11
Feb-12
May-12
Aug-12
Dec-12
Fuel Oil Tank 2 (150 m)
Fuel Oil Tank 5 (50 m)
TPP limit



Copper
Copper content (mg/kg)
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Jan-11
Apr-11
Jul-11
Nov-11
Feb-12
May-12
Aug-12
Dec-12
Fuel Oil Tank 2 (150 m)
Fuel Oil Tank 4 (100 m)
Fuel Oil Tank 5 (50 m)
Fuel Oil Tank 6 (10 m)
TPP limit



Zinc
Zinc content (mg/kg)
25.0
20.0
15.0
10.0
5.0
0.0
Jan-11
Apr-11
Jul-11
Nov-11
Feb-12
May-12
Aug-12
Dec-12
Fuel Oil Tank 2 (150 m)
Fuel Oil Tank 4 (100 m)
Fuel Oil Tank 5 (50 m)
Fuel Oil Tank 6 (10 m)
TPP limit



603. **Humus.** Humus content is important for the soil because its concentration impacts on buffer and absorptive capacity of toxic components. For the region, the soil has humus content between 1.14 and 1.18%. The humus content decreases by several grades in the following underlying layer. Therefore, in general, the screen buffer role of soils for man-made penetration of toxic elements from the surface to the groundwater and accumulation on the surface is low. The scattering and removal of elements dominates.

604. **pH.** The analyses determined that the soil in the surroundings of the fuel tanks has a neutral or slightly acid pH. Measurements performed in May 2012 show a more acid pH.

605. **Dry residual.** The dry residual was also measured. Its values widely vary from 1.10 to 16.80.

606. **Nitrates and phosphates.** The content of phosphates does not vary significantly and is very close to the TPP's limits (27.2 mg/kg). The content of nitrates shows a wide variation and is also below the TPP's MAC (130 mg/kg). As noted in the above figures, nitrates and phosphates levels in soil samples are high near fuel oil tank 6. Nitrates and phosphates high levels are due to agricultural activities and are not related with industrial activities as the TPP operation. Nitrates and phosphates are added as fertilizers but the risk of pollution came from the runoff of the excess amounts which in streams and other surface waters can accelerate aquatic plant growth causing rapid oxygen depletion or eutrophication in the water.

607. **Oil products.** Oil products appear in soil samples in a concentration between 0.01 and 0.02 mg/kg, which is below the TPP's limit (0.03 mg/kg) and, logically, it decreases with the distance to the fuel tanks.

608. **Metals.** The copper, zinc and manganese content in the soil samples have been measured. 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 TPP's MACs are not exceeded.

609. In addition to these analyses, a comprehensive soil study has been carried out in order to confirm or rule out potential soil contamination with hazardous substances or petroleum products within the area of the future CCGT. On 2nd March 2013, 13 samples were taken in different places situated within Takhiatash TPP plot. Points 1 to 9 are located in the new area for the CCGT units and points 10 to 13 in the existing evaporation ponds. They are marked in the image below.

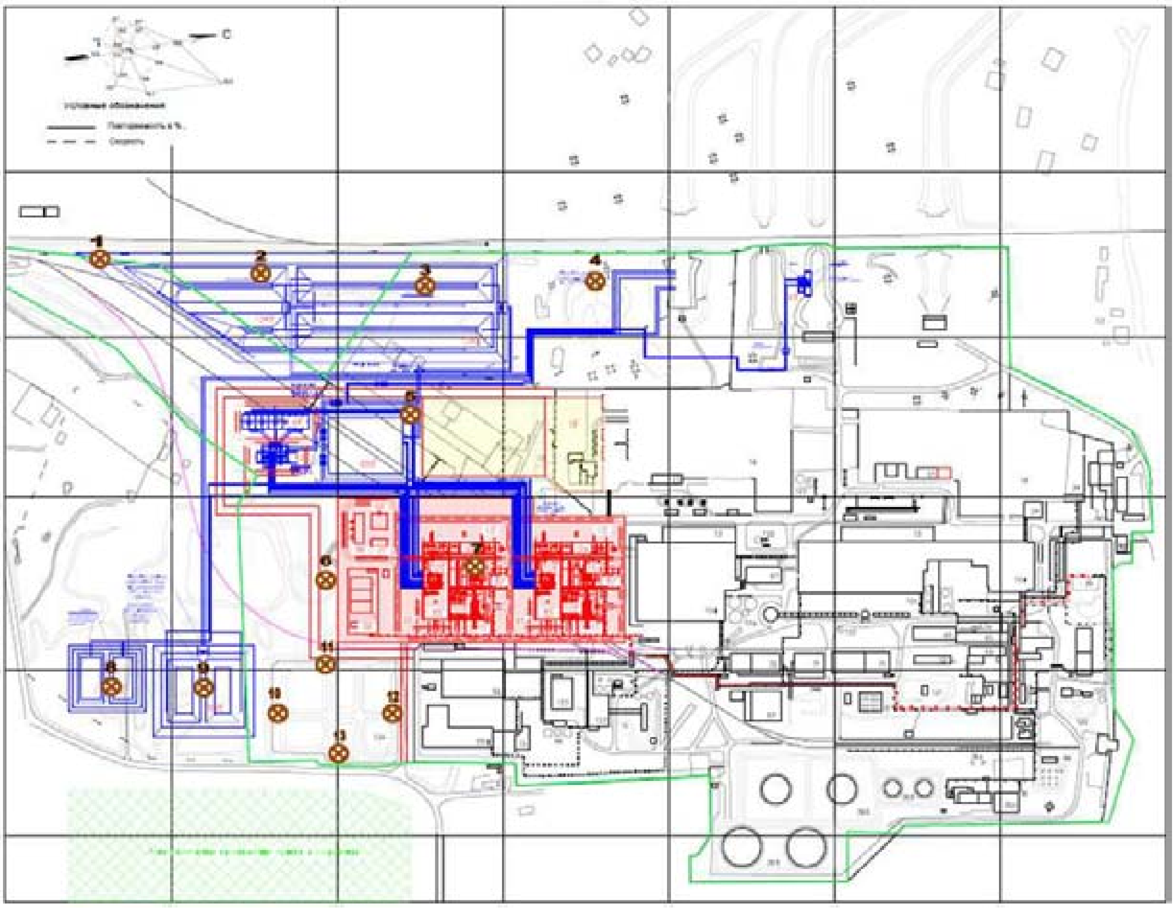


Figure 31. Sampling site within Takhiatash TPP plot

610. All soil samples have been analyzed within the stipulated holding time limits for the following parameters:

- Organochlorine Pesticides: α-HCH, Ƴ-HCH, DDE, DD, DDT.
- Heavy Metals: lead, mercury, cadmium copper, zinc, cobalt, nickel, arsenic.
- Dry residue, moisture, phenol, humus, pH and oil products.

611. The results obtained by a specialised laboratory have been compared to the following Uzbek and international standards:

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

- 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».

612. MACs (Maximum Allowable Concentration), 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.

613. 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.

614. Therefore, the concentrations of contaminants in the 13 soil samples have been also compared against their respective maximum values for industrial soil quality class, established in the Soil Quality Regulation[4] (SQR) 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.

615. In Annex V, it can be found all the information related to soil sampling and analysis results and their interpretation and conclusions. In order to draw conclusions, the results of the analyses carried out are shown in the following graphs.

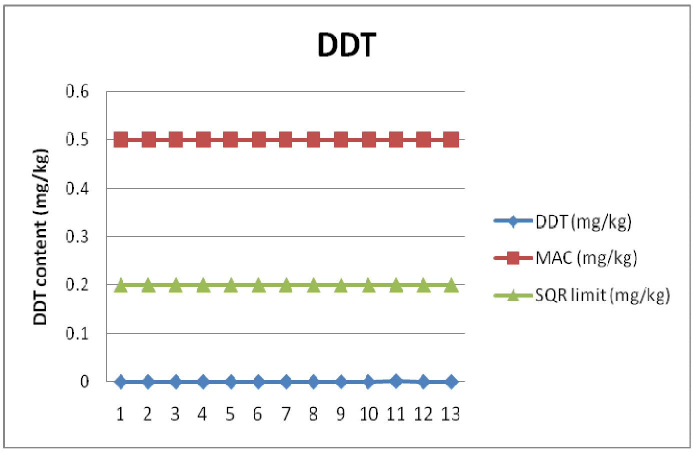


Figure 32. Results of Organochlorades Pesticides content in soil samples

[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).

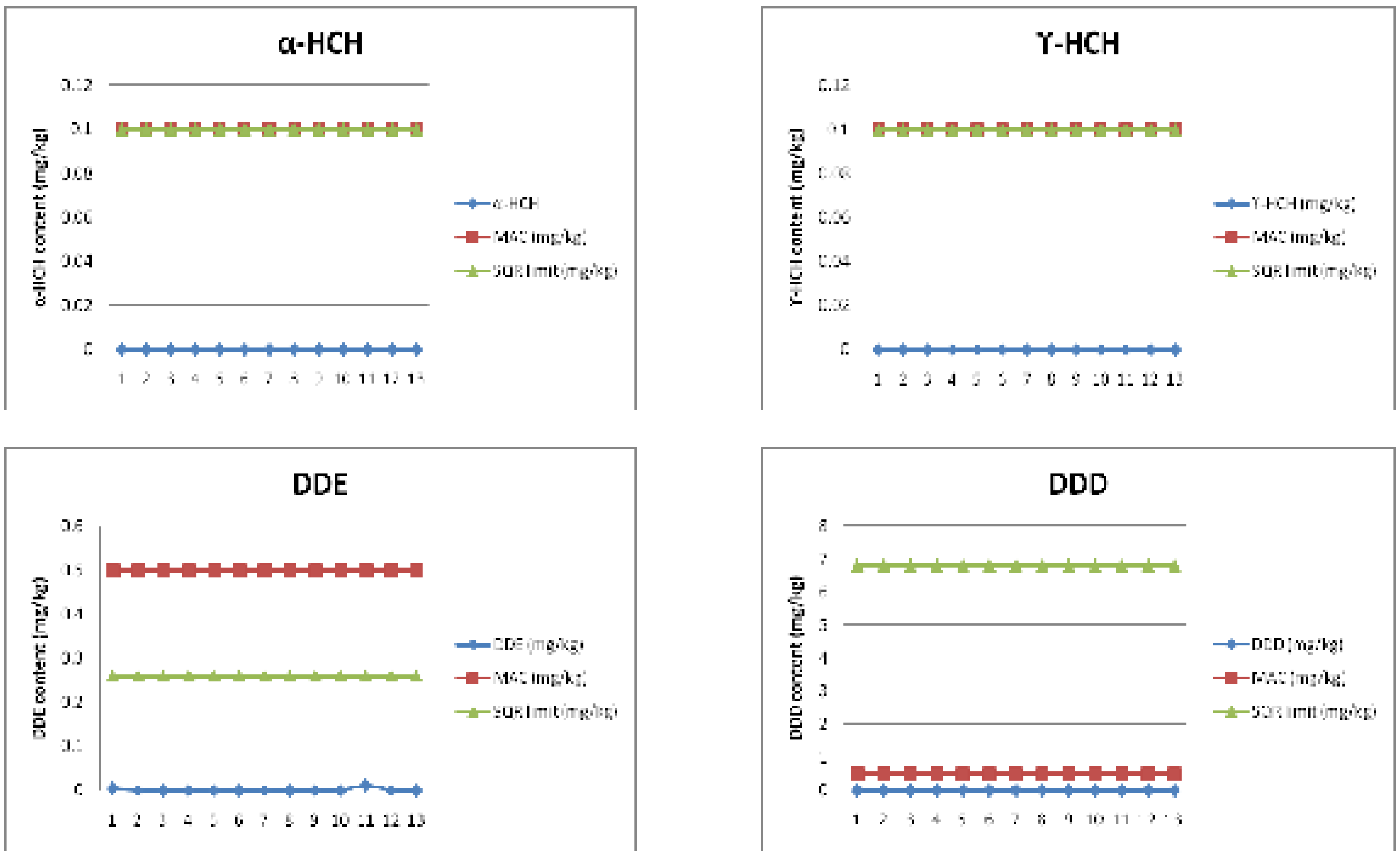


Figure 33. Results of Organochlorades Pesticides content in soil samples

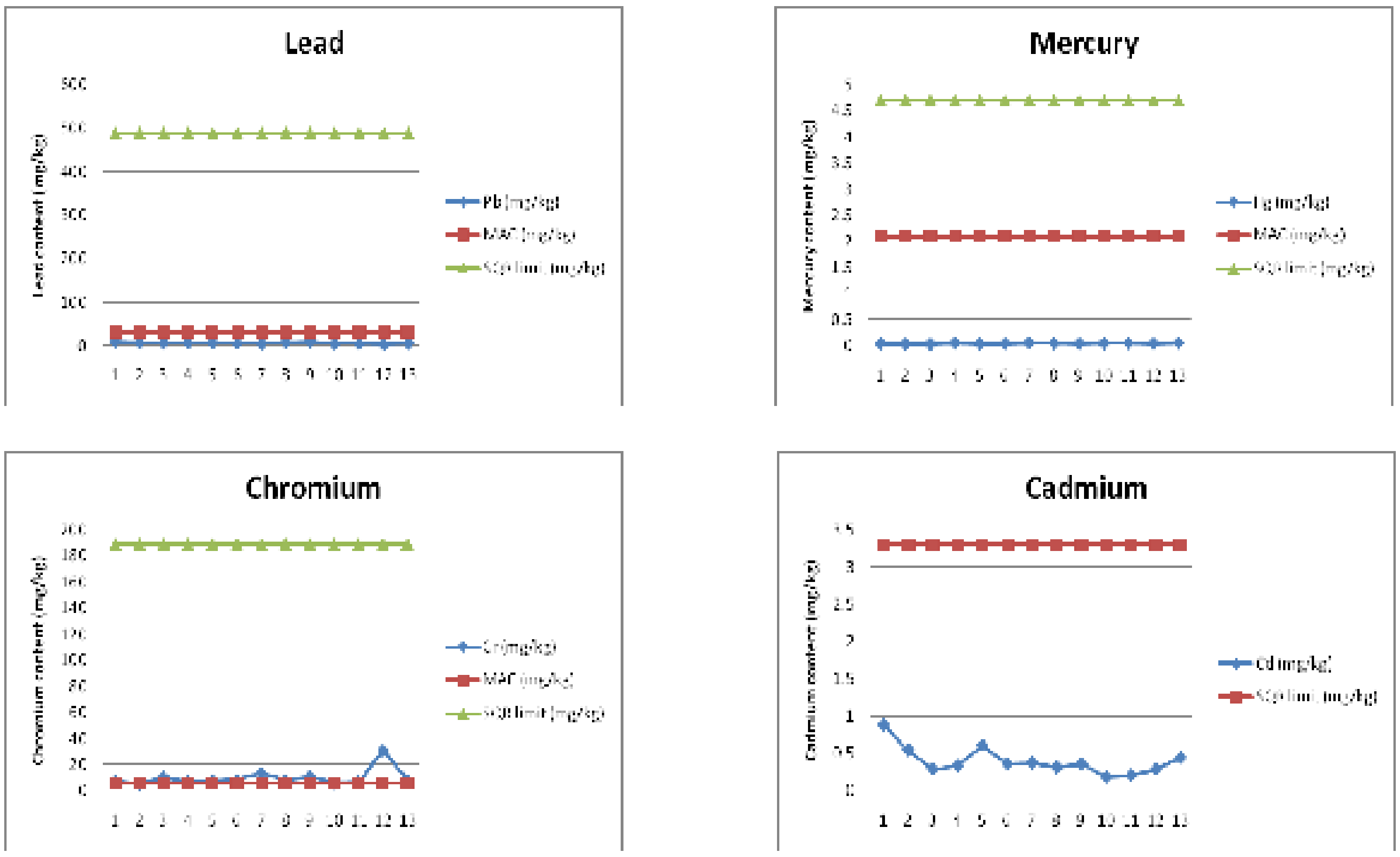


Figure 34. Results of Heavy metals content in soil samples

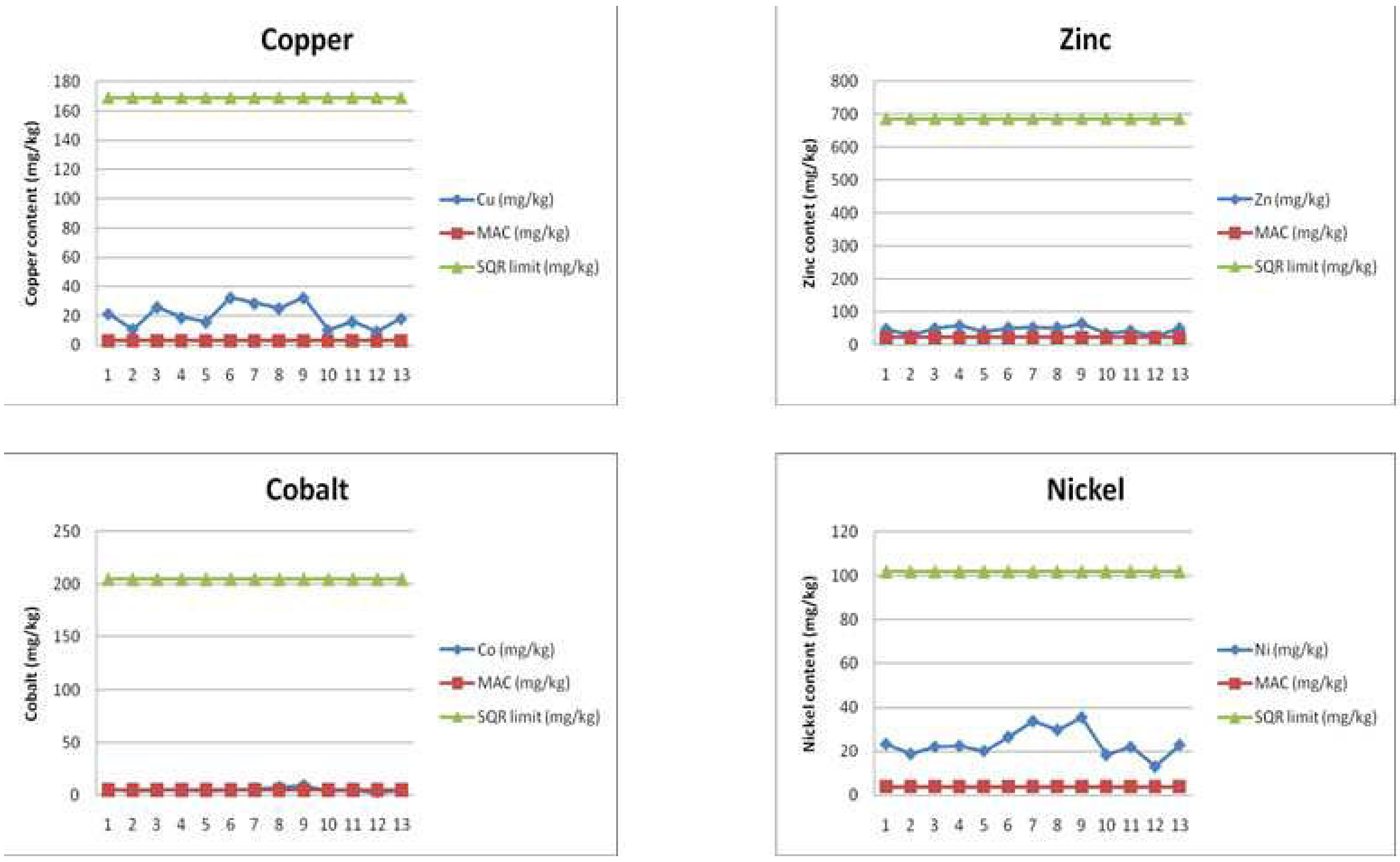


Figure 35. Results of Heavy metals content in soil samples

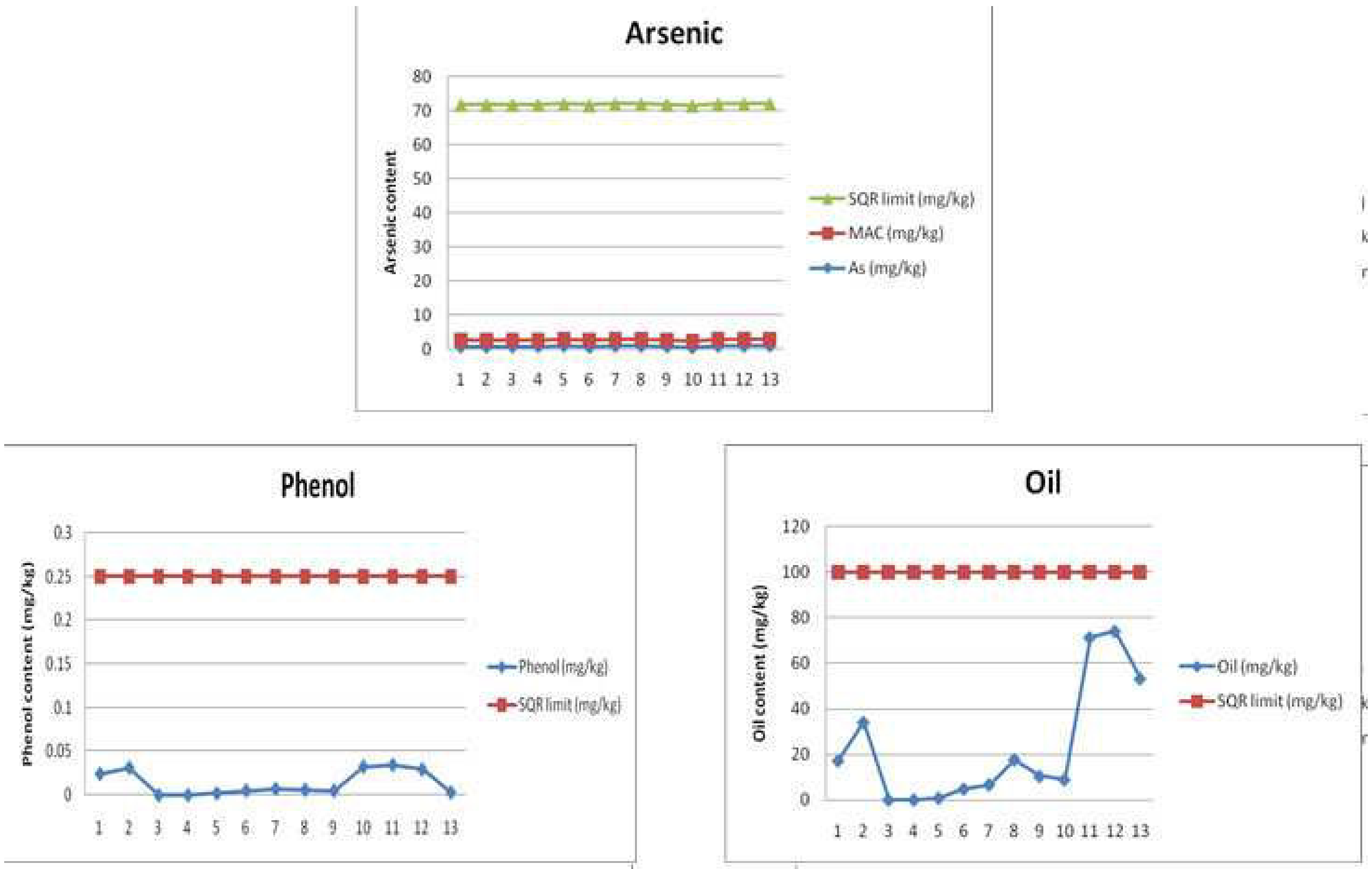


Figure 36. Results of Arsenic, Phenol and oil content in soil samples

616. All detected contaminant concentrations in soil are much below their respective corrected maximum value for industrial soil quality class.

617. 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.

E.1.6. Hydrogeology

618. Underground waters of the Amu Darya delta consist of artesian and ground waters. Artesian waters appear in the Cretaceous and Jurassic sediments, and groundwater appears in the Quaternary alluvial deposits of the Amu Darya River.

619. Quaternary aquifer of the Aral delta of the Amu Darya River is a single groundwater basin, which is generally defined as inland. Desiccation of the Aral Sea, hydrological regime of the Amudarya River and the largest irrigation canals as well as Tuyamuyun reservoir impact on the groundwater level. The formation of groundwater regime is related to the irrigation regime. The maximum falls on the irrigation period and reaches 0.6-0.8m, as well as minimum falls on the autumn and winter months. The fluctuation range reaches 1m.

620. At the TPP site ground water appear at the depth of 0.3-2.2 m. According to hydro-regime observations the water table maximum position is noted during May-June months and minimum during October-November. The water is saline and has strong sulfate aggressive to concrete in ordinary cement.

621. Ground waters of alluvial sediments have various degrees of mineralization. Fresh waters occur as lenses near the Amu Darya river bed and narrow water strips along irrigation channels. Mineralization of ground waters gradually increases with the increase of distance from fresh waters. In few dozen meters from the Keneges channel the mineralization degree increases from 2.4 to 12.3 g/dm^3.

622. The majority of ground waters belong to the sulfate-sodium-calcium type, sometimes they belong to the chloride-sulfate-sodium type. They have sulfate aggressivity to concrete in ordinary cement and high corrosivity to metal. Content of hydrocarbon fluctuates with the range 421-573 mg/dm^3; chloride 1336-4752 mg/dm^3; sulfate 2400-2784 mg/dm^3; calcium ion 560-1080 mg/dm^3; magnesium –576-612 mg/dm^3; sodium and potassium 441-2296 mg/dm^3 . Chemical analysis of groundwater:

- Dry residue - 4048 mg/dm^3;
- HCO_3 ion content - 325 mg/dm^3;
- Cl^- ion content - 770 mg/dm^3;
- SO_4^{2-} ion content - 1679 mg/dm^3 ;
- Ca^{2+} ion content - 256 mg/dm^3;
- Mg^{2+} ion content - 63 mg/dm^3;
- Na^+, K^+ ion content - 1012 mg/dm^3.
- Filtration rate – 1.6 m/days

623. The area is characterized by high-level phenol contamination of groundwater. Due to the absence of general sewer systems and cleaning of discharges of livestock and agricultural enterprises big area of ground waters is contaminated with phenols (up to 10-30 MAC and more for drinking water). Phenols (phenic acid, carbolic acid, herbicides, etc.) are toxic to humans and biota. But the most carcinogenic impact occurs in the case of chlorination of, for example, drinking water, since it leads to the formation of very stable chloroorganic compounds – dioxins.

624. Thus, Takhiatash is located in the area of high level phenol contamination of groundwater - up to 10-30 MAC and more, that is, in the high-risk area of adverse impact on human health when using groundwater for human consumption.

625. Hydrological conditions of the area are unfavorable for the construction, as groundwater is close to the surface and aggressive to concrete of all types of sulfate-resistant cement. Without drainage basements can be flooded and emergency situations can occur.

626. Uzbekenergo carries out regular monitoring (every three months) of underground water quality inside the wells and in the immediate vicinity of the Takhiatash TPP site.

627. In order to study the groundwater composition, a piezometric network formed by 57 wells-piezometers was deployed at the TPP. Some of the 57 wells located at the TPP are inactive and require reconstruction. The location of the wells where the analysis where performed is shown in following figure.

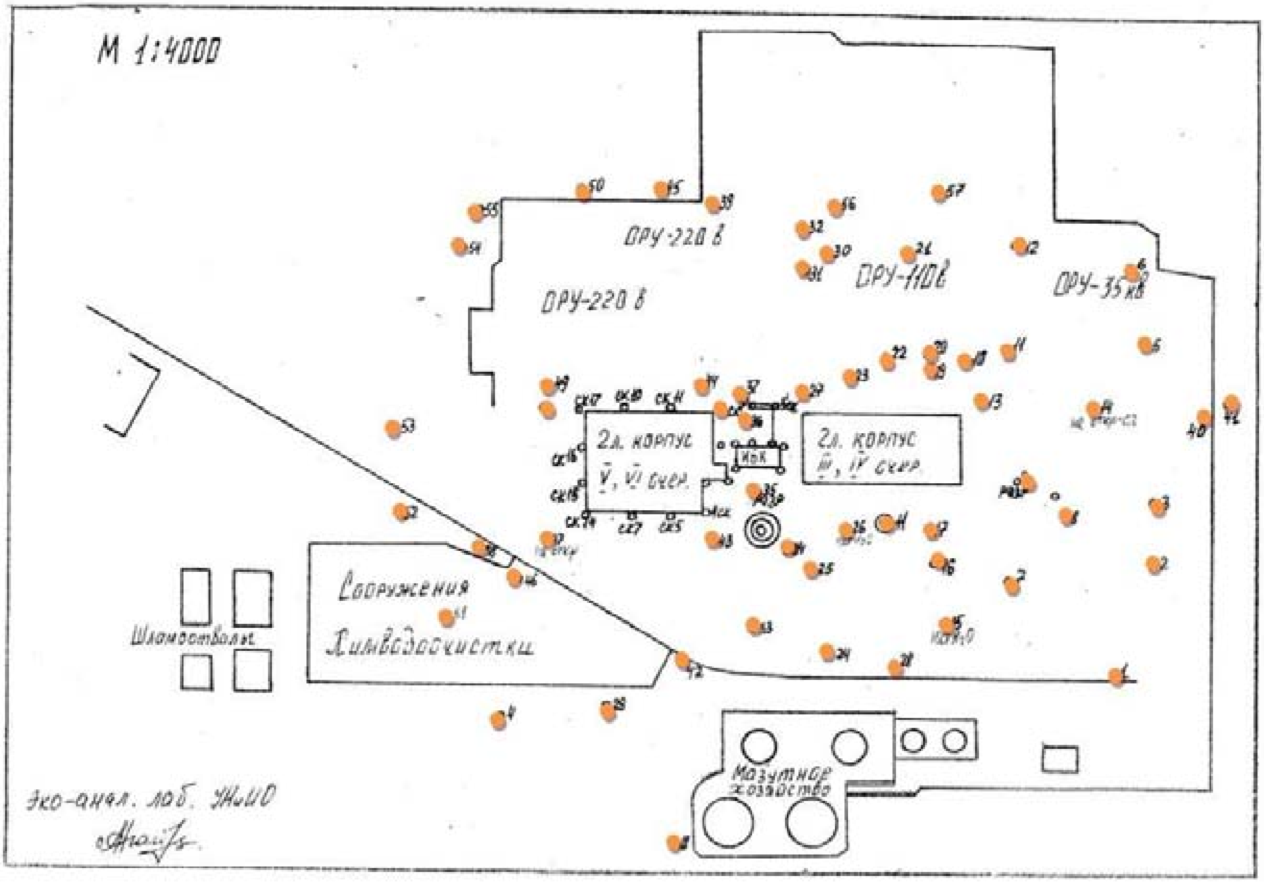
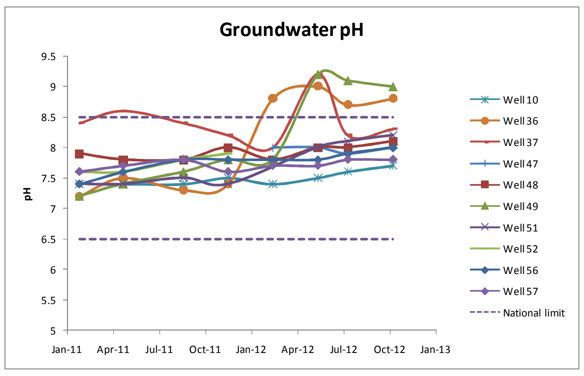
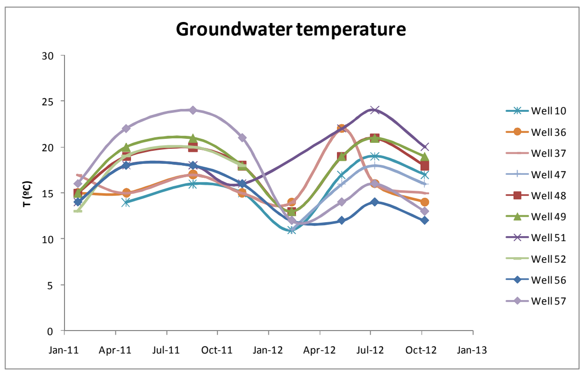


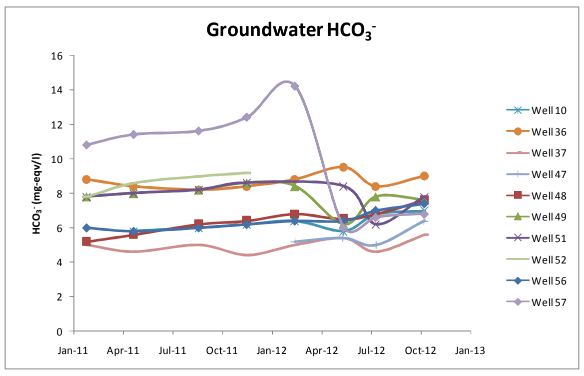
Figure 37. Groundwater sampling

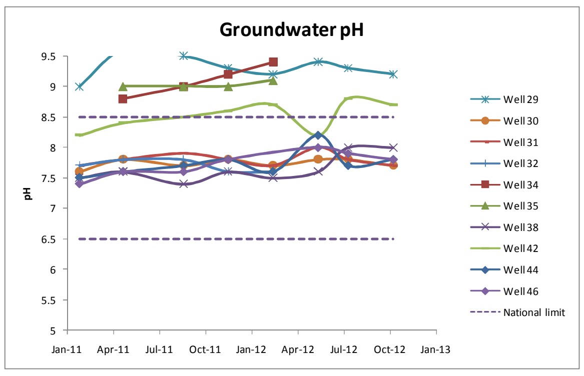
628. The figures in the next page give the groundwater characteristics measured inside the TPP site and in the immediate vicinity. These groundwater measurements analyze 9 parameters: content of cations (Ca^{2+}, Mg^{2+}, Na^{+}), chlorides (Cl^{-}), sulphates, carbonates (HCO_3^{-}), pH, hardness and temperature. As there are no Uzbek Standards specifically for groundwater, the ones for surface water can be used as reference.

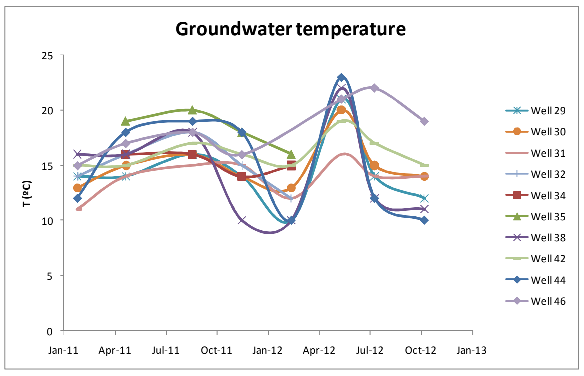
Results of groundwater analysis.

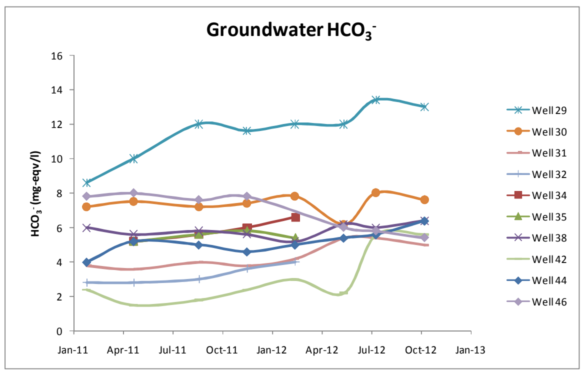


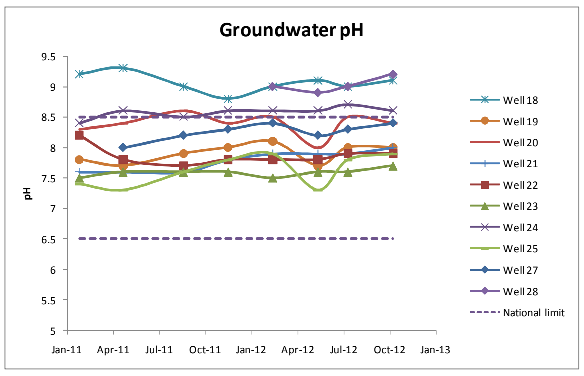


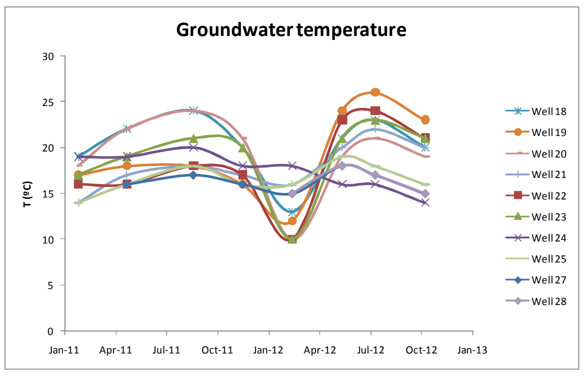


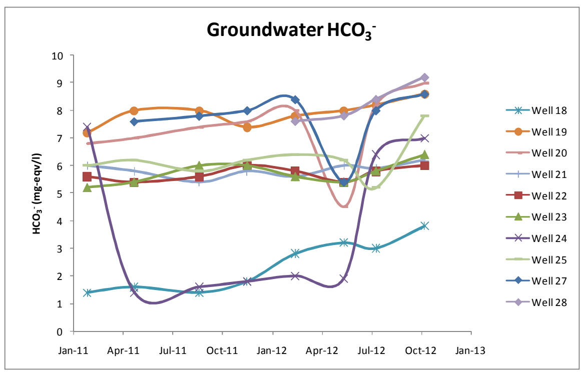


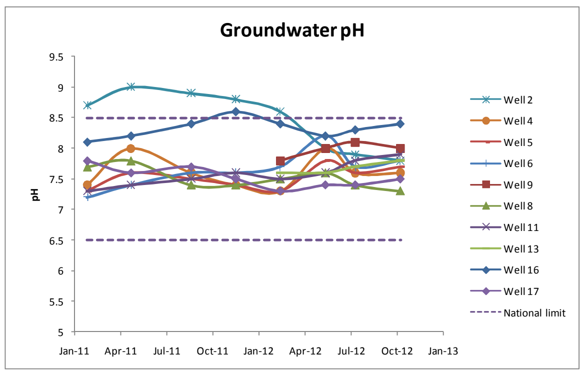


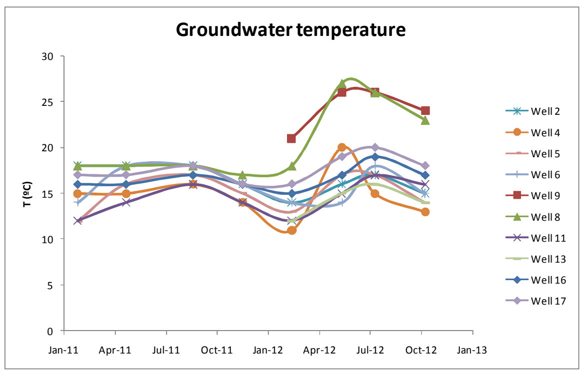


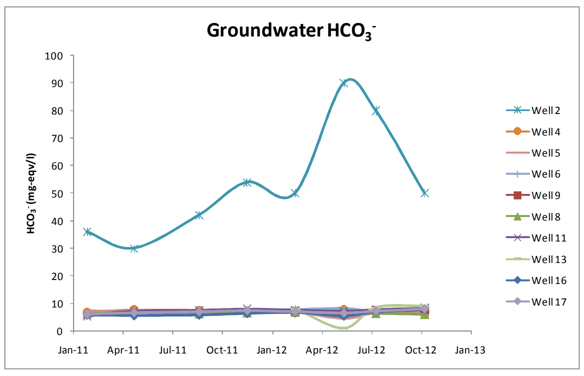

Groundwater pH
pH
Jan-11 Apr-11 Jul-11 Oct-11 Jan-12 Apr-12 Jul-12 Oct-12 Jan-13
Well18
Well19
Well20
Well21
Well22
Well23
Well24
Well25
Well27
Well28
National limit

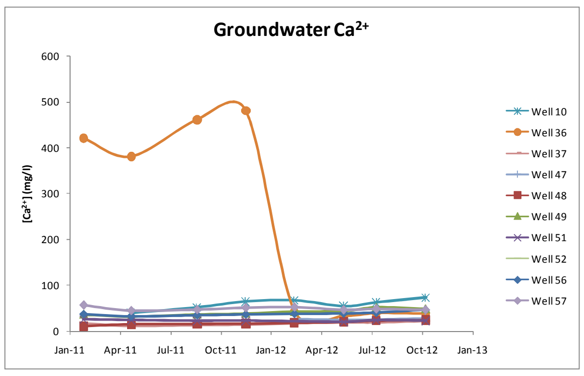

Groundwater temperature
T (°C)
Jan-11 Apr-11 Jul-11 Oct-11 Jan-12 Apr-12 Jul-12 Oct-12 Jan-13
Well18
Well19
Well20
Well21
Well22
Well23
Well24
Well25
Well27
Well28

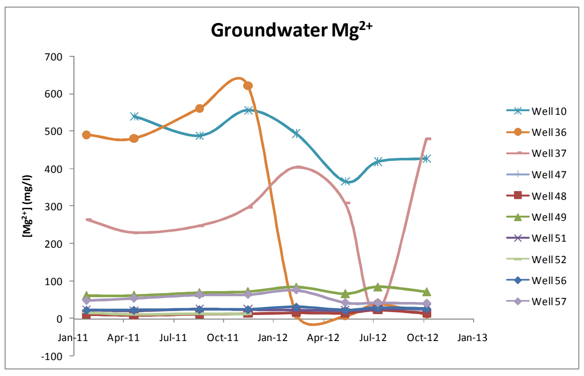

Groundwater HCO_3^-
HCO_3^- (mg-eqv/l)
Jan-11 Apr-11 Jul-11 Oct-11 Jan-12 Apr-12 Jul-12 Oct-12 Jan-13
Well18
Well19
Well20
Well21
Well22
Well23
Well24
Well25
Well27
Well28

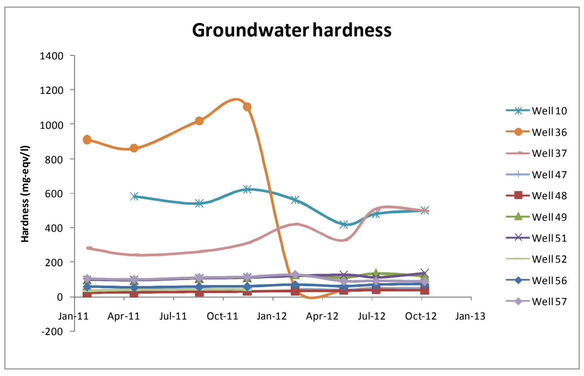

Groundwater pH
pH
Jan-11 Apr-11 Jul-11 Oct-11 Jan-12 Apr-12 Jul-12 Oct-12 Jan-13
Well2
Well4
Well5
Well6
Well9
Well8
Well11
Well13
Well16
Well17
National limit

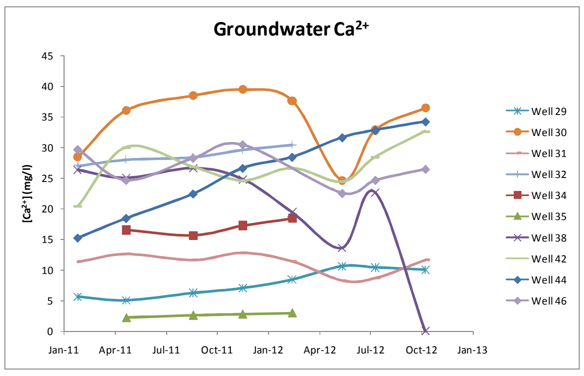

Groundwater temperature
T (°C)
Jan-11 Apr-11 Jul-11 Oct-11 Jan-12 Apr-12 Jul-12 Oct-12 Jan-13
Well2
Well4
Well5
Well6
Well9
Well8
Well11
Well13
Well16
Well17

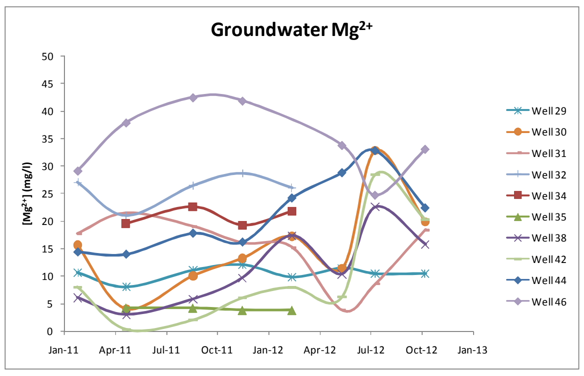

Groundwater HCO_3^-
HCO_3^- (mg-eqv/l)
Jan-11 Apr-11 Jul-11 Oct-11 Jan-12 Apr-12 Jul-12 Oct-12 Jan-13
Well2
Well4
Well5
Well6
Well9
Well8
Well11
Well13
Well16
Well17

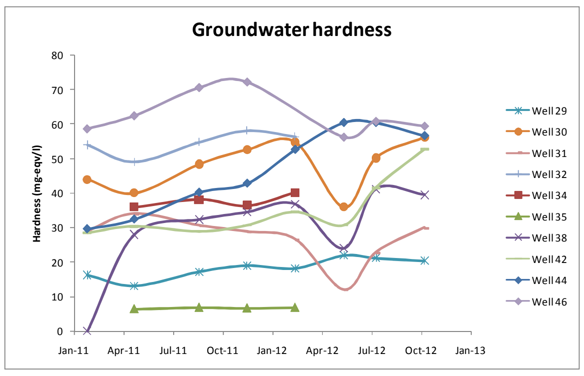

Groundwater Ca^{2+}
$[Ca^{2+}]$ (mg/l)
Jan-11 Apr-11 Jul-11 Oct-11 Jan-12 Apr-12 Jul-12 Oct-12 Jan-13
Well 10
Well 36
Well 37
Well 47
Well 48
Well 49
Well 51
Well 52
Well 56
Well 57

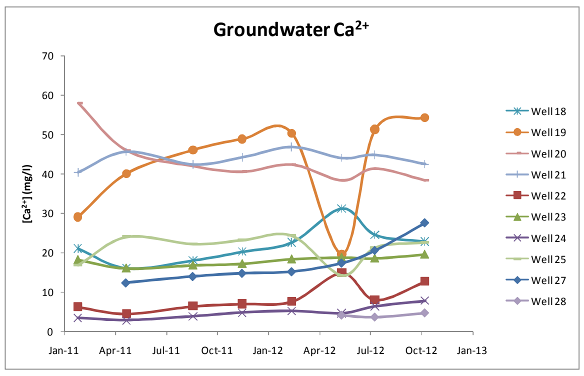

Groundwater Mg^{2+}
$[Mg^{2+}]$ (mg/l)
Jan-11 Apr-11 Jul-11 Oct-11 Jan-12 Apr-12 Jul-12 Oct-12 Jan-13
Well 10
Well 36
Well 37
Well 47
Well 48
Well 49
Well 51
Well 52
Well 56
Well 57

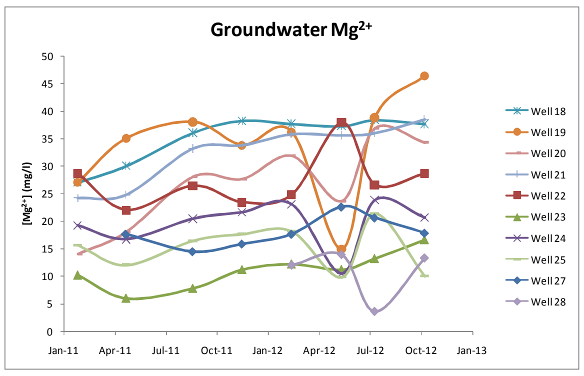

Groundwater hardness
Hardness (mg-eqv/l)
Jan-11 Apr-11 Jul-11 Oct-11 Jan-12 Apr-12 Jul-12 Oct-12 Jan-13
Well 10
Well 36
Well 37
Well 47
Well 48
Well 49
Well 51
Well 52
Well 56
Well 57

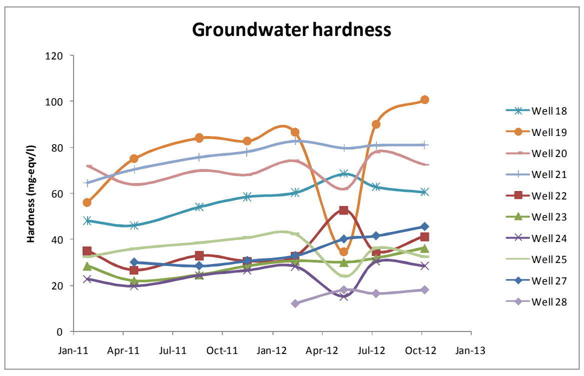

Groundwater Ca^{2+}
$[Ca^{2+}]$ (mg/l)
Jan-11 Apr-11 Jul-11 Oct-11 Jan-12 Apr-12 Jul-12 Oct-12 Jan-13
Well 29
Well 30
Well 31
Well 32
Well 34
Well 35
Well 38
Well 42
Well 44
Well 46

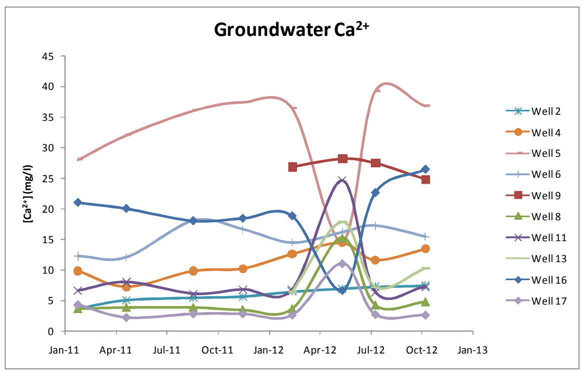

Groundwater Mg^{2+}
$[Mg^{2+}]$ (mg/l)
Jan-11 Apr-11 Jul-11 Oct-11 Jan-12 Apr-12 Jul-12 Oct-12 Jan-13
Well 29
Well 30
Well 31
Well 32
Well 34
Well 35
Well 38
Well 42
Well 44
Well 46

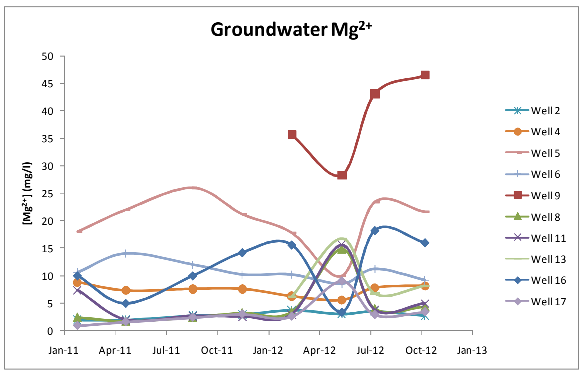

Groundwater hardness
Hardness (mg-eqv/l)
Jan-11 Apr-11 Jul-11 Oct-11 Jan-12 Apr-12 Jul-12 Oct-12 Jan-13
Well 29
Well 30
Well 31
Well 32
Well 34
Well 35
Well 38
Well 42
Well 44
Well 46

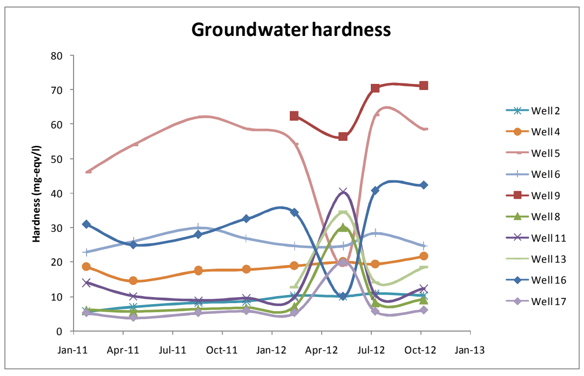

Groundwater Ca^{2+}

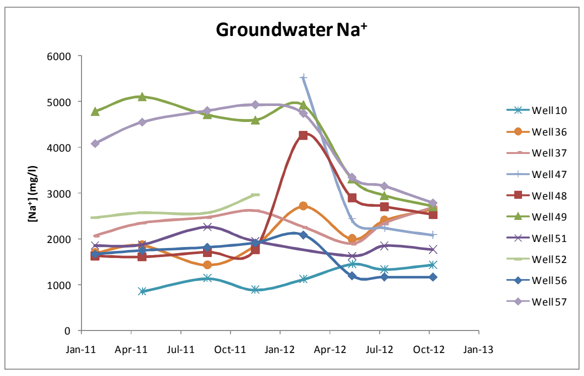

Groundwater Mg^{2+}

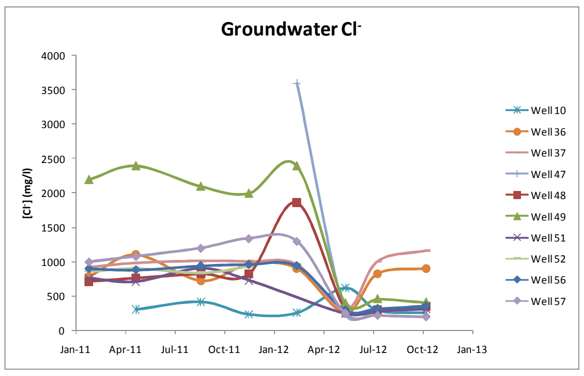

Groundwater hardness


Groundwater Ca^{2+}


Groundwater Mg^{2+}


Groundwater hardness


Groundwater Na⁺
[Na⁺] (mg/l)
Jan-11 Apr-11 Jul-11 Oct-11 Jan-12 Apr-12 Jul-12 Oct-12 Jan-13
Well 10
Well 36
Well 37
Well 47
Well 48
Well 49
Well 51
Well 52
Well 56
Well 57


Groundwater Cl⁻
[Cl⁻] (mg/l)
Jan-11 Apr-11 Jul-11 Oct-11 Jan-12 Apr-12 Jul-12 Oct-12 Jan-13
Well 10
Well 36
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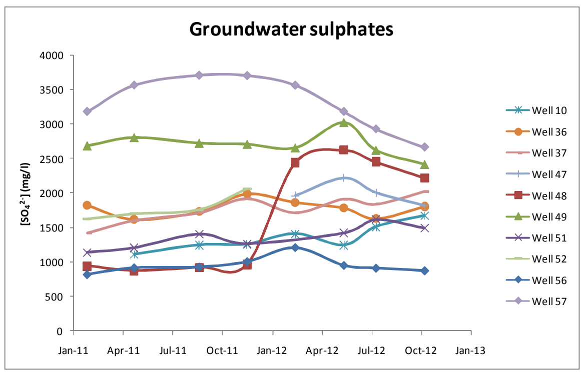
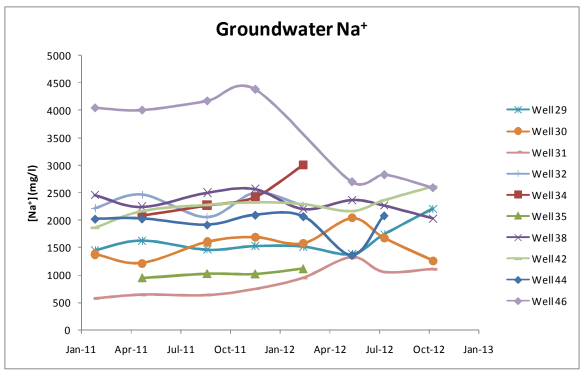
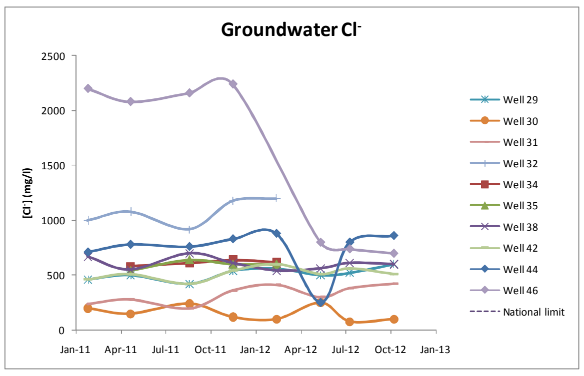
Well 48
Well 49
Well 51
Well 52
Well 56
Well 57


Groundwater sulphates
[SO₄²⁻] (mg/l)
Jan-11 Apr-11 Jul-11 Oct-11 Jan-12 Apr-12 Jul-12 Oct-12 Jan-13
Well 10
Well 36
Well 37
Well 47
Well 48
Well 49
Well 51
Well 52
Well 56
Well 57


Groundwater Na⁺
[Na⁺] (mg/l)
Jan-11 Apr-11 Jul-11 Oct-11 Jan-12 Apr-12 Jul-12 Oct-12 Jan-13
Well 29
Well 30
Well 31
Well 32
Well 34
Well 35
Well 38
Well 42
Well 44
Well 46


Groundwater Cl⁻
[Cl⁻] (mg/l)
Jan-11 Apr-11 Jul-11 Oct-11 Jan-12 Apr-12 Jul-12 Oct-12 Jan-13
Well 29
Well 30
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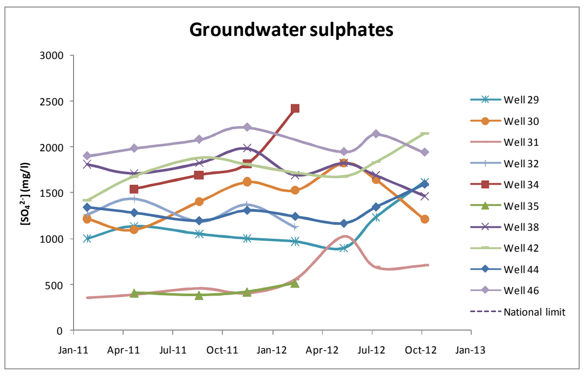
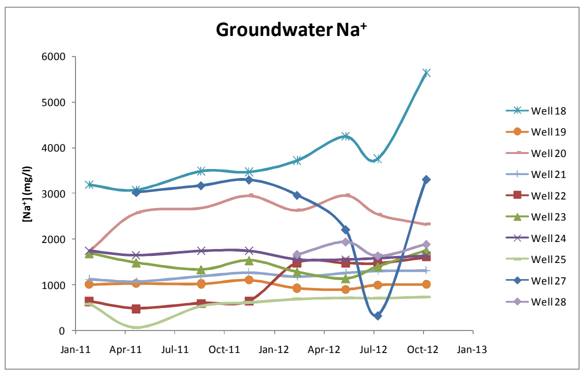
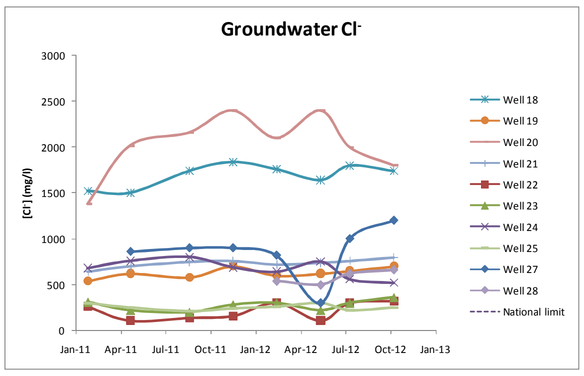
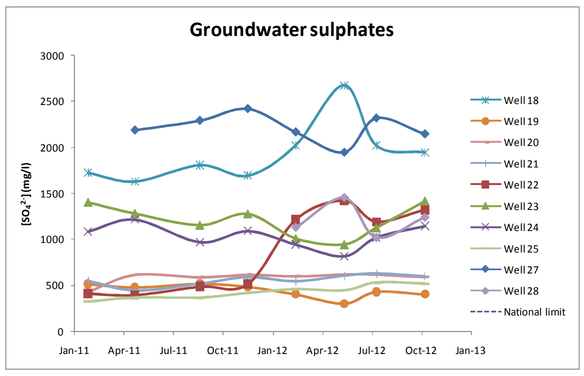
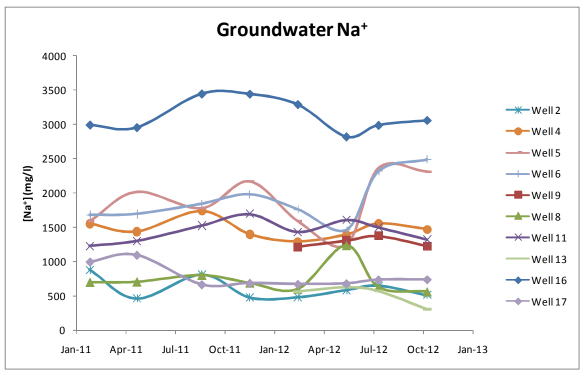
Well 32
Well 34
Well 35
Well 38
Well 42
Well 44
Well 46
National limit

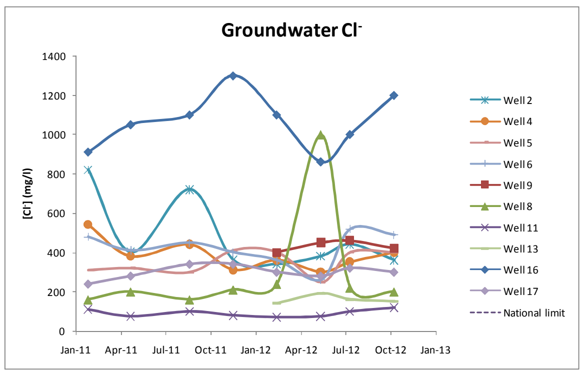

Groundwater sulphates
[SO₄²⁻] (mg/l)
Jan-11 Apr-11 Jul-11 Oct-11 Jan-12 Apr-12 Jul-12 Oct-12 Jan-13
Well 29
Well 30
Well 31
Well 32
Well 34
Well 35
Well 38
Well 42
Well 44
Well 46
National limit

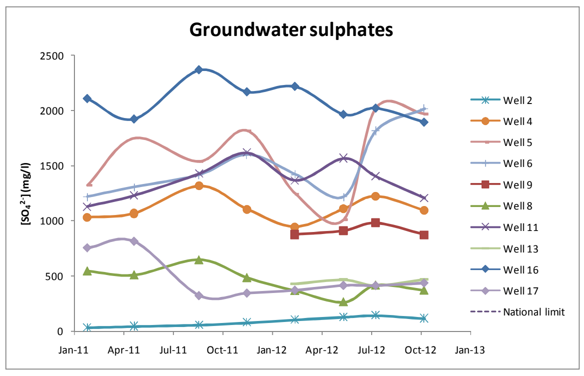

Groundwater Na⁺
[Na⁺] (mg/l)
Jan-11
Apr-11
Jul-11
Oct-11
Jan-12
Apr-12
Jul-12
Oct-12
Jan-13
Well 18
Well 19
Well 20
Well 21
Well 22
Well 23
Well 24
Well 25
Well 27
Well 28


Groundwater Cl⁻
[Cl⁻] (mg/l)
Jan-11
Apr-11
Jul-11
Oct-11
Jan-12
Apr-12
Jul-12
Oct-12
Jan-13
Well 18
Well 19
Well 20
Well 21
Well 22
Well 23
Well 24
Well 25
Well 27
Well 28
National limit


Groundwater sulphates
[SO₄²⁻] (mg/l)
Jan-11
Apr-11
Jul-11
Oct-11
Jan-12
Apr-12
Jul-12
Oct-12
Jan-13
Well 18
Well 19
Well 20
Well 21
Well 22
Well 23
Well 24
Well 25
Well 27
Well 28
National limit


Groundwater Na⁺
[Na⁺] (mg/l)
Jan-11
Apr-11
Jul-11
Oct-11
Jan-12
Apr-12
Jul-12
Oct-12
Jan-13
Well 2
Well 4
Well 5
Well 6
Well 9
Well 8
Well 11
Well 13
Well 16
Well 17


Groundwater Cl⁻
[Cl⁻] (mg/l)
Jan-11
Apr-11
Jul-11
Oct-11
Jan-12
Apr-12
Jul-12
Oct-12
Jan-13
Well 2
Well 4
Well 5
Well 6
Well 9
Well 8
Well 11
Well 13
Well 16
Well 17
National limit


Groundwater sulphates
[SO₄²⁻] (mg/l)
Jan-11
Apr-11
Jul-11
Oct-11
Jan-12
Apr-12
Jul-12
Oct-12
Jan-13
Well 2
Well 4
Well 5
Well 6
Well 9
Well 8
Well 11
Well 13
Well 16
Well 17
National limit

Comments

629. **Chlorides.** As it can be observed in the charts, the content of chlorides greatly varies among the different wells. It ranges between 100 and 1300 mg/l although it occasionally reaches 2,400 mg/l.

630. **Sulphates**. The content of sulphates greatly varies among the different wells, ranging from 300 to approximately 2,700 mg/l. The maximum content in sulphates corresponds to well nº 49, which amounts to 3,700 mg/l. Such high concentrations could be due partly to the influence of the Aral Sea influence and partly due to artificial pollution from sulphate products used in agriculture.

631. **Sodium**. Sodium is usually associated with chloride ions, highly soluble in water, and is affected by the basic exchange process with alkaline earths. The presence of salt bearing formations or the influence of seawater provide additional quantities of those elements, as is the case in the area of interest with the proximity of the Aral Sea, where concentration levels of Na+ range from 500 to 3,500 mg/l, reaching in certain measurement points 5,000 mg/l.

632. **Calcium and magnesium**. Calcium content is closely linked to magnesium content, and they define the hardness of the water. Local content levels in Ca^{2+} and Mg^{2+} vary between 3-60 mg/l and 2-45 mg/l, respectively. Some measurements at wells nº 10, 36 and 37, which are located in the surroundings of the power island buildings, show very high content in calcium and magnesium, reaching 500 and 600 mg/l.

633. **Carbonates.** Carbonates are present in rather lower levels than other substances. Locally, concentration levels vary between 1.5 and 14 mg-eqv/l.

634. **Temperature.** The temperature of underground water, at a given place and time, is an indication of the state of balance between heat input and heat extraction at the place in question. For practical purposes, it can be considered that aquifers possess a neutral zone, at constant temperature, and that any significant variations above this temperature are caused by daily or seasonal ambient temperature variations. In all cases, underground water temperature varies very little among the different wells, ranging between 10 and 24 ºC depending on the season.

635. **pH.** Underground water is slightly alkaline, with pH values between 7 and 9.5 as the graphs show. There are certain wells (nº 2, 18, 28, 29) that exceed the National upper pH limit for surface water (applicable to groundwater), established in 8.5.

E.1.7. Surface Hydrology

636. The closest to the Takhiatash TPP large surface watercourse is Amudarya river. Amudarya is the largest river in catchment area and water availability in Central Asia and is formed by Pyandj and Vakhsh rivers conjunction. Its total length from Pyandj River head to Aral Sea is 2574 km, from conjunction place 1415 km. Takhiatash city locates at the lower (downstream Tuyamuyun) reaches of Amudarya basin. In lower reaches on both riverbanks big canal system are constructed: Tashsaka, Pakhtaarna, Klychniyazbay, Urgench-Oktyabr-arna, Khan-yab (Sovet-yab), Kyzytken, Suenly.

637. The Amudarya River is the irrigation source of the Republic of Karakalpakstan and in dry years, collector water is used for irrigation by mixing it with irrigation water from the canals.

638. There are no other sources of irrigation in the territory of the Republic. Existing lakes are mainly located on the periphery of the irrigation systems and their formation and inflow result from the river spill water. The lake water is highly mineralized and is not suitable for irrigation.

639. Water is drawn from the river by main canals. The southern regions: Turtkul, Beruni and Ellikkala are served by the Pakhta-arna main canal. The total irrigated area is 98.9 thousand ha. The water intake at the border of the regions in 2004 was 1,595.04 million m^3.

640. The Suenly main canal serves the group of Left Bank regions: Khojaly, Shumanay, Kanlykul, Kungrad and Muinak with a total irrigated area of 152.2 thousand ha. The actual water intake was 1,886.24 million m^3.

641. According to the GlavHydromet, for the last 5 years water flow rate at Kipchak (the closest monitoring point at the Amudarya river) transit was lower than long-time average annual (663 m^3/s) and amounted to 509 m^3/s. Average deep is 6-7 meters and width 16-42 meters, being average speed 1.1-1.2 m/s. Chemical composition of the river water is formed to a large degree under the impact of contaminants coming to the river on the territory of Turkmenistan, agricultural flows and waste waters of factories in Drujba, Turtkul, Urgench and Mangit cities. Water of Amudarya river is characterized by high turbidity. For the period of observations the long-time average annual turbidity was equal to 1.995 kg/m^3; minimal – 1.4 kg/m^3. Long-time average annual water turbidity fluctuates from 0.24 кг/m^3 in January to 5.1 kg/m^3 in May. Granulometric composition of suspended load from 0.1 % (1- 0.5 mm) to 39.5 % (0.05- 0.01 mm).

642. Oxygen regimen of the water in the closest to Takhiatash city transit (in Nukus city region) is satisfactory. The average concentration of dissolved oxygen is 10.9 mg O_2/dm^3. The content of organic substances in terms of COD - mg O_2/dm^3

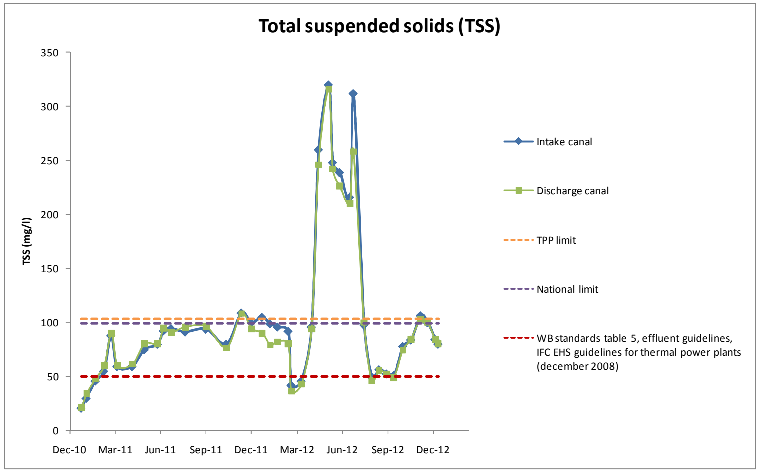
643. Contamination of river water by toxic agents: with regard to phenols – 1 MAC, to nitrite and nitrate nitrogen – 0,8 MAC, to copper, zinc, arsenic, chrome, fluorine – significantly less than threshold limit values. Content of HCCH amounted to 0.008 mg/dm^3, while according to the regulation norms there should be no HCCH at all. Mineralization of water is at the level of 1 MAC

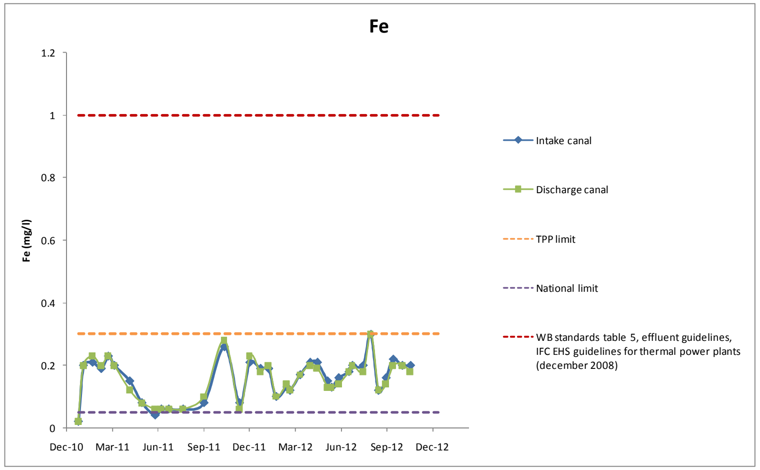
644. Analysis of technogeneous products of pollution showed that pesticides, widely used on the irrigated areas of Karakalpakstan and Khorezm region are not represented in the surface waters of the observed territory (close to Takhiatash city). Their concentration does not exceed 1 MAC in Takhiatash region, while their concentration on the irrigated areas reach tens of MAC.

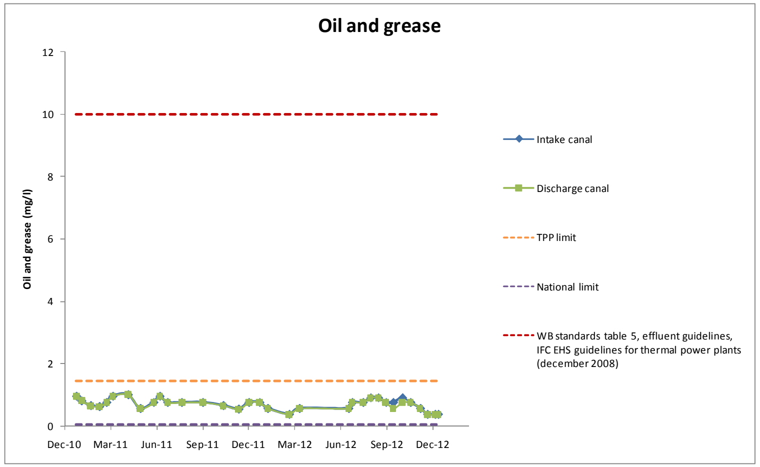
645. Available results of the previously conducted studies confirm that the large part of the Takhiatash area is under the intensive negative regional impact of phenol contamination of surface waters. Quality of river water falls into the III class – class of moderately contaminated waters.

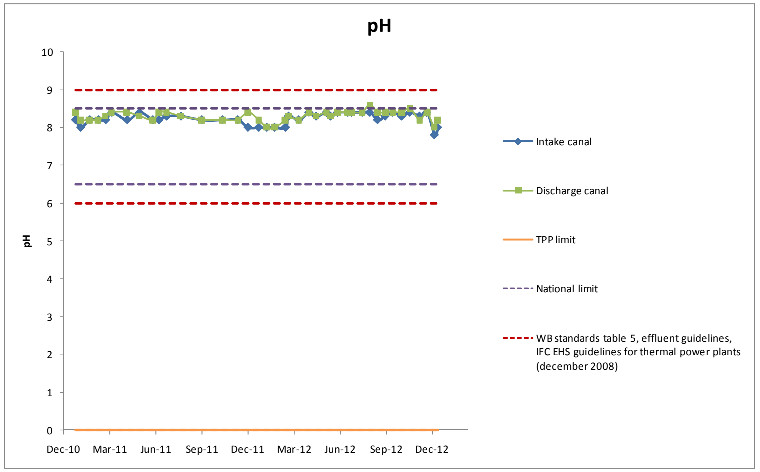
646. Takhiatash TPP intake and discharge is located in Suenly canal. In order to reflect the water quality conditions of the Suenly canal, a number of parameters are measured in both Takhiatash TPP intake and discharge points to the channel in a bimonthly basis. These parameters have been represented 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.

Results of surface water analysis.

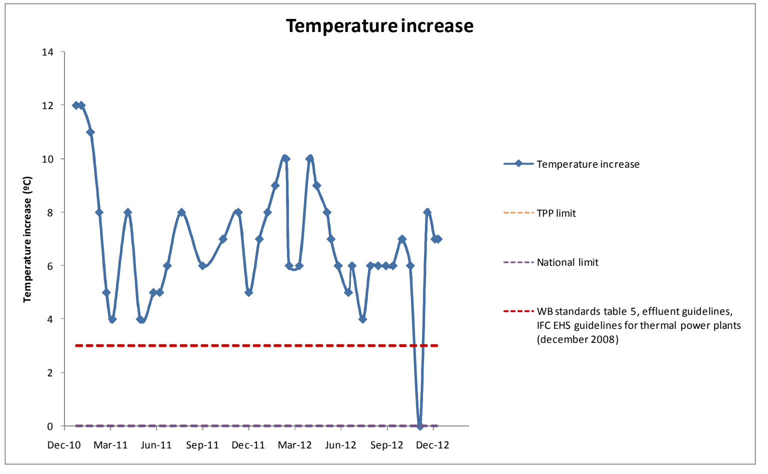


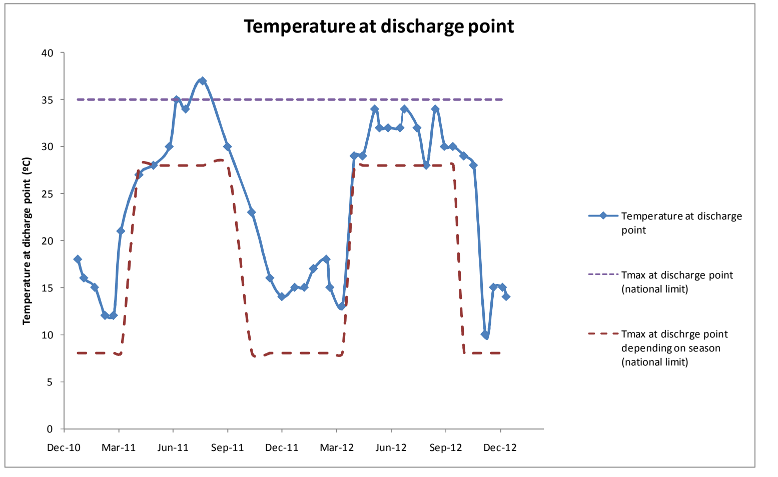


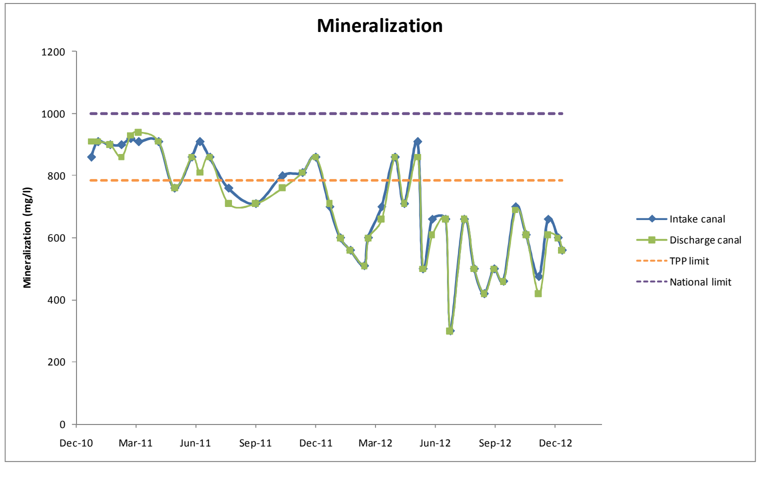


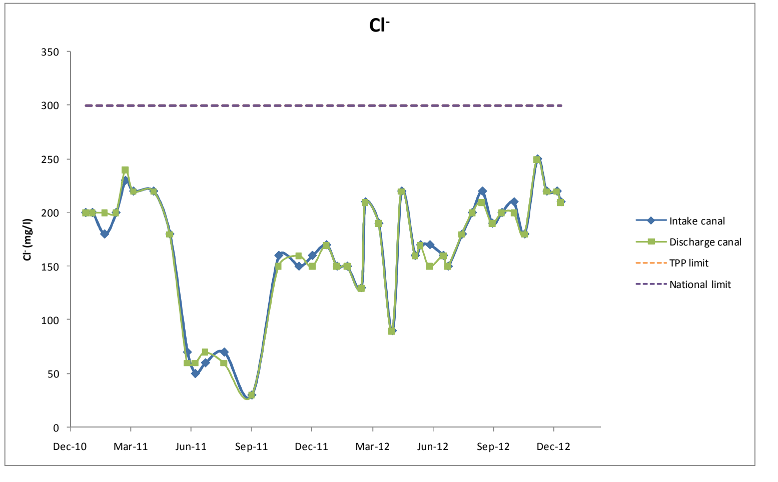


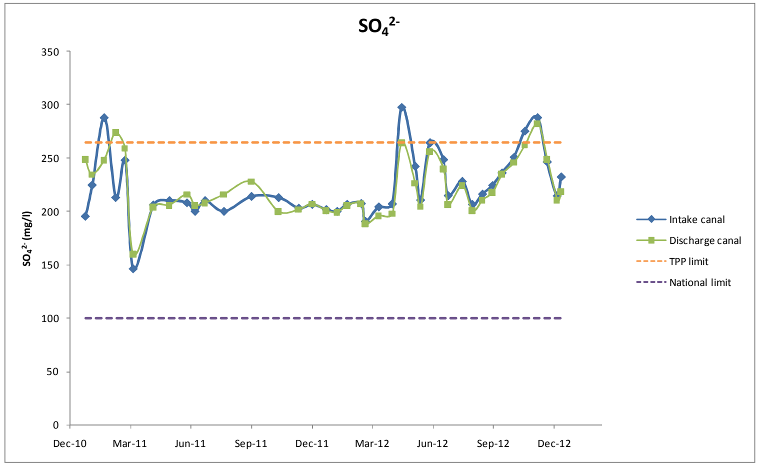
Results of groundwater analysis.

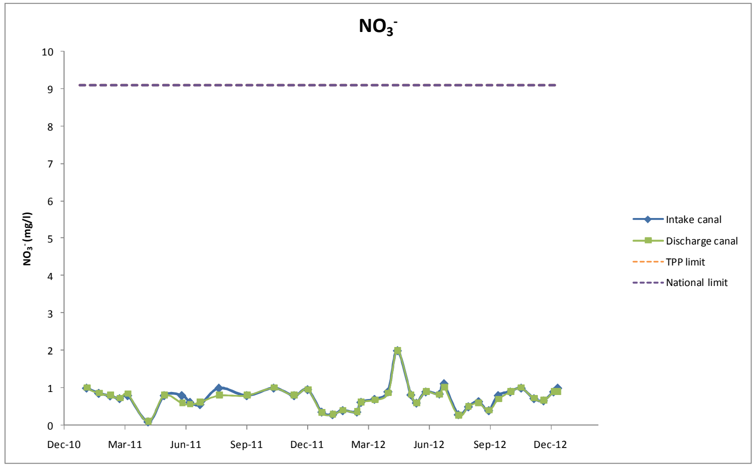


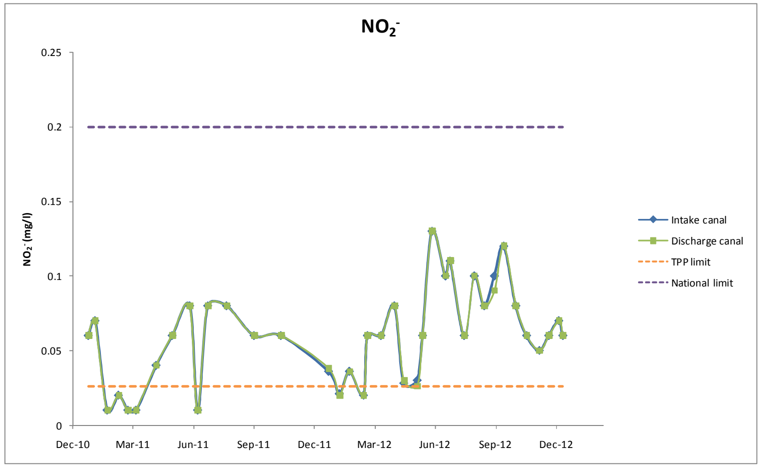


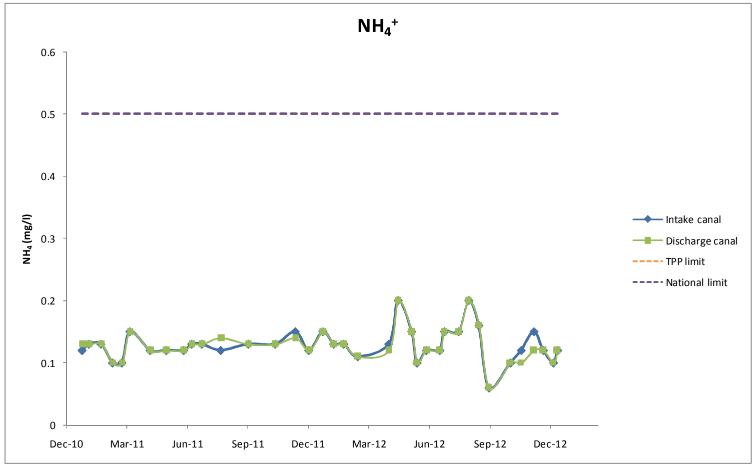


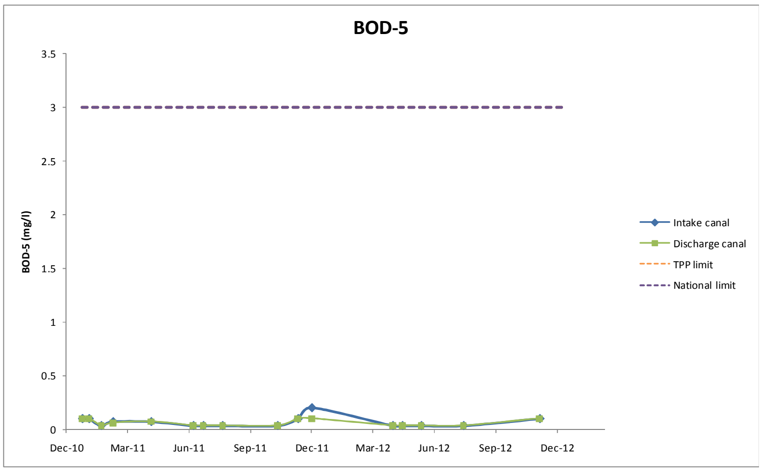



SO_4^{2-}
SO_4^{2-} (mg/l)
350
300
250
200
150
100
50
0
Dec-10
Mar-11
Jun-11
Sep-11
Dec-11
Mar-12
Jun-12
Sep-12
Dec-12
Intake canal
Discharge canal
TPP limit
National limit


NO_3^-
NO_3^- (mg/l)
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


NO_2^-
NO_2^- (mg/l)
0.25
0.2
0.15
0.1
0.05
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


NH_4^+
NH_4 (mg/l)
0.6
0.5
0.4
0.3
0.2
0.1
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



<u>Comments</u>

647. **Total suspended solids**. The content of total suspended matter widely varies from one measurement to the next, having reached values above 300 mg/l.

648. 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/l and 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.

649. **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.

650. **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 0.9mg/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 is more restrictive.

651. **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.

652. 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 5 ºC compared with the average monthly temperature of the hottest month. As in this period of measurements (2011-2012) maximum temperature has been 30 ºC, the allowed temperature increase should not exceed

35 ºC, but a maximum absolute temperature at the discharge point is established in 8 ºC for winter and 28 ºC for summer. Both standards are exceeded even at the intake point.

653. **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.

654. **Mineralization**. Although all the measurements are below the national limit for mineralization parameter, in several occasions the TPP's limit is exceeded.

655. **Chlorides**. The content of chlorides widely differs between different measurements depending on the date, varying from 30 to 250 mg/l. Nevertheless, these values do not exceed the TPP's and National standards, established in 300 mg/l.

656. **Sulphates**. The concentration of sulphates slightly varies between intake and discharge points and in certain measurements it is lower in discharge water. It ranges from 145 and 300 mg/l, values that exceed national standard (100 mg/l) and, sometimes, are above the TPP's limit (265 mg/l).

657. **Nitrates and ammonia.** The concentration of nitrates and ammonia scarcely varies between intake and discharge points and, in certain measurements the content of both substances in discharged water is lower than the intake. These parameters do not exceed the TPP's limits, which are the same than Uzbek standards.

658. **Nitrites**. At the same way that nitrates and ammonia, the concentration of nitrites hardly varies between intake and discharge measurements. The content of nitrites is below the National limit but, in many occasions, it is above the TPP's limit (0.026 mg/l), which is much more stringent.

659. **Biological Oxygen Dema**nd. The Biological Oxygen Demand (BOD_5) is the precise amount of oxygen required to eliminate organic matter in water through aerobic biological processes, referred to a five day period. BOD_5 measurements are between 0.036 an 0.2 mg/l, which are much below both the National and the TPP's limits.

660. It can be concluded that, except temperature, the parameters that exceed standards are being already exceeded by the water quality in the Suenly canal previously to the intake for the TPP. In some cases the discharge values improve water quality compared with the intake values. For temperature, the operation of the TPP clearly causes an important increase of this parameter in the Suenly canal after the TPP discharge.

661. 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 the next table:

Table 78. Results of analysis undertaken within EIA

	Water intake canal			Water discharge canal			TPP limits	WB limits
Parameter	Actual concentration mg/dm³	Compliance with TPP limits?	Compliance with WB limits?	Actual concentration mg/dm³	Compliance with TPP limits?	Compliance with WB limits?	MAC mg/dm³	MAC mg/dm³
Pb	0.0001	✓	✓	0.0001	✓	✓	0.03	0.5
Cd	0.00032	✓	✓	0.00035	✓	✓	0.005	0.1
Cu	0.0065	X	✓	0.0059	X	✓	0.001	0.5
Zn	0.011	X	✓	0.0096	✓	✓	0.01	1
Fe	0.6435	X	✓	0.7155	X	✓	0.3	1
Cr^{3+}	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	130	✓	✓	120	X	X	103	50
Residual chlorine	Not detected	-	✓	Not detected	-	✓	-	0.2
Oil products	0.08	✓	✓	0.22	✓	✓	1.45	10

662. World Bank standards are fulfilled except for suspended solids at the intake and the discharge point. National standards are fulfilled except for Cu, Fe and Zn (at the intake) and suspended solids (at the discharge). From the parameters that are exceeded both in the intake and discharge, only Cu concentration decreases at the discharge. Fe has an increase at discharge point of 1.1 times. Oil products, although its limit is fulfilled, increase 2.75 times at the discharge point.

E.2. Biological environment

E.2.1. Flora

663. On the vast territory of the Republic of Karakalpakstan, which includes the lower course and delta of the Amudarya River, the adjacent sand and gypsum Kyzylkum deserts, the Ustyrt plateau and the Aral Sea there are about 1,000 species of higher plants and up to 400 species of vertebrates. The natural conditions of the area under study have defined the development of arid vegetation communities. Precipitation in winter and spring has led to the fact that plants have adapted to its effective use for the development of biological and soil processes. Therefore, vegetation especially in the sands and takyrs covers the area in early spring with a solid cover of sand sedge and other plants. Various types of wormwood and Salsola shrub also find here favourable conditions for their development. Thus, upon occurrence of favourable moisture conditions observed in early spring, sands are covered with quite diverse and abundant vegetation, the main and most typical representatives being sand sedge — Carex physodes, Haloxylon, Salsola, Calligonum and other shrubs. In addition, there is common annual Salsola vegetation including xerophilous and halophilic herbaceous annual plants of the goosefoot (Chenopodiaceae) family. Most of these plants have an extended growing season: Their shoots appear in early spring; the plants slowly grow and bloom

throughout the spring and summer, their ripening only occurring in fall. Very few species of the annual goosefoot family have a short growing season, ending their life cycle shortly after the ephemerae. The most common are annual Salsola species (turcomanica, crassa), Halimocnemis (karelinii, molissima, sclerosperma, etc.), Suaeda, Petrosimonia, Gamanthus (gamocarpus) and some other species.

664. Vegetation of Takhiatash town is represented by ornamental and fruit trees, vegetable and field crops. Woody vegetation includes the following: acacia, willow, Turkmen elm and poplar. The most popular fruit trees are apple, quince, pear, apricot and cherry. Plant species composition is small and represented by 20 species of trees and shrubs. Vegetation is sparse. Thickset of ornamental trees can be found in the town center: in the park and on the main streets. High soil and water salinity, high insolation, dust storms as well as insufficient irrigation system cause to the paucity of vegetation.

665. The presence of halophytic species (Halostachus Caspian, Aeluropus) - indicators of high soil salinity - in the vegetation cover confirms the presence of stress in the environmental situation of the city. Habit of these plants is much less than normal.

666. Vegetation within the radius of 2-3 km from Takhiatash TPP has various degrees of drying, especially the tops of trees. Significant degree of drying was observed in elms and black poplars. Aryan poplar (Turanga), Matsuda willow and Turkmen oleaster are the most resistant species to contaminants and natural conditions.

667. Thus, the region has scanty vegetation. Some species (black poplar and elm) are in poor condition due to man-made and natural factors.

E.2.2. Fauna

a) Terrestrial fauna

668. Fauna of the territory is varied. The most notable of the mass of desert animals are the many and various reptiles, rodents and small insects crawling on the ground.

669. Sparseness of vegetation, dispersal of shelters and food resources have developed the ability to move fast in many desert animals. It is typical for many running insects, arachnids, lizards, snakes, birds, and mammals. Such, for example, is the extremely agile mesh lizard chasing small insects. The gazelle and the tolai hare are quite fast runners. Exceptions are relatively rare – these are animals well protected from enemies and with a better supply of food. Such, for instance, are the shell-covered steppe tortoise (the herbivorous form, only active in spring during the growing season of ephemera and ephemeroids), quill-protected porcupine, long-eared and Brandt's hedgehogs.

670. The steppe tortoises are rather numerous in the desert. Among the other specific members of this order, we must mention the sand boa, which easily mines the dry sand, and the rather numerous in the desert fine, delicate and extremely fast arrow-snakes. They mainly hunt lizards in which they wait for, hiding in the branches of the shrubs.

671. The most remarkable feature of the fauna of the desert rodents is the exceptional diversity of species and the abundance of the group of original prancing animals — jerboas.

b) Aquatic fauna

672. There are more than 50 types of fish in Aral sea basin. Withdrawing water for agricultural activity, construction number of dams and canals negatively impacted on the fishes. Around 10 types of fish are included into Uzbekistan book as a rare species. Among them are big and small Pseudosaphirhynchus kaufmanni, Barbus brachycephalys, Aral acipenser nudiventus. There are some fishes into the Suenly as well. Among them Ctenopharyngodon idella and Silurus glanis. However, in most of the cases these fishes flow in Suenly canal from the closest lakes over the high water level in Amudarya river.

E.2.3. Natural Protected Areas

673. There are three protected areas on the territory of Karakalpakstan:

- Low Amudarya biospheric reserve (established in 2011) – in accordance with IUNC classification belonged to category 1.
- Saygachiy preserve (1991) – Category IV.
- Sudochue lake (1991) - Category IV.

674. The closest protected area to the project is Low Amudarya biosphere reserve which locates on the territory of Amudarya, Beruniy district of Republics Karakalpakstan around 75 km on the east-south from Takhiatash city.

Figure 38. Location of Baday Tukay Reserve

675. The Low Amudarya Biosphere Reserve with a total area of 68,717.8 ha is established based on closing the Baday – Tugay State Reserve and the transfer of its 6,462.1 ha land to the State Biosphere Reserve as well as on land plots of: The Kipchat forestry, Amudarya region and Beruni forestry, Beruni region, Republic of Karakalpakstan, with a total area of 5,106.2 ha. Thus, the conservation area is 11,568.3 ha.

676. The territory of the Low Amudarya State Biosphere Reserve is picturesque and has a high level of biological diversity of the flood-plain forest. In addition, the largest areas of flood-plain forests of the Republic of Uzbekistan are on the lower Amudarya River and should be regarded as a natural reserve of unique flora and fauna. Currently, in the Low Amudarya State Biosphere Reserve flood-plain forests two types of Asiatic poplars: Heterophyllous poplar (Populus diversifolia) and blue-gray poplar (Populus pruinosa) as well as two types of oleasters: Elaeagnus ongustifolia and Elaeagnus orientalis are the major tree species.

677. Forage vegetation is more diverse and there are good stocks of plants such as:Karelinia, Alhagi, Halostachys, liquorice, and several types of tamarisk that grow in the additionally included flood-plain forests Taldyk– Tugay and Nazarkhan.

678. There are 167 plant species in the reserve of which two are in the Red Book of the Republic of Uzbekistan. The fauna includes: 26 species of fish, 2 species of amphibians, 13 species of reptiles, more than 91 species of birds, 15 species of mammals including the Amudarya pheasant, the jackal, the jungle cat, and the wild boar. Among species listed in the IUCN Red Book and the Red Book of the Republic of Uzbekistan are: Fish – 5, birds – 4, mammals – 1: Big Amudarya shovelnose, pike chub, ostroluchka (Capoetobrama kuschakewitschi), white-eye (Abramis sapa), Aral barbell (Barbus brachycephalus), marsh harrier, great and small white heron, pygmy cormorant, and Bukhara deer (Cervus elaphus bactrianis).

679. Currently, the number of deer in the nature and the neighbouring territories is more than 300.

Figure 39. Amudarya Pseudoscaphirhynchus kaufmanni.y Tukay Reserve

E.3. Socio-economic environment.

680. Takhiatash TPP is located in Takhiatash city, in Khodjeyliy region of the Republic of Karakalpakstan. In general, Republic of Karakalpakstan has an important role in the economy of Uzbekistan. Gross regional product of the Republic of Karakalpakstan in the period 2010-2011 in current prices is 1 389.8 billion soums, the growth rate for the period 2009-2010 in comparable prices is 110.0%. In Karakalpakstan GRP the share of agriculture industry is 9.6%, construction 8.3 %, trade and catering – 8.1%, transport and communication - 7,6%, taxes – 6,4%.

Table 79. Consolidated macroeconomic indicators of Karakalpakstan for 2010-2011.

Indicator	Amount
Gross Regional Product	1,389.8 billion sum
Volume of industrial production	406,673.8 billion sum
Gross agricultural output in current prices	482,353.9 billion sum
Volume of investment	457,852.4 billion sum
Retail turnover	684,244.6 billion sum
Paid services	207,459.5 billion sum
Foreign trade turnover	115,426.2 thousand USD
Revenues of the local budget	512,914.2 billion sum
Local public expenditure	509,008.4 billion sum

681. Takhiatash TPP is located in Takhiatash city, in Khodjeyliy district of the Republic of Karakalpakstan.

682. Khodjeyli region was found in 1927, the total area of the district is 750 km square. Takhiatash city was found in 1953 and locates at the right bank of Amudarya river. Takhiatash city had it own Hokimiyat[5] but from now on forwards it will belong to the Khodieyli Hokimiyat. There are 10 Makhallas[6] in Takhiatash city, with the total number of 9745 families residing in 8841 households. The average size of the household is 5.5 people. The closest mahalla to the TPP is called "1 Brigada".

E.3.1. Employment

683. The average number of people working in different branches of national economy in Takhiatash city is presented in the following table and graph.

[5] Local authorities/local government
[6] Mahalla - In Uzbekistan, this word means a body of self-governance of citizens. Officially named as Mahalla assembly of citizens (MAC). Makhalla is a traditional neighbourhood community in urban areas. After independence, makhallas have been revived as an institute of social control.

Table 80. Amount of people per branches of national economy

Branches of national economy	Number of people
Total in national economy of Takhiatash city	16,700
Including:	
Industry	1,721
Agriculture	1,630
Transport	785
Logistics	44
IT sector	4
Providing services	740
Health care, physical, art	1,090
Finance and insurance	99
Others (administration, internal affairs, community organizations and etc.)	9,626

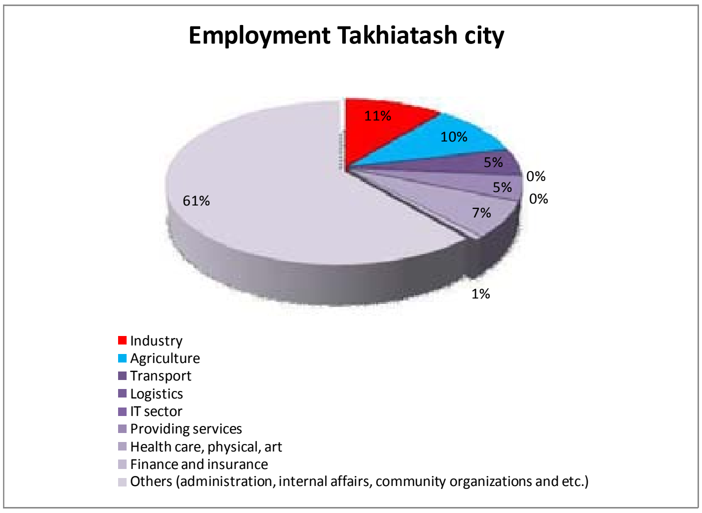


Figure 40. Employment of Takhiatash city

684. In Takhiatash city 61.2% are people of employable age The employment level of employable age population in the city is a little lower than in average in Karakalpakstan and in 2012 was about - 61%. At the same time population of the city characterised by a high percentage of youth within the population (almost 32%). In 2012, 1,525 people were registered in employment offices as seeking for job, and 1,374 (or 90%) were provided with the employment during this period of time.

Table 81. Employment Indicators in Karakalpakstan and Takhiatash City

Karakalpakstan AR	**Total**
Employable-Age Population	982,300
Employed	609,026
Takhiatash City	**Total**
Employable-Age Population	27,300
Employed	16,700
Officially registered People seeking for Employment	1,525
Provided with Employment	1,374
Receive unemployment subsidies	n/a

Source: Households Survey, February 2013

E.3.2. Distribution of income

685. Distribution of average incomes of workers in Takhiatash city by branches of national economy in 2012[7].

Table 82. Distribution of average incomes of workers in Takhiatash city by branches of national economy in 2012

Branches of national economy	**Income, sum**	**Income, US$**
Takhiatash city	1.038.444,0	507
Including:		
Industry	1.160.009,6	566
Agriculture	529.357,9	258
Transport	1.204.850,2	588
Communication	846.495,5	413
Trade	795.557,5	388
Construction	895.805,6	437
Health care, physical, social security	699.139,3	341

[7] Data provided by Takhiatash hokimiyat, 2012

Education	788.156,9	384
Culture and art	478.879,6	234
Finance	975.975,0	476
Administration	1.018.018,9	497

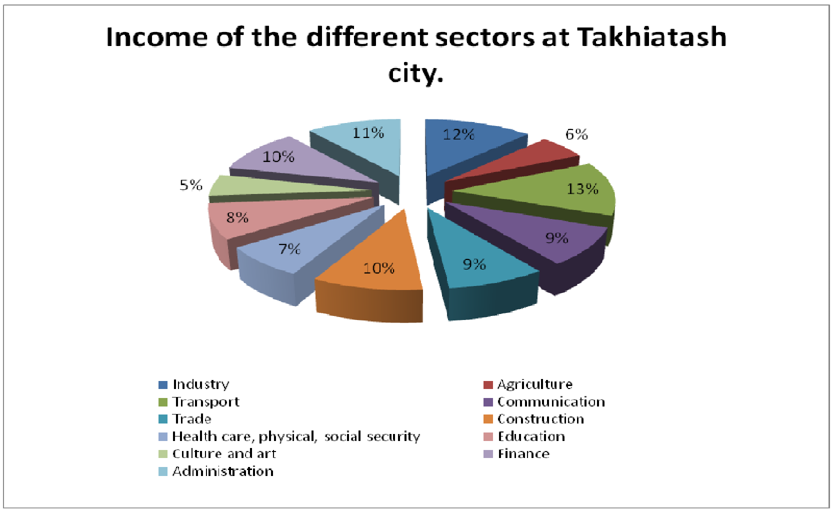


Figure 41. Income per sector at Takhiatash city.

686. Average monthly income per family in 2012 was 1,047,584.6 sum and per family member 115,372.8 sum.

E.3.3. Socio-economic conditions

687. The total population in Khodjeyli district is 134.4 thousand people, and 47.5 thousand people in Takhiatash city. From them 49% are males and 51% are females. From total population around 25 % is less than 16 years old. Ethnic distribution of population is presented in Table 83 (percentage as for 1989).

Table 83. Ethnic distribution of population

Ethnic	Khodjeyli district[8] (%)	Takhiatash city[9] (%)
Karakalpak	33.9	18.1
Uzbek	36.2	19.4

[8] http://sovminrk.gov.uz/lang/ru/cities-and-regions/khodzhayli/
[9] Data provided by Takhiatash hokimiyat

Ethnic	Khodjeyli district[8] (%)	Takhiatash city[9] (%)
Kazakh	27.1	44.4
Russian	0.5	3.05
Korean	1.1	3.05
Turkmen	5.7	6.7
Others	2.4	5.3

E.3.4. Land use

688. Land use distribution in Khodjeyli district are presented below:

Area: 705 km. Sq (70.582 ha), from them:

- Agricultural land — 35.081 ha.
- High saline — 1.453 ha.
- Settlement are and yards — 4.708 ha.
- roads — 1.845 ha.
- forest area — 1.411 ha.
- streets — 698 ha.
- other lands (rivers, hills, industrial zones, transmission lines) — 26.839 ha.

E.3.5. Infrastructure facilities

689. As for January 1 of 2013, 99.8% of total population of Takhiatash city is connected to centralized water supply system. There are two drinking water supply sources in Takhiatash city: canal “Arginbaev” and “Tuyamyun-Nukus” water pipe system. “Tuyamyun-Nukus” water pipe system originated from Tuyamyun water reservoir. The total length of water pipe system is 78.6 km. 19.5% of houses connected to municipal sewage network. 99.9% of houses are connected to centralized gas supply system.

690. Takhiatash city has a municipal waste water treatment plant with a biological treatment. Communal wastes are disposed at the municipal landfill located 2 km to the south from Takhiatash city.

Figure 42. Location of Takhiatash city Municipal landfills and water treatment plant

691. These landfills are using for the disposal of communal wastes from the Takhiatash city and most part of the industrial wastes from Takhiatash industrial enterprises. According to national legislation[10], only permitted wastes are allowed to be disposed on the municipal landfills. Other hazardous wastes like used batteries, oil residual, luminescent lumps have to be disposed in accordance with appropriated regulations - in specialized treatment plants or special disposal places for hazardous materials.

692. The landfill is not sited, designed and operated to isolate the wastes from the surrounding environment as indicated for instance in the IFC EHS Waste Management Facilities Guidelines (December 2007).

- e.g. the location of the municipal landfill is closer that the 250 meters to residential areas
- There is not a soil cover material, with base and side slopes designed o minimize infiltration and facilitate collection of leachate.
- There are not low-permeability landfill liners to prevent migration of leachate.
- There is not drainage and collection system and landfill cover (daily, intermediate, and final) to minimize infiltration.
- There is not a leachate treatment on site and/or discharge to municipal wastewater treatment.
- There are not perimeter drains and landfill cell compaction, slopes and daily cover materials to reduce infiltration of rainfall into the deposited waste.
- There is not a prevention system of the run-on precipitation into the active area of the landfill neither a collection and control run-off system.

[10] SanR&N No 0127-02 "Sanitarian Rules of inventory, classification, storage and disposal of industrial wastes"

- Quantity and quality of leachate generated is not measure and recorded.
- There are not groundwater monitoring wells

Figure 43. Takhiatash city municipal landfill

693. Takhiatash TPP uses this landfill for the disposal of its wastes. Domestic effluents are also driven to the municipal treatment plant.

E.3.6. Transportation

694. There is Nukus-Khodjeyli highway at 4 km to the north of TPP. Railway and road run at the distance of 150 m from Takhiatash TPP. Further railway runs at the distance of 1.3 km.

695. On the other hand, the closest airport is at Nukus, around 20 km far away from the TPP.

E.3.7. Power sources of transmission

696. The only power supply source in the area is the Takhiatash TPP. The TPP supplies with energy to all Karakalpakstan, Khorezm province and some districts in Central part of Uzbekistan.

697. At the same time, some pilot projects founded through various national and international organizations are being implemented in Karakalpakstan. Among them, Goskompriroda and UNDP own a project called “Clean energy for rural community in Karakalpakstan” which consist in a pilot solar PV station (capacity 100 W) installed in Karayzyak and Takhtakupir districts of Karakalpakstan.

E.3.8. Planned development activities

698. There are several development activities currently taken place in the Karakalpakstan. Chemical, gas-refining industries and construction materials production are been developed in the Republic. A number of big gas production and treatment companies (“Lukoil”, “Gazprom”, «KNOC», «KOGAS», «DAEWOO international») are operating in Usturt plateau. There is an increasing production in textile goods, the most of them to export.

699. The Government pays special attention to the construction of rural houses. There is a special investment program for the development of rural area supported with credit from ADB.

E.3.9. Public Health

700. EIA conducted by design institute provides results of analysis of the health status of the project area, which was conducted on the basis of statistical recording of sickness rate in Karakalpakstan in comparison with the general sickness rate of population of the Republic of Uzbekistan.

701. Statistical data analysis showed that the level of overall sickness rate and the majority of clinical entities in the Republic of Karakalpakstan is higher than the average rate for Uzbekistan.

702. In nosological groups sickness rates are higher than national average rates: diseases of the blood and blood-forming organs (3 times higher), genitourinary system (1.6 times higher), nervous system and sense organs (1.4 times higher), skin and subcutaneous tissue (1.3 times higher), respiratory organs (1.1 times higher). Pregnancy complications are 1.2 times higher than in Uzbekistan in general.

703. In the Republic of Karakalpakstan diseases of the blood and blood-forming organs (45.0% of total incidences), respiratory organs (15.1%), nervous system and sense organs (8.0%), urinary system (6.3 %), digestive system (4.9%) and diseases of cardiovascular system (4.3%) dominate in clinical entities.

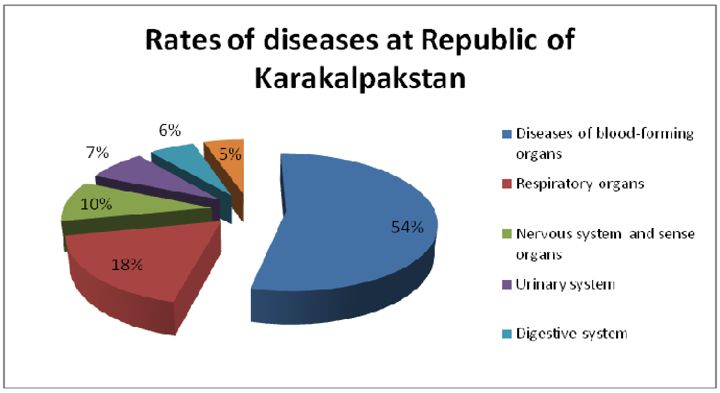


Figure 44. Diseases at Republic of Karakalpakstan

704. In the dynamics of the past five years the overall level of population sickness goes down, at the same time there is a steady growth of cancer diseases, diseases of the endocrine system, blood and blood-forming organs.

705. Similar results were observed in the group of adults, except for the additional excess rate for diseases of the musculoskeletal system in comparison with the national average rate.

706. The incidence of children under 14 years in the Republic of Karakalpakstan is generally lower than the incidence of the adult population. However, the excess of the national average rate observed for child diseases of the blood and blood-forming organs (3.4 times), genitourinary system (1.1 times), nervous system and sense organs (1.2 times) is higher than among adults.

707. Among adolescents aged 15-17 years in the Republic of Karakalpakstan the sickness rate is higher than among children under 14.

708. In addition, the overall sickness rate of adolescents is higher the average national rate (1.3 times higher), including the four clinical entities: endocrine disorders (1.1 times), diseases of the blood and blood-forming organs (2.7 times), nervous system and sense organs (1.3 times), diseases of the skin and hypodermic glands (1.4 times).

709. In Karakalpakstan the rate of hepatitis, cholelithiasis and stone formation in kidneys and ureters is higher than in Uzbekistan in general.

710. The main health problems include the following:

a) decreased kidney and liver function, arthritis, chronic bronchitis, typhoid and hepatitis, which increased dramatically over the past 10-15 years;
b) high rate of maternal and infant mortality;
c) increased level of genetic disorders;
d) children's diseases, typhoid, tetanus, intestinal diseases caused by the lack of purified water and poor sewage treatment in many settlements;
e) acute respiratory infections, especially among children;
f) anemia almost among all women, as well as among children and men.

711. By the criteria of health indicators Tahiatash town refers to 3rd grade: dangerous level, the zone of pre-critical environmental situation under the "Methodical guidelines on environmental hygiene division of the territory of the Republic of Uzbekistan on the risk degree to public health”.

712. Takhiatash city has one hospital for 200 beds and has following departments: infection departments, children’s ward, maternity ward. Moreover, there are two more clinics: adults and children, designed to provide service for 500 patients.

E.3.10. Education

713. There are 4 Universities on the territory of Karakalpakstan: the Karakalpak State University, Nukus Pedagogical University, the Nukus Branch of Tashkent Pediatric Medical Institute, the Nukus Branch of Tashkent Information Technology University, the Nukus Branch of Tashkent Agrarian University, the Nukus Branch of Tashkent State Art Institute.

714. 645 pupils enrolled in 9 secondary schools located in Takhiatash city. There are 2 colleges in Takhiatash.

E.3.11. Vulnerable groups and gender issues

715. There are no vulnerable groups or ethnic minorities defined on the project area and gender issues are not objet of special investigation either as inequality has not been observed.

E.3.12. Cultural properties & cultural heritage

716. Karakalpakstan locates in historical area of Ancient Khorezm. There are a number of historical monuments: Gyaur Kala (4^{th}-3^{rd} centuries, BC), Toprak-Kala (3^{rd}-2^{nd} centuries, BC), Ayaz-Kala (4^{th}-2^{nd} centuries, BC), Kyzyl-Kala (3^{rd}-2^{nd} centuries, BC) as well as architectural ensembles of the later period, such as the mausoleum of Naridzhan-Bobo (14^{th} cent.) and the unique Maslumhan-Sulu Mausoleum (14^{th}-17^{th} centuries).

717. Fragments of ancient inscriptions, which are considered the oldest in Uzbekistan, have been found during archaeological excavations of Koi-Krilgan-Kala. Details of sculptures, frescoes, inscriptions on ancient Khorezm language are stored in the Karakalpak Museum of Fine Arts.

718. The closest historical monuments to the Takhiatash TPP are remains of Mizdakhan city and the Mausoleum Mazlumhon Suluv. Mizdahkan is remains a major medieval town, located 8 km west of the city Khodjeyli[11].

[11] http://xodjeyli.uz

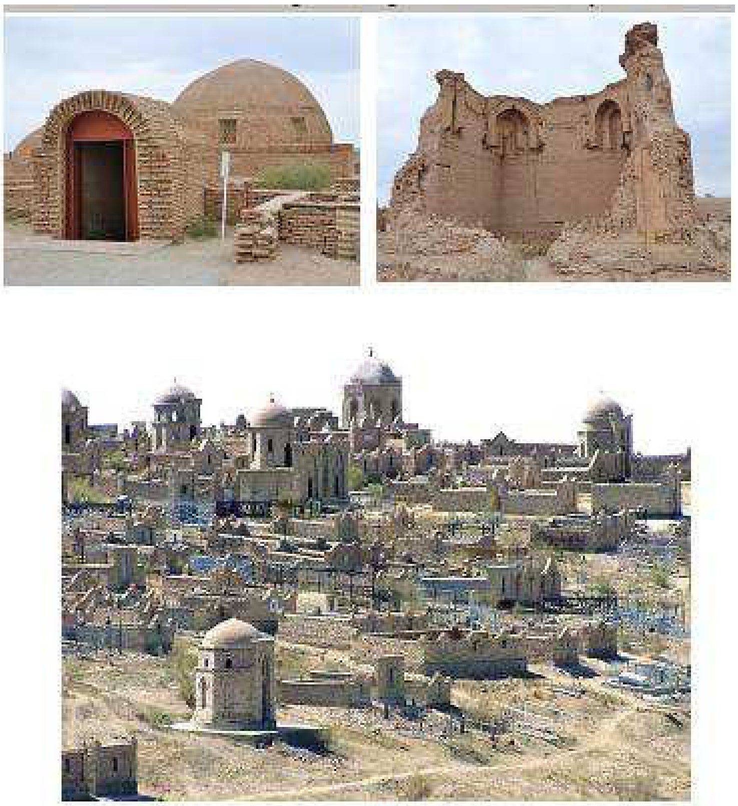


Figure 45. Archaeological vestiges of Mizdakhan city

F. ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

F.1. Impact Identification

F.1.1. Introduction

719. In order to identify the impact of the construction and operation of the new CCGT units as well as the decommissioning of the existing III and IV units and the demolition of the units I and II, a cross-reference was made between the project activities that might have an effect on the environment and the environmental factors that might be affected by those activities. A two-dimensional matrix was used for this purpose (project activities or environmental factors potentially adversely affected), where the impacts were presented in a synthetic and visual form. The information presented in the matrix was obtained from the following sources:

- Detailed project analysis and the conclusions of the baseline
- List of project activities likely to cause impacts
- List of environmental factors likely to be affected
- Consultations with groups of experts
- Usage of compared scenarios

F.1.2. Project activities likely to have an effect on the environment

720. The following table summarizes the activities associated to the various components of the project under study.

Table 84. Summary of project activities for Modernization of Takhiatash TPP

PROJECT STRUCTURES	PROJECT ACTIVITIES		
	CONSTRUCTION PHASE	OPERATIONS PHASE	DECOMMISIONING
2 CCGT units includes per unit a Power Generation Block (gas turbine, heat recovery steam generator and steam turbine with a cooling system and all their auxiliaries), Water treatment facilities, oil & chemical produce storage facilities, etc.	• Occupation of land • Land and vegetation clearing • Earthmoving • Trench digging • Construction • Presence of equipment and stocks • Equipment operation (vehicle movement, gas emissions, sound emissions, maintenance) • Hiring personnel • Waste generation, transportation and management. • Mechanic and electrical assembly & commissioning	• Flue gas emissions to the atmosphere • Noise emissions • Water intake • Water consumption • Effluent discharge • Waste generation, transportation & management. • Physical presence of the Power Plant • Hiring personnel and services • Electricity generation • Steam plume from the cooling towers • Maintenance	

PROJECT STRUCTURES	PROJECT ACTIVITIES		
	CONSTRUCTION PHASE	OPERATIONS PHASE	DECOMMISIONING
EQUIPMENT OF THE EXISTING UNITS III AND IV OF TAKHIATASH TPP (oil-gas boilers, steam generators and steam turbines, smoke exhausters, condensers, etc)			• Earthmoving • Decommissioning • Presence of equipment and stocks • Equipment operation (vehicle movement, gas emissions, sound emissions, maintenance) • Hiring personnel • Waste generation, transportation and management.

F.1.3. Environmental factors likely to be affected

721. The baseline lists in a tabular format the environmental factors likely to be affected by the project activities. The table was created by breaking down the environmental subsystems into the lowest level of environmental subfactors. This table is shown on the following page.

Table 85. Environmental factors hierarchy for Modernization of Takhiatash TPP project

SUBSYSTEM	ENVIRONMENT	FACTOR	SUBFACTOR
NATURAL PHYSICAL SUBSYSTEM	PHYSICAL ENVIRONMENT	ATMOSPHERE	CLIMATE
			NOISE COMFORT
			AIR QUALITY
		SOIL	RELIEF
			SOIL AND SUBSOIL QUALITY
			STRUCTURE
		HYDROLOGY	WATER QUALITY
			GROUNDWATER QUALITY
	BIOTIC ENVIRONMENT	FAUNA	FAUNA HABITATS
			BEHAVIOUR PATTERNS
		FLORA	NATURAL VEGETATION
			ANTHROPIC VEGETATION
	PERCEPTUAL ENVIRONMENT	LANDSCAPE	LANDSCAPE QUALITY
			VISUAL INTRUSION

SUBSYSTEM	ENVIRONMENT	FACTOR	SUBFACTOR
POPULATION AND ACTIVITIES SUBSYSTEM	LAND USE	RURAL	AGRICULTURE AND LIVESTOCK USE
		PRODUCTIVE	INDUSTRIAL USE
		NATURE CONSERVATION	PROTECTED LAND
	CULTURAL HERITAGE	RESOURCES	ARCHEOLOGICAL
			INDIGENOUS PEOPLE
	POPULATION	OCCUPATION	EMPLOYMENT
			HEALTH AND SAFETY
		WELFARE	POPULATION WELFARE
			DEVELOPMENT OF LOCAL ECONOMY
	COMMUNICATION AND INFRASTRUCTURES	INFRASTRUCTURE	ENERGY INFRASTRUCTURE
			NON-ENERGY INFRASTRUCTURE

F.1.4. Impact identification matrices

722. Finally, the cross-reference between project actions and environmental factors was generated, as the main item of the impact identification process. The matrix of identification is shown next, in which are included the potential interactions between the project actions and the environmental factors (potential impacts).

Table 86. Impact identification matrix – Works phase

IMPACT IDENTIFICATION MATRIX – WORKS PHASE																										
ENVIRONMENTAL FACTORS																										
PROJECT ACTIVITIES		**NATURAL PHYSICAL SUBSYSTEM**																**POPULATION AND ACTIVITIES SUBSYSTEM**								
		PHYSICAL ENVIRONMENT									BIOTIC ENVIRONMENT				PERCEPTUAL ENVIRONMENT		LAND USE			CULTURE HERITAGE		POPULATION				INFRA ST.
		Atmosphere		Geomorphology	Soil		Hydrology / Hydrogeology		Process		Flora		Fauna		Landscape		Rural	Productive	Nature Conservation	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				■			■															■			

Table 87. Impact identification matrix – Operation phase

IMPACT IDENTIFICATION MATRIX - OPERATION PHASE																						
ENVIRONMENTAL FACTORS																						
		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.
PROJECT ACTIVITIES		Climate	Noise comfort	Air quality	Soil and subsoil quality	Resource quantity	Water quality	Groundwater quality	Natural Vegetation	Anthropic Vegetation	Fauna habitats	Behavior patterns	Landscape quality	Visual Intrusion	Agriculture and livestock use	Industrial Use	Protected land	Employment	Health & Safety	Population welfare	Development of local economy	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																	■	■		■	
	Electricity generation															■		■	■	■	■	■

Table 88. Impacts identified

IMPACTS IDENTIFIED	
CONSTRUCTION, DEMOLISHING AND DECOMMISSIONING PHASES	**OPERATING PHASE**
- Potential discrete and local increase in particulate matter suspended in air. - Potential degradation of air quality due to exhaust emission from construction and decommissioning equipment. - Potential increase in the noise level of the construction and decommissioning sites. - Potential degradation of the local geomorphology. (*) - Potential soil compaction. - Potential increase of suspended solids in water, as a result of construction work. (*) - Potential soil and water contamination due to improper storage or manipulation of the work materials and/or waste. - Potential contamination of surface water by sanitary water from workers. - Potential increase of erosion risk due to construction work. (*) - Potential modification of natural drainage in the work area. (*) - Potential elimination of vegetation (*) - Potential reduction in the total area of fauna habitats in the work area. (*) - Impact on and potential discomfort to terrestrial fauna. - Potential modification of landscape during the construction, demolishing and decommissioning - Potential impact on natural areas. - Potential impact on agriculture, livestock, etc, which take place in the work area due to changes in land use. (*) - Potential impact on historical and archaeological heritage. (*) - Hiring of personnel and reactivation of the local economy during construction, demolishing and decommissioning phases. - Potential hazards for the health of the personnel and the population. - Increase in traffic. - Potential damage to road infrastructure owing to heavy duty construction traffic. (*) Only in construction phase.	- Greenhouse gases emission reduction by the replacement of an obsolete with an energy efficient technology. - Outdoor air quality improvement due to the emission reduction by the replacement of an obsolete with an energy efficient technology. - Potential increase in noise levels. - Potential increase of soil salinity due to the cooling towers steam plume deposition - Potential soil and groundwater pollution by accidental spillages or improper waste management. - Water resources intake reduction - Potential effects on water resources due to the increase of water consumed for the new CCGT. - Potential 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. - Potential impact on the landscape due to the physical presence of the new CCGT. - Potential impact on the landscape caused by the cooling water steam plume. - Potential impact on natural areas. - Potential hiring of personnel for operation of the new CCGT. - Development of the local and regional economy. - Potential health risk for the operation of the cooling towers - Potential hygienic risks for the health and safety of personnel and the surrounding population. - Increase in installed electrical power

F.2. Impact Assessment

F.2.1. Assessment methodology

723. The evaluation of each effect includes the following steps:

A) <u>Description of each impact</u>

724. The impact is first described and analyzed. If it is found INSIGNIFICANT, no assessment is performed. If it is found SIGNIFICANT, it is characterized and evaluated. The decision about the impact significance is based on a technique developed by an expert group.

B) <u>Characterization of effects according to their attributes</u>

725. If the impact is significant, its characterization is performed using the following attributes:

- Sign: **positive** if the effect is good compared to the previous state of the action, and **negative** if it is harmful.
- Immediacy: **direct** if the effect on an environmental factor is immediate, or **indirect** if the effect is a result of the interaction of multiple environmental factors.
- Accumulation: simple if the impact does not cause side effects, or **cumulative** if its severity increases when the action that generated it continues.
- Synergy: **non-synergistic** if the effect in question does not promote other effects, and **synergistic**, if it does.
- **Timing: short-term** if the effect occurs within one year, midterm if it occurs within five years, and **long-term** if it occurs after a longer time.
- Persistence: permanent if the effect results in a deterioration that is unlimited in time, and **temporary** if the deterioration has a limited term.
- Reversibility: **reversible** if the original conditions naturally reappear after an average period of time, and **irreversible** if the actions of natural processes are by themselves not sufficient to determine the recovery of the original conditions.
- Recoverability: **recoverable** if it is possible to conduct practices or take corrective actions that lower the severity or cancel the effect, and **non-recoverable** if such measures are impossible. It is important to consider whether the affected environment can be replaced.
- **Periodicity: periodic** if the effect is recurrent, or **non-periodic** if it is unpredictable.
- Continuity: continuous if the deterioration is constant in time, or discrete if it occurs intermittently or irregularly.

C) Impact incidence

726. The determination of the impact incidence is carried out in three steps:

727. A weight is assigned to the characteristic that can be taken by each attribute, lying between a maximum value for the most unfavorable and a minimum value for the most favorable.

728. The weight values assigned are as follows:

Table 89. Assigned values

ATTRIBUTE	TYPE	WEIGHT
NATURE	Positive Negative	-- --
IMMEDIACY (Inm)	Direct Indirect	3 1
ACCUMULATION (A)	Cumulative Simple	3 1
SYNERGY (S)	Synergistic Non-synergistic	3 1
TIMING (M)	Short-term Midterm Long-term	3 2 1
PERSISTENCE (P)	Permanent Temporary	3 1
REVERSIBILITY (R)	Reversible Irreversible	1 3
RECOVERABILITY (Rc)	Recoverable Non-recoverable	1 3
PERIODICITY (Pr)	Periodic Non-periodic	3 1
CONTINUITY (C)	Continuous Discrete	3 1

.

729. Applications of a weighted sum function of the attributes, according to their significance. The incidence of each impact is calculated in this manner.

INCIDENCE = Inm + 2A + 2S + M + 2P + 2R + 2Rc + Pr + C

730. This function enables to assess as more significant those attributes such as accumulation, synergy, persistence, reversibility, and recoverability of the impact, multiplying their effect by two when compared to others.

731. Normalization of the incidence values to values between 0 and 1, using the following formula:

$$I_s = \frac{I - I_{min}}{I_{max} - I_{min}}$$

Where:
I_s : impact incidence, normalized between 0 and 1
I : impact incidence, without normalization
I_{max} : maximum value of impact incidence
I_{min} : minimum value of impact incidence

732. The values I_{min} and I_{max} are 14 and 42, respectively, for all except the positive impacts, which are 10 and 30, respectively, to which the recoverability and reversibility attributes were not assigned, as not applicable.

D) Determining the magnitude

733. Compared scenarios and the expert group technique were used to determine the magnitude, assigning values of high, medium, and low. The magnitude of each impact is a function of the quality and quantity of the affected environmental factor. The quality reflects the factor value while the quantity is a measure of the impact extent or intensity.

E) Final value and assessment

734. Finally, the assessment of each impact was based on its incidence and magnitude:

a. **Compatible** impact, if the impact is of low severity and the environment recovers by itself without corrective actions, as soon as the action ceases.

b. **Moderate** impact, if the recovery takes some time, without intensive corrective actions.

c. **Severe** impact, if the recovery takes an extended amount of time, even when corrective actions occur.

d. **Critical** impact, if the environmental conditions are permanently altered, with no possible recovery, even when corrective practices or actions are implemented.

735. In the case of positive impacts, the above characterization does not apply, as they are completely defined by their incidence and magnitude. The impacts defined in the previous sections are assessed below.

F.2.2. Impact assessment and mitigation measures

736. The assessment was performed separately for the construction, demolishing/decommissioning and operation phases, to clearly distinguish the impacts generated by each phase and to be able to efficiently devise a series of preventive and corrective actions specific to each phase.

737. In order not to be redundant, the mitigation measures are not described in detail in this section as they are deeply explained in the EMP. In the present chapter, mitigation measures for every impact are just mentioned and summarized. In this regard, the EMP includes several measures that are not mentioned in this chapter as they are referring to general management or to impacts that are assessed as insignificant but even so, the inclusion of mitigation measures will result in an improvement of the environmental baseline.

738. As it has been mentioned in the description of the project, the scope of the present assessment relates to the construction of two 255 MW CCGT units at Takhiatash TPP as well as the whole decommissioning of the obsolete existing equipment of units III and IV and the demolition of the already dismantled units I and II.

739. Neither an extension in the transmission line nor Suenly canal is considered in the short term, but this may be further considered if the electricity demand increases. Gas pipeline to the Gas Distribution Station has a 2 km length and the final tack is still not defined. It could be traced parallel to the existing pipeline or a new path could be needed.

740. In the Land Acquisition and Resettlement Plan (LARP) conducted as an independent document to the EIA, assessment of the physical and economic involuntary displacement impacts caused by the temporary and permanent land acquisition for the TPP terrains and the gas pipeline is undertaken. These impacts are: Business and residential displacement; loss of trees; temporarily loss of employment, residential and agricultural land. Mitigation measures to provide adequate displacement and rehabilitation assistance to the affected households and to restore or improve their pre-project standard of living are also included, therefore, the above impacts have not been considered in the present section, neither in the EMP.

F.2.2.1. Construction, demolishing and decommissioning phases

741. Despite the fact that construction and decommissioning works take place at different times of the project, impacts caused on the environment as a consequence of those activities are fairly similar. This is a logical statement since construction and decommissioning include analogous activities and it is just the sequence of them that is inverse. Therefore, both phases will be analyzed together.

<u>IMPACTS ON ATMOSPHERE</u>

Potential discrete and local increase in particulate matter suspended in air

742. <u>Description.</u> This impact is due to moving the earth during the levelling work for the construction of the new 2 CCGT units, such as excavation of foundations, digging trenches for pipes (water, gas and wiring), opening access paths, etc., and by the movement of equipment on non-paved areas. Moreover, demolition of structures of blocks I-II and decommissioning of buildings and structures of the units III and IV may also cause an increase of particulate matter in the air.

743. In the present case, since the project is located within an existing industrial facility (Takhiatash TPP), it will not be necessary to build new access routes and certain infrastructure, these are already in place for existing Units. This applies specially to the decommissioning site, which is already well communicated.

744. All the facilities are located within industrial land, including the 40 hectare plot required to establish the new 2 CCGT units, so that most land has already been leveled and the earthmoving to be performed will not be too extensive.

Figure 46. Location of the surrounding habited areas

745. Outside of the TPP terrains, the impact from the gas pipeline construction will derive from: digging a trench; works of directional drilling (to cross the Suenly Canal if needed) and from the movement of machinery across non-asphalted surfaces.

746. Despite the fact that the closest inhabited areas are just around 300 meters far from Takhiatash new 2 CCGT units construction site, taking into account the characteristics of the project (usage of existing accesses, flat relief, paved ground, etc.) and the implementation of corrective measures to

control dust generation included in the EMP chapter (water sprinkling, trucks covered over with tarpaulins, speed control, etc.), this impact is assessed as **INSIGNIFICANT.**

Potential degradation of air quality due to exhaust emission from construction and decommissioning equipment

747. Description. To carry out all construction, demolishing and decommissioning works, a considerable fleet of vehicles and equipment is required. Most of this equipment needs a constant consumption of fossil fuels to be burnt, so that exhaust gases are released to the atmosphere.

748. The works have been planned to require the use of various equipment for commissioning activities (cranes, excavators, transportation trucks, etc.) beside the typical demolishing and decommissioning machinery. This should INSIGNIFICANTLY degrade the air quality considering that, as discussed in the EMP, all the vehicles and equipment will have their inspection certificates completed and will be maintain under the programs recommended by manufacturers, which will ensure and efficient consumption of fuel and, consequently, a reduction in their emissions. Therefore, this impact is assessed to be **INSIGNIFICANT**.

Potential increase in the noise level of the construction and decommissioning sites

749. Description. During the construction, demolishing and decommissioning phases, the works will cause an increase in the sound pressure levels in the vicinity and surrounding areas, due to the very nature of the work (earthmoving, transportation of materials, equipment and vehicle traffic, etc.) as well as the presence and movement of the on-site personnel.

750. For the determination of the sound pressure level (SPL) generated during the construction phase, demolishing and decommissioning, it was assumed that the sound wave would propagate through a homogeneous atmosphere, without losses due to attenuation. Therefore, the SPL is defined as follows:

$$SPL_1 = SPL_2 - 20 \times \log_{10} (r_1 / r_2)$$

Where SPL_1 is the sound pressure level at the distance r_1 and SPL_2 is the sound pressure level at the distance r_2.

751. The construction, demolishing and decommissioning activities will vary according to the advancement of the work. For instance, in the case of construction works, the first stage consists of comprising the filling and preparation of the foundations, which will be the noisiest. The noise levels will change throughout a work day, according to the equipment in operation at a given moment in time.

752. The table below shows the levels of sound pressure generated by the equipment during the works, which are measured at a distance of 1 m from the emission source, correlated with the equipment

utilization factors. This data was obtained from measurements performed during works of similar intensity, with variations of ± 3 dB(A).

Table 90. Levels of sound pressure generated by construction/ demolishing/decommissioning equipment

Equipment	Maximum level of noise dB(A)	Utilisation factor
Air compressor	98	0.4
Backhoe	101	0.16
Concrete mixer	97	0.4
Concrete pump	100	0.4
Concrete vibrator	99	0.1
Crane	91	0.12
Crawler tractor	98	0.16
Generator	100	0.4
Grader	105	0.05
Drilling machine	102	0.1
Loader	92	0.16
Pneumatic tool	99	0.04
Pump	100	0.4
Saw	98	0.1
Truck	90	0.3
Excavator	97	0.2
Welding machine	90	0.3

753. The noise levels will vary over time, depending on the equipment that is in operation at each moment. The following graph represents the variation of the level of sound pressure generated by the noisiest piece of equipment (105 dB(A)) with distance.

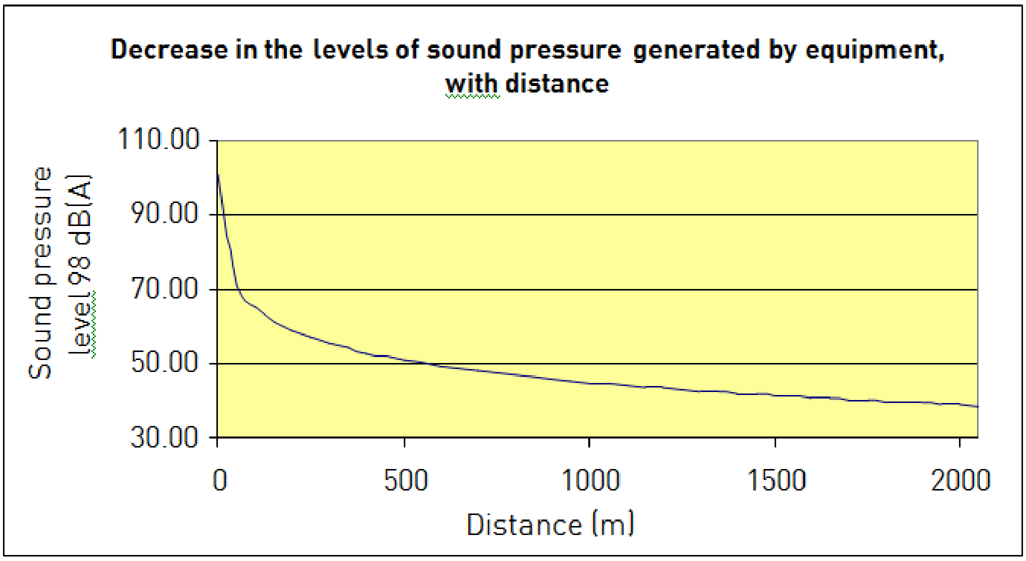


Figure 47. Decrease in the levels of sound pressure generated by equipment, with distance

754. It can be noticed in this graph that the noise falls rapidly with distance (as the emitting source moves farther away).

755. The Uzbek national construction noise norms that are relevant to all stages of the construction, demolishing and decommissioning phase are provided by law KMK 2.01.08-96 "Protection from noise".

756. The "Sanitarian Rules and Norms on providing allowed noise level into the living building, public building 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.

757. For another hand, the project must observe World Bank Directives ("Environmental, Health and Safety General Directives, 2007 ") based on those of the WHO. As for the impact of noise beyond the perimeter, the EHS Guidelines stipulate that such noise shall not result in a greater increase of ambient noise than 3 dB at the nearest receiving area outside the site.

758. 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.

759. On 4th and 5th March 2013, a noise campaign was done around Takhiatash TPP in order to know the background level noise. Noise measurements were conducted 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.

760. The next picture indicates the measured points in the campaign. Points 1 to 4 are classified as industrial area and points 5 to 8 as residential area.

Figure 48. Location of monitoring points for noise measurements

761. In the following table, results of the background measurements, noise produced by the noisiest equipment at the eight receptors considered in the noise campaign, and the total noise perceived in these points is calculated.

Table 91. Results of the background measurements

Point	Monitoring campaign results (dB(A))		Distance to the centre of the new 2 Units (m)	Equipment SPL at the measurement points (dB(A))	Total = Campaign SPL + Equipment SPL		Reference standard, by law (dB(A))		QUANTITATIVE ASSESSMENT = EQUIPMENT CONTRIBUTION (dB(A))		QUALITATIVE ASSESSMENT	
	Day	Night			Day	Night	Day	Night	Day	Night	Day	Night
P1	55	62	710	48	56	62	70	70	1	0	Without increase	Without increase
P2	54	60	460	52	56	61	70	70	2	1	Without increase	Without increase
P3	55	62	152	61	62	65	70	70	7	3	50% noisier	Barely perceptible
P4	51	44	595	50	53	51	70	70	2	7	Without increase	50% noisier
P5	53	54	742	48	54	55	55	45	1	1	Without increase	Without increase
P6	58	64	220	58	61	65	55	45	3	1	Barely perceptible	Without increase
P7	48	40	630	49	52	50	55	45	3	10	Barely perceptible	Two times noisier
P8	45	43	730	48	50	49	55	45	4	6	Perceptible increase	50% noisier

762. According to the table above, the noise levels are already exceeded in the nearby residential area (points 5 and 6).

763. In practice the propagation of the sound waves in open space is affected by a very diverse range of factors and this also has to be considered. Therefore, at great distances the real sources can only be detected occasionally, since the atmosphere is not uniform and there are also topographical irregularities. In short, there are various factors that can affect the propagation of sound, and these can also occur both individually and simultaneously. Because of this, when works are carried out, it can be expected that the real sound pressure level values (SPL_1) will be less than those estimated by the calculations.

764. Analysing the calculations shown in the table below, it is noticeable the fact that points P7 and P8 will suffer the impact of the noise caused by construction, demolishing and decommissioning works, especially during night time. Nevertheless, day levels are fulfilled. At points P5 and P6 there is not a noise increase.

765. Due to the estimation carried out, this impact is considered **SIGNIFICANT.**

766. Characterization and incidence. This impact is direct and negative, is simple and non-synergistic, as it does not facilitate the actions of other impacts. The impact is generated by construction of the new 2 CCGT units, demolishing of blocks I and II and the decommissioning of the existing units III and IV, and is thus considered temporary, periodic and discrete because it occurs intermittently during construction, demolishing and decommissioning works. It is reversible, as the original conditions naturally reappear after a period of time when the works finish. It is recoverable, as corrective measures are planned, in order to reduce the impact. The impact is short-term, when works start.

767. According to the methodology previously described, numerical values will be assigned to the form taken by the attributes, as shown below:

ATTRIBUTE	**CHARACTERIZATION**	**NUMERICAL VALUE**
SIGN	Negative	-
IMMEDIACY	Direct	3
ACCUMULATION	Simple	1
SYNERGY	Non-synergistic	1
TIMING	Short-term	3
PERSISTENCE	Temporary	1
REVERSIBILITY	Reversible	1
RECOVERABILITY	Recoverable	1
PERIODICITY	Periodic	3
CONTINUITY	Discrete	1

ATTRIBUTE	CHARACTERIZATION	NUMERICAL VALUE
(I=Inm + +2A + 2S + M + 2P + 2R + 2Rc + Pr + C)		26
NORMALIZED INCIDENCE (IS=I-Imin/Imax-Imin)		0.43

768. Magnitude. It must be pointed out that in measurement points P7 and P8 the excess of noise reach 10 dB(A) and 8 dB(A) respectively over the level required at nights. It should be noted that the increase in the noise level for these zones due to the works required will be higher than the value of 3 dBA for the maximum increase in the ambient noise prescribed by the World Bank directives.

769. Construction, demolishing and decommissioning works will last around 33, 15 and 6 months respectively but, as explained before, noise intensity will vary within this period depending on the work schedule. In this regard, the construction of the 2 km gas pipeline moves across the track resulting in a punctual and decreasing perception for the fix receivers.

770. In order not to impact in the surrounding population several measures have been included in the EMP. As a rule, the operation of heavy equipment shall be conducted in the time span 7am-7pm only and 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.

771. It is expected, that the noise standards will not cause a significant increase in the background noise levels, due to necessary corrective measures. Therefore, the magnitude of the impact is estimated to be medium.

772. Final impact assessment/value. The medium magnitude and the moderate value of incidence (0.43) lead to assess the impact to be MODERATE, with the adoption of protective measures envisaged.

IMPACTS ON GEOLOGY AND EDAPHOLOGY

Potential degradation of the local geomorphology

773. Description. During construction works, it may be necessary to modify the local geomorphology through grading, foundation excavation, access path widening, etc.

774. Regarding surface conditioning, the most of the land where the facilities of the CCGT are planned is classified as industrial use land and is already fairly leveled.

775. The planned construction work will be limited to the industrial site and the gas pipeline track for the construction ranges between 11 and 14 meters width and 2 km length. Gas pipeline (30 cm minimum diameter) track is not defined. In case the track would need to cross Suenly canal, environmental friendly construction technique indicated in the EMP is directional drilling which as a insignificant impact in the geomorphology.

776. The project area land does not comprise significant geomorphological elements and therefore will not require major changes in the environment. Therefore, this impact is assessed to be **INSIGNIFICANT**.

Potential soil compaction

777. Description. The movement of equipment and the temporary storage of materials on the ground during the construction, demolishing and decommissioning phases may cause the compaction of the soil. This compaction will take place in the area affected by the construction, demolishing and decommissioning works, in its vicinity, in the access areas, pipelines, etc.

778. The compaction of the soil involves an increase in its impermeability through the reduction in porosity and the alteration of its capacity to support vegetation (by preventing a correct development of the root systems and the edaphic fauna).

779. The area involved in the construction of the new 2 CCGT units is located in an industrial site where the land is already highly modified and in the gas pipeline track (ranges between 11 and 14 meters width and 2 km length). In any case mitigation measures are been proposed, with the objective of limiting the impact outside the works area and, where appropriate, restoring and revegetating any land that may be affected. Therefore, the impact is assessed to be **INSIGNIFICANT**.

IMPACTS ON HYDROLOGY

Potential increase of suspended solids in water, as a result of construction work

780. Description. During the construction phase, an increase of suspended matter in the surface water (Suenly canal) close to the work area might occur. This could happen in case of the gas pipeline crossing Suenly canal. This impact would be caused by the drift of fine particles and particulate matter from the bare surfaces which are likely to experience washouts and landslides by run-off water from rain, determining an increase in water turbidity.

781. As mentioned previously, most Takhiatash 2 CCGT units site is located within the plot of the existing Takhiatash TPP, in a flat terrain, so there are not steeply sloping areas which make the drift of particulates easier.

782. In terms of climatic conditions, Takhiatash TPP site belongs to Central Asia zone of deserts and semideserts which is characterized by a very low level of precipitation. According to the observations of the meteorological stations, in long-term data, precipitation is in the amount of 80-100 mm per year that falls in the autumn-winter period.

783. By other hand, the construction of water intake station to be built within the existing water intake canal could increase level of particles. In this respect, it should be take into account that the construction work will be performed over a short period of time and that mitigation measures will be implemented to reduce the possibility of materials drift.

784. Gas pipeline (30 cm minimum diameter) track is not defined. In case the track would need to cross Suenly canal, environmental friendly construction technic indicated in the EMP is directional drilling. This technic consist into crossing a perpendicular obstacle without disturb it (entering by one of the sides by a directed drilling wich cross the obstacle underneed and ending in the other side). Therefore, the potential drif of fine particulars to the canal is avoided with this technic.

785. Taking into account the characteristics of the project described above, beside the fact that the rainfall of the area is low, the probability of fine particles drift does not become relevant. Therefore, this impact is assessed to be **INSIGNIFICANT**.

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

786. Description. The impacts by contamination of the soil and water in the immediate vicinity, which should be considered, are those caused by incorrect storage or handling of the products or waste generated as a consequence of construction, demolishing and decommissioning works.

787. Waste resulting from construction, demolishing and decommissioning phases will be classified as **harzadous** according to "Basel Convention" (that which is made up of materials with certain hazardous characteristics to health and the environment) and **non hazardous** (that which by nature can be treated or stored on the same premises as household waste)

788. Non hazardous waste includes the group of household and similar waste (all domestic waste, waste generated in offices and toilets, packaging, plastics, paper, cardboard, wood, palettes etc.) and waste such as concrete, brick, rubble, iron scrap, steel etc.

789. Despite this kind of materials will be also found among waste generated during decommissioning works, there will be a substance which will require specially exhaustive management: asbestos. This substance has an extraordinary harzadous nature; therefore specific measures for a proper handling and treatment will be undertaken.

790. The list of the main waste materials expected to be generated in the decommissioning of units III and IV and the demolition of units I and II, is shown below:

Table 92. Main waste materials expected in the decommissioning and demolishing

Materials	Total quantity (t)	Hazard (according to Basel Convention)
Asbestos cement plaster	278.4	Harzadous (Annex I: A2050; Y36)
Basalt extra-thin fibre	37	Non-harzadous
Wire netting	16.95	Non-harzadous
Fire resistant concrete	1080	Non-harzadous
Thermo-isolated concrete	762	Non-harzadous (except if containing asbestos)
Structural steel	1685	Non-hazardous
Structural concrete	65,671	Non-hazardous (except if containing asbestos)

791. Incorrect storage or handling of these products, materials, and/or waste, may cause accidental spills (leaks and overflows), causing the contamination of soil and water as well as the possible effect on health of nearby population and ecosystems. In order to avoid these possible effects, prior to start of construction, demolishing or decommissioning, an inventory of waste fractions expected to be generated should be developed for approval of disposal routes and sites. This information will be part of a comprehensive Decommissioning Plan which will provide all the information needed to implement a proper handling of waste and harzadous substances.

792. In light of the amount of waste which might be produced, the nature of those substances, this potential impact turns out to be relevant.

793. Considering the current situation of Takhiatash TPP waste management, there is still a high probability of small quantities of waste being released and causing serious effects. Therefore this impact is SIGNIFICANT.

794. Characterization. The effect is negative, direct, and short-term on the quality of the soil and water.

795. It is cumulative and synergistic, as it does not enable the actions of other effects. Nevertheless, it is also temporary.

796. It will be local to the area where the impact and the deposition occurred, it will be irreversible, because the environment cannot absorb the impact within a short time, and the original conditions will not recover.

797. The effect is also discrete and recoverable, taking into account the implementation of protective and corrective measures. Finally, it is non-periodic, manifesting itself only during the actions that cause it.

798. According to the methodology previously described, numerical values will now be assigned to the form taken by the attributes:

ATTRIBUTE	CHARACTERISATION	NUMERICAL VALUE
SIGN	Negative	-
IMMEDIACY	Direct	3
ACCUMULATION	Cumulative	3
SYNERGY	Synergistic	3
TIMING	Short-term	3
PERSISTENCE	Temporary	1
REVERSIBILITY	Irreversible	3
RECOVERABILITY	Recoverable	1
PERIODICITY (	Non-periodic	1
CONTINUITY	Discrete	1
INCIDENCE (I = Inm +2A + 2S + M + 2P + 2R + 2Rc + Pr + C)		30
NORMALIZED INCIDENCE (I_S=I-I_{min}/I_{max}-I_{min})		0.57

799. Magnitude. The storage areas for materials and wastes will be marked out and no materials or waste of any kind will be authorized outside the work areas. The waste management for the future Takhiatash TPP should be adapted to international guidelines and those wastes considered by the Basel Convention to be hazardous will under no circumstances be dumped on the terrain. A general guideline on waste management is included in the EMP.

800. Basically, waste shall be processed depending on type:

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. Municipal landfill currently being used by the TPP is not design in an environmentally sound manner. An improvement of this landfill to avoid soil and groundwater pollution is advisable, if not, the EPC contractor will have to design and develop a specific non-hazardous waste storage.

Hazardous

-Disposed:

The disposal of wastes should 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.

801. In this respect, the TPP mazut storage located 35 km far away from the power plant, which is currently being emptied (see Project Description chapter), could be adapted to act as long-term hazardous storage. In the EMP several recommendations regarding the adaptation of the storage are included. If every one of the concrete tanks has a capacity of 10000 m^3 it could be possible to fit all the decommissioning hazardous wastes in one of the units.

Figure 49. Location of the mazut storage to adapt as hazardous waste storage

802. In conclusion, through compliance with that established in the waste management system there will be no possibility of contaminating the soil or groundwater. In addition, it has to be considered that most of the waste generated will have an inert nature. The magnitude of the impact is assessed to be medium.

803. Final impact assessment/value. The medium magnitude of the impact combined with its incidence value of 0.57 results in the impact being assessed to be **MODERATE**.

Potential contamination of surface water by sanitary water from workers

804. Description. The activities of the construction of the new 2 CCGT units, demolition of the foundations, building and stack of units I and II, and decommissioning of units III and IV, personnel will generate sanitary water that may be released directly to the ground, determining a degradation of the quality of water sources close to the outfall as well as the contamination of soil, and groundwater.

805. During the construction work, the used sanitary water will under no circumstances be released directly into Suenly canal or different nearby streams. The workers will have access to portable toilet units or septic tanks. The tanks will be periodically cleaned and the effluents will be collected and properly processed (e.g. in the Takhiatash municipal waste water treatment plant). In any case, delivery note/receipt of the final treatment should be kept. Therefore, the impact is assessed to be **INSIGNIFICANT**.

IMPACTS ON ENVIRONMENTAL PROCESSES

Potential increase of erosion risk due to construction work

806. Description. The emergence of these erosion phenomena is linked to the land and vegetation clearing, earthmoving, and trench digging activities and to the permanence of bare surfaces in the area occupied by the future Takhiatash CCGT.

807. As it has been previously mentioned, the new 2 CCGT units facility will be mostly located within a 40 hectare plot located on the southern border with the TPP which means that it will be still within the industrial zone, getting similar features. Gas pipeline construction track ranges between 111 and 14 meters and the length is just 2 km.

808. As already mentioned, there are no significant gradients in the area under study and therefore, although the rainfall is slight and vegetation is scarce, the appearance of erosive processes deriving from the construction activities will be limited to a very few, easily identified areas while the works will be carried out. In this respect, a mitigation measure to restrict work areas by means of proper beaconing.

809. Existing access and infrastructure will be used, thereby minimizing the construction area and erosion risks. Furthermore, the topography is relatively flat, therefore relevant erosion processes are not expected to take place as consequence of construction works. Under these circumstances, the impact is assessed to be **INSIGNIFICANT**.

Potential modification of natural drainage in the work area

810. Description. During the construction phase of the Takhiatash CCGT, earthmoving, trench digging, foundation excavations, and building construction activities are necessary. All these activities may alter the natural drainage of the work area, thus modifying the surface run-off due to the interruption of the regular stream lines.

811. This situation is limited to all the surroundings of the Takhiatash CCGT. Gas pipeline construction track ranges between 11 and 14 m width and the length is just 2 km. Considering the fact that the new facility is situated beside existing Takhiatash TPP and in partially already constructed area (railway, buildings, etc), the natural drainage is already modified. No modification to the surface drainage is intended; therefore this impact is assessed to be **INSIGNIFICANT**.

IMPACTS ON VEGETATION

Potential elimination of vegetation

812. Description. This impact is due to the elimination of the vegetation during land and vegetation clearing of the areas to be occupied by expansion of the new 2 CCGT units.

813. The existing access roads will be used and, if the need occurs, new roads will be built within the designated site. The total area that potentially may require clearing will be 40 hectares in the TPP terrains and 4.55 ha temporary land acquisition for the construction of the gas pipeline.

814. In accordance with the environmental baseline carried out by the present environmental impact assessment, there is not a high density of specimens; vegetation is characterized by being mainly sparse. This is due to the high soil and water salinity, sunstroke, frequent dust storms and insufficient system. The presence of halophytic species (***Halostachus caspian, Aeluropus***) is a clear indicator of high soil salinity.

815. More specifically, the vegetation on the 2 CCGT units expansion site occurs on land designed for anthropogenic use. Most of the formations encountered throughout the site are anthropogenic (simple herbaceous formations, rarely complex, woody bottom herbaceous). Nevertheless, taking into account the Land Accquisition and Ressetlement Plan, there are 202 trees affected in the TPP terrains and 1035 in the gas pipeline construction area. These trees are fruit and timber species of antropogenic value and no natural protected species are affected. In order to compensate these affected trees a specific mitigation measure to develop a green area has been included in the EMP.

816. Given the scarcity of vegetation in this area and the mitigation measures that compensate affected trees, this impact is assessed to be **INSIGNIFICANT**.

IMPACTS ON FAUNA

Potential reduction in the total area of fauna habitats in the work area

817. Description. This impact, due to the elimination of the vegetation during land and vegetation clearing of the areas to be occupied, may cause the displacement of the local animals and therefore a reduction in the fauna habitats of the species living in the area to be occupied.

818. Similar to the impact previously described, owing to the location of the new Takhiatash 2 CCGT units is on industrial land, the presence of fauna in this area is low, both in quantity and in value. Fauna is already used to living in a no natural environment. Moreover the fauna has no particular value or uniqueness (no rare, endangered or protected species were identified within the study area).

819. Thus, the site surface is little in terms of fauna and the anthropogenic species that live there can move to adjacent areas of similar characteristics. Therefore, the impact is assessed to be **INSIGNIFICANT**.

Impact on and potential discomfort to terrestrial fauna

820. Description. During the construction phase of the Takhiatash TPP expansion, the increase in equipment associated with a stronger human presence may cause a change in regular behaviour of fauna and the temporary or permanent displacement of some individuals from the area.

821. In general, the conversion of the surrounding habitats from natural to anthropogenic, as a result of industrial activity, and the daily presence of the existing TPP workers cause the existing species to adapt to the Power Plant staff presence and operations. Therefore, their behaviour of the specimens living in the area is not affected.

822. Furthermore, mitigation measures will be implemented to minimize the impact, such as traffic control, vehicle speed limitation, restriction on movement of personnel to work areas, use of vehicles with their inspection certificates completed, etc. Therefore, this impact is assessed to be **INSIGNIFICANT**.

IMPACTS ON LANDSCAPE

Potential modification of landscape during the construction, demolishing and decommissioning

823. Description. The presence of infrastructure and equipment required by the construction of Takhiatash 2 CCGT units, demolition of units I and II and decommissioning of the existing units III and IV, as well as the land and vegetation clearing and earthmoving activities will alter the landscape during the construction phase and decommissioning.

824. The landscape around the proposed location for Takhiatash CCGT is dominated by anthropogenic structures (Takhiatash TPP, construction industry enterprises, sintering plant, cereal products plant, etc.). Thus, the occurrence of construction work on a parcel of land which is mostly located within the existing Takhiatash TPP area, in a landscape already artificially altered, makes its intrinsic visual fragility rather low.

825. Regarding the gas pipeline, there will be a temporary modification to the landscape due fundamentally to the opening of the works road and the temporary presence of works installations, machinery and piles of material. However, this impact is temporary and will not occur at the same time along the whole route, as the works will be carried out in sections that will be shorter than the whole length of the pipeline.

826. Construction, demolishing and decommissioning sites are deeply anthropised and have already undergone the impact of industrial use. Therefore, it cannot be considered that the works of the project will mean a relevant alteration on the landscape. Keeping in mind all said above, this impact is assessed to be **INSIGNIFICANT**.

<u>IMPACTS ON LAND USE</u>

Potential impact on natural areas

827. <u>Description.</u> During the construction works of the new Power Thermal Plant and the new gas pipeline, natural areas may undergo the impact of using the land as part of the industrial facility.

828. According to the information compiled in the environmental baseline, Takhiatash TPP is not settled in a protected natural area, sensitive areas or any other level of protection land. Low Amudarya Biosphere Reserve is the closest protected area to Takhiatash CCGT, located on the territory of Amudarya, Berunity districts of Republics Karakalpakstan. That means a distance of around 75 km between Takhiatash CCGT and the Biospheric Reserve.

829. Considering the distance to the closest protected area, there are no expected impacts on natural areas. Therefore, this impact is assessed to be **INSIGNIFICANT**.

Potential impacts on agriculture, livestock, etc., which take place in the work area due to changes in the land use.

830. <u>Description.</u> The power plant will be mainly located within Takhiatash TPP plot, 40 adjacent hectares will have to be obtained for supporting service buildings and various facilities. In the Land Accquistion and Ressetlement Plan is mentioned that temporary land acquisition for gas pipeline will affect also 2 agricultural farms. The affected agricultural fields are mainly occupied by cotton. The surface affected is 4 ha, which represent just a 0.03% of the extension of these two farms. Therefore, only this surface of terrain could cause potential changes in the current use of land.

831. Nevertheless, there are no lands destined for agricultural or livestock uses in the TPP area. All the nearby terrains are planned to give service to industrial enterprises.

832. Moreover, as it is mentioned in the EMP, once the works are finished the fraction of land used temporally will be restored to its original condition and the farms affected will be compensed for the temporary impact. This impact is assessed as **INSIGNIFICANT**.

IMPACTS ON CULTURAL HERITAGE

Potential impact on historical and archaeological heritage

833. Description. The land and vegetation clearing, earthmoving, and land occupation activities during the construction of the new power thermal plant and the new gas pipeline may affect the archaeological heritage in the area designated for the planned structures.

834. As said before, the new 2 CCGT units is planned to be placed in an area previously affected by the construction and operation of existing units of Takhiatash TPP. For other hand, gas pipeline to the Gas Distribution Station located to the NW of the TPP has just 2 km length. In the baseline chapter is concluded that, after studying the environment, no archaeological vestiges in the area under study have been found.

835. The closest archeological sites are the remains of Mizdakhan city and the Mausoleum Mazlumhon Suluv around 16 km far from Takhiatash CCGT.

836. In addition, considering that the area under study has no historical and archaeological value and that corrective measures will be taken in case an archaeological vestige is discovered during earthmoving, the impact is assessed to be **INSIGNIFICANT**.

IMPACTS ON POPULATION

Hiring of personnel and reactivation of the local economy during construction, demolishing and decommissioning works

837. Description. The construction phase of the new 2, CCGT units, new gas pipeline, demolition of units I and II, and the decommissioning of units III and IV will require personnel to perform the work. This is a positive impact, resulting in the creation of jobs.

838. The majority of the jobs created during the construction work, estimated to last approximately 33 months will need up to 1.000 people at a peak. In the case of decommissioning activities, estimated to last approximately 15 months, it will be required up to 400 workers at a peak. For demolishing activities, estimated to last approximately 6 months, 40 workers will be required.

839. According to the baseline, regarding the percentage of population employed in different sectors, three major activity sectors can be distinguished: 61% other services (the economic activity in this sector is mainly focused on administration, internal affairs, community organizations and etc.), 11% in the industrial sector and 10% in agriculture.

840. The total population in Khodjeyli district is 134.4 thousand people and 47.5 thousand people is in Takhiatash city. From total population around 25 % is less than 16 years old.

841. The majority of the jobs created during construction, demolishing and decommissioning activities will be temporary during these phases take place.

842. In addition to the direct effect of hiring staff on employment, the construction, demolishing and decommissioning phases will create other indirect jobs to provide for the needs of housing, catering, petrol stations, etc.

843. Moreover, to purchase the new plot and operate the power plant, it will be required the payment of taxes to the public administration, which means a significant income for the nearby towns. This implies a positive impact on the local economy.

844. In the following graphic is shown the distribution of average incomes of workers in Takhiatash city by branches of national economy in the year 2012.

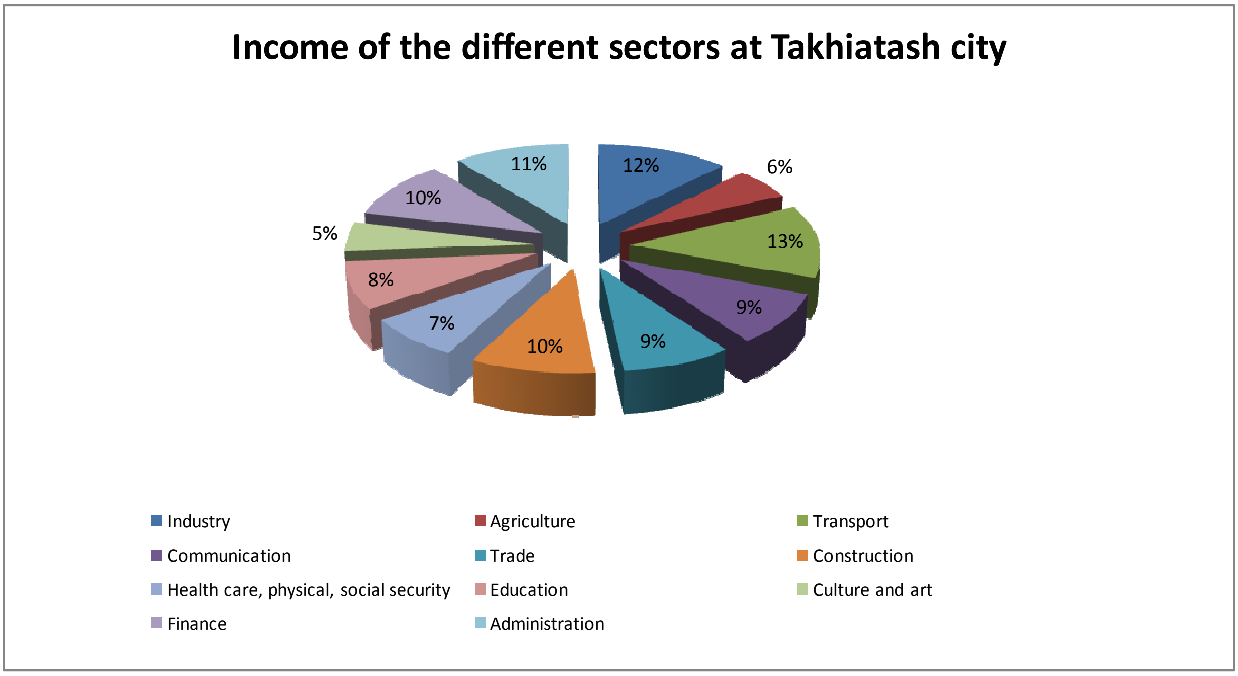


Figure 50. Income per sector at Takhiatash city

845. It can be noticed that the contribution by the different sectors is quite equitable. The economic activity generated by the implementation of construction, demolition and decommissioning works will specially increase profits of industry, transport and construction.

846. The reactivation of the local economy might also bring a positive effect on national economy due to the importance role that Republic of Karakalpakstan has in the economy of Uzbekistan.

847. Given the high number of jobs created and the duration of construction, demolition and decommissioning phases, this impact is considered SIGNIFICANT and is evaluated below.

848. Characterization. The effect is positive and direct on employment. It is simple, as it does not induce secondary or synergistic effects and it enables other favorable effects.

849. It is temporary, as it is limited to approximately 60 months in total, the duration of the construction, demolition and decommissioning, and it is short-term. The effect is non-periodic and continuous, and the modification is constant over the duration of the project construction, demolition and decommissioning phase.

850. According to the methodology previously described, numerical values will now be assigned to the form taken by the attributes:

ATTRIBUTE	CHARACTERISATION	NUMERICAL VALUE
SIGN	Positive	+
IMMEDIACY	Direct	3
ACCUMULATION	Simple	1
SYNERGY	Synergistic	3
TIMING	Short-term	3
PERSISTENCE	Temporary	1
PERIODICITY	Non-periodic	1
CONTINUITY	Continuous	3
INCIDENCE (I = Inm + 2A + 2S + M + 2P + 2R + 2Rc + Pr + C)		20
NORMALIZED INCIDENCE (I_S=I-I_{min}/I_{max}-I_{min})		0.50

851. Magnitude. This positive impact will be presented only for the duration of the construction work, demolition and decommissioning activities (approximately 60 months). This period will certainly contribute to improving employment in nearby villages, the unemployment rate in the area of Takhiatash being 11.79% (male) and 17.17% (female). In a basic calculation, if we consider population of Takhiatash city, a part of the 1400 workers could be hired from the 39900 people over 16 years.

852. Gender-inclusive core labor standards to promote female employment opportunities with non-discrimination, equal pay for work of equal value will be followed.

853. The number of jobs created and the rise in the wealth of the nearby cities makes this impact to be assessed to be of medium magnitude.

854. Final impact assessment/value. This **POSITIVE** impact is of medium magnitude and has an incidence of 0.50 points.

Potential hazards for the health of the personnel and the population

855. Description. Transboundary epidemic disease transmission is well known and has been observed in many settings. Many infectious diseases, such as cholera, influenza and meningitis, can rapidly and easily spread across national borders, particularly when a project attracts a large influx of potential job seekers during a construction, demolition and decommissioning phase. Similarly, a project may bring in large numbers of overseas workers for short-term specially construction work, demolition and decommissioning. In some situations, the disease spectrum of the imported workers may be quite different from the host country, e.g., multi-drug resistant tuberculosis, ***vivax*** versus ***falciparum*** forms of malaria. In some cases, it may be appropriate for very large scale transboundary projects to consider the potential for global or regional level disease epidemic transmission, e.g., avian influenza and SARS (***Severe Acute Respiratory Syndrome).***

856. Increased incidence of communicable and vector-borne diseases attributable to construction, demolition and decommissioning activities represent a potentially serious health threat to project personnel and residents of local communities.

857. Communicable diseases pose a significant public health threat worldwide. Health hazards typically associated with large development projects are those relating to poor sanitation and living conditions, sexual transmission and vector-borne infections. The communicable diseases of most concern during the construction phase due to labour mobility are sexually-transmitted diseases (STDs), such as HIV/AIDS.

858. The HIV concerns 14 administrative districts of Uzbekistan, with a rate of prevalence between adults of less than 1 %. In January, 2010, there was calculated in 30.000 the number of persons who were living with HIV in the country.

859. Other source of risk for the personnel health in the construction, demolishing and decommissioning of the TPP is the fact that workers can handle hazardous materials (for instance, removing asbestos that are carcinogenic in the decommissioning phase). In order to prevent this risk an Environmental, Health and Safety Plan will be developed for the different phases (this mitigation measure has been included in the EMP). In the EHS Plan, specific training and use of PPE procedures should be included.

860. Recognizing that no single measure is likely to be effective in the long term, successful initiatives typically involve a combination of behavioral and environmental modifications. Measures to prevent this issue that should be taken into account in the EHS manual for the activities during the construction, demolition and decommissioning phase includes the following recommended interventions at the project level:

- Providing surveillance and active screening and treatment of workers.
- Preventing illness among workers in local communities by:
- Undertaking health awareness and education initiatives, for example, by implementing an information strategy to reinforce person-to-person counselling addressing systemic factors that can influence individual behaviour.
- Training health workers on disease treatment.

- Conducting immunization programmes for workers in local communities to improve health and guard against infection.
- Providing health services.
- Providing treatment through standard case management in on-site or community health care facilities. Ensuring ready access to medical treatment, confidentiality and appropriate care, particularly with respect to migrant workers.
- Training for workers working with hazardous materials with special attention for workers exposed to asbestos.
- Promoting collaboration with local authorities to enhance access by workers' families and the community to public health services and promote immunization.
- Reducing the impact of vector-borne disease on the long-term health of workers. This is best accomplished through the implementation of diverse interventions aimed at eliminating the factors that lead to disease.

861. Moreover, the maximum number of workers (1.000 for construction works, 40 for demolition and 400 for decommissioning) will only be onsite on isolated occasions, meaning a much smaller group will be present throughout most of the works, especially because decommissioning activities will take place once the construction of the new 2 CCGT units is finished.

862. Considering, that workers will be medically supervised and will live in proper hygienic conditions, that the number of workers and size of the project are not large enough to easily pose disease epidemics or transmission problems and that, above all, a whole series of preventive measures should be included in the EHS manual (including training and use of PPEs), the impact is assessed as **INSIGNIFICANT**.

IMPACTS ON COMMUNICATIONS AND INFRASTRUCTURES

Increase in traffic

863. Description. The construction phase will generate increased traffic due to trucks used for construction work and vehicles used by staff to travel to the work areas. In the same manner, demolishing and decommissioning activities will require an intense movement of materials and waste from the demolishing of units I and II and the dismantling of units III and IV, as well as the raise in traffic due to the workers who take part in decommissioning activities. This could cause inconvenience to the population and therefore this impact is assessed to be **SIGNIFICANT**.

864. Characterization. This impact is direct and negative, is simple and non-synergistic, as it does not facilitate the actions of other impacts. The impact is generated by construction of the new 2 CCGT units, new gas pipeline, demolishing of units I and II and the decommissioning of the existing units III and IV, and is thus considered temporary, periodic and discrete because it occurs intermittently during construction, demolishing and decommissioning works. It is reversible, as the original conditions naturally reappear after a period of time when the works finish. It is recoverable, as corrective measures are planned, in order to reduce the impact. The impact is short-term, when works start.

865. According to the methodology previously described, numerical values will be assigned to the form taken by the attributes, as shown below:

ATTRIBUTE	CHARACTERIZATION	NUMERICAL VALUE
SIGN	Negative	-
IMMEDIACY	Direct	3
ACCUMULATION	Simple	1
SYNERGY	Non-synergistic	1
TIMING	Short-term	3
PERSISTENCE	Temporary	1
REVERSIBILITY	Reversible	1
RECOVERABILITY	Recoverable	1
PERIODICITY	Periodic	3
CONTINUITY	Discrete	1
(I=Inm + +2A + 2S + M + 2P + 2R + 2Rc + Pr + C)		26
NORMALIZED INCIDENCE (IS=I-Imin/Imax-Imin)		0.43

866. Magnitude. In all circumstances, traffic control measures will be implemented to reduce the potential inconvenience, as shown in the EMP.

867. Basically, a traffic management plan will be developed to include:

- 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

868. After the implementation of the traffic management plant, the magnitude is considered to be **MEDIUM**.

869. Final impact assessment/value. The medium magnitude of the impact combined with its incidence value of 0.43 results in the impact being assessed to be **MODERATE**.

Potential damage to road infrastructure caused by heavy duty construction/decommissioning traffic

870. Description. Both, construction, demolishing and decommissioning phase of the project will produce a rise in heavy duty traffic, which may cause the deterioration of the existing road system.

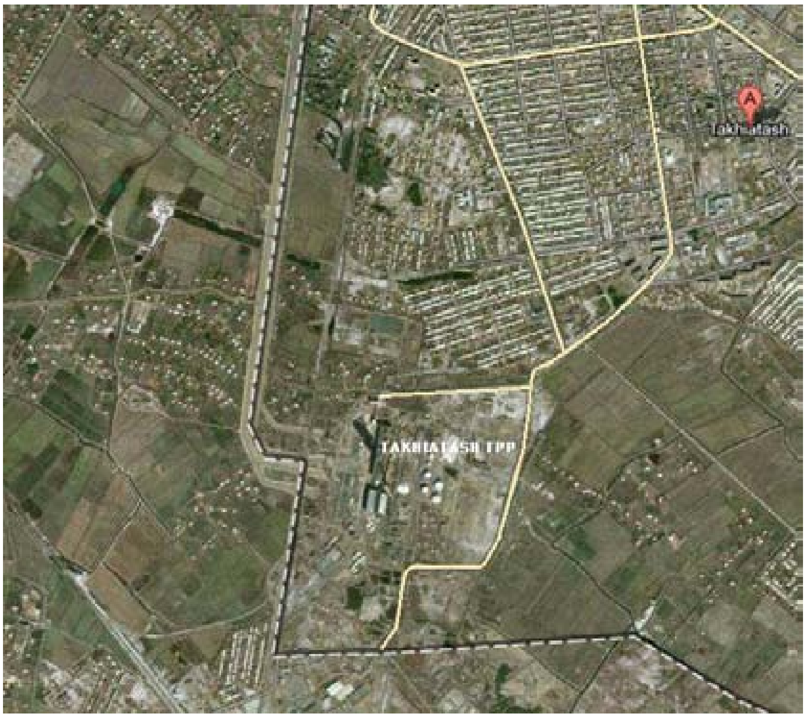


Figure 51. Main existing roads which connect Takhiatash city to the Thermal Power Plant

871. If during the works a deterioration of the communication network is caused by the heavy duty traffic, the damages will be repaired to return to their original condition the roads that might have been affected. Therefore, this impact is assessed to be **INSIGNIFICANT**.

Table 93. Impact assessment summary-construction/decommissioning phases

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	MODERATE
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, demolishing 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, demolishing 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, demolishing and decommissioning traffic	-	INSIGNIFICANT		

F.2.2.2. Operations phase

<u>IMPACTS ON ATMOSPHERE</u>

Greenhouse gases emission reduction by the replacement of an obsolete with an energy efficient technology

872. Description. The greenhouse gases absorb a portion of the solar radiation reflected by the earth, the energy being retained in the atmosphere. Conventional wisdom states that rising greenhouse gas emissions could cause global climate changes, potential earth warming, and rising sea levels.

873. The emissions produced by humans during the last decade and their contribution to the global warming of the earth are: carbon dioxide (CO_2, 68%), methane (CH_4, 19 %), nitrous oxide (N_2O, 7 %) and chlorofluorocarbons (CFC, 6 %).

874. Trends in world CO_2 emissions show an accelerated increase during the last century (a trend that should continue unless we take action against it). The increase in world CO_2 emissions has led to a rising concentration of CO_2 in the atmosphere.

875. Uzbekenergo (UE) is the national company in charge of the electricity sector through joint-stock companies in which the State is the main shareholder. Uzbekenergo owns and operates 10 thermal power plants (TPPs) and 28 hydropower plants (HPPs), which represent 87.6% and 12.4% of the total generation capacity, respectively.

876. In 2010, Uzbekistan generated about 51,935 GWh of electric power. The major part of electricity generation was done by thermal power plants. The natural gas was used for 94% of thermal power generation.

877. Uzbekistan's energy intensity per unit of GDP is one of the highest in the world and significantly above other middle-income countries. As a result of intensive industrial use of energy, carbon emissions per unit of GDP in Uzbekistan are among the highest in the world. Lowering energy intensity and carbon emissions will increase the economy's competitiveness and mitigate climate change impacts.

878. Energy security, affordability, and efficiency are key priorities of the government's energy strategy. The government has adopted policy and legal frameworks with clear goals to reduce energy intensity and losses.

879. In this respect, power generation from burning gas in a CCGT is the cleanest method of generation using fossil fuels. The CCGT turbines burning natural gas produce significantly less greenhouse gases than traditional coal or oil fired thermal power stations, as a result of both the less greenhouse intensive nature of natural gas and the greater inherent energy conversion efficiency of CCGT technology. Its performance is much higher (approximately 55%) than a conventional power plant (around 32%). Replacing the existing power generation assets with the energy efficient CCGT technology is a key strategy for Uzbekistan in order to save energy, secure reliable power supply and mitigate climate change impacts.

880. Within this framework, two of the main objectives for the energy sector in Uzbekistan settled by the ADB by 2016 are:

- Thermal power generation efficiency increased from current 31% to 50%.
- Greenhouse gas emissions reduced from 4.1 to 2.7 $mtCO_2e$/GDP.

881. As mentioned in the Country Partnership Strategy 2012–2016 for Uzbekistan (August 2012), ADB will provide support for energy efficiency enhancement as this is closely aligned with Uzbekistan's emphasis on promoting energy security and affordability, and reducing energy intensity.

882. The implementation of this project will allow cutting operational expenses, increasing the efficiency and the reliability of the energy supply to consumers, as well as improving the environmental quality in its area of influence according with the Government and ADB strategies.

883. Uzbekistan is engaged in the fight against Climate Change (CC) at the international and national level. In 1999, it ratified the Kyoto Protocol. The Project will comply with all national standards for GHG emissions in order to contribute to Uzbek targets set in line with the adoption of the Kyoto Protocol.

884. From a global perspective, the replacement of the old conventional units III and IV with a new 2 CCGT units for the generation of electricity may play a key role in a global, integrated strategy to reduce greenhouse gas emissions. This impact is assessed as **SIGNIFICANT** and is evaluated below.

885. Characterization. The reduction in greenhouse gases has a direct and positive impact on the climate. It is cumulative and synergistic, because the reduction in greenhouse gases has varying degrees of effect, some reinforcing the effects of others. It occurs in the short term, although it is permanent because the effect is indefinite. Equally, it is periodic and continuous as it occurs recurrently and constantly.

886. Following the methodology described, numerical values were assigned to the attributes:

ATTRIBUTE	CHARACTERIZATION	NUMERICAL VALUE
SIGN	Positive	+
IMMEDIACY (Inm)	Direct	3
ACCUMULATION (A)	Cumulative	3
SYNERGY (S)	Synergistic	3
TIMING (M)	Short-term	3
PERSISTENCE (P)	Permanent	3
PERIODICITY (Pr)	Periodic	3
CONTINUITY (C)	Continuous	3
INCIDENCE (I=Inm+2A+2S+M+2P+2R+2Rc+Pr+C)		30

ATTRIBUTE	CHARACTERIZATION	NUMERICAL VALUE
STANDARDISED INCIDENCE (I_S=I-I_{min}/I_{max}-I_{min})		1

887. Magnitude. The CO_2 emission per year for the new power units CCGT will be:

Table 94. CO_2 emission per year

UNITS	Installed Capacity (MW)	Power Generation (GWh/yr)	CO2 Emission (1000 tCO2e)
Existing Units	730	3276	2117
New Units	508	3511	1478
Decommissioning	310	956	741
Remaining	420	426	253
Net Change	198	661	-386
After Project	**928**	**3937**	**1731**

Note: CO2 emissions have been calculated to take into account the operation of units V and VI as backup (1014 h/year) and the operation of new 2 CCGT units (6912 h/y/unit).

888. The reduction of emissions in frames of the project is defined as spread between avoided emissions due to decommissioning III and IV units, the operation of V and VI units as backup and the emissions of the new 2 CCGT units: 386,000 ton CO_2 equivalent/year.

889. Greenhouse gases emission reduction by the replacement of an obsolete with an energy efficient technology will be represented by 16% reduction of CO_2 emissions per year.

890. If we consider electric power generated in 2010, the reduction the previous percentage between the thermal power plants production would mean a 1.3% national global reduction.

891. Therefore, given the power of the power plant, the impact on the global greenhouse effect is assessed as low.

892. Final impact assessment/value. This POSITIVE impact is low in magnitude and high in incidence (1).

Outdoor air quality improvement due to the emission reduction by the replacement of an obsolete with an energy efficient technology

893. Description. During the operation of the Takhiatash TPP, the combustion gases will be emitted to the atmosphere, which can produce a degradation of the air quality nearby the facility.

894. To analyse this impact, the fact that air pollution is an integrated system with three basic components should be taken into consideration:

a. Emission: all substances that pass to the atmosphere after leaving the sources from which they proceed.
b. Dispersion: after the emission, the pollutants are distributed in the atmosphere via a dispersion process which depends on the characteristics of the pollutants and of the emission source, as well as of the actual weather conditions.
c. Immission: existing levels of air pollution around the emitting source.

895. Modelling (see Annex III) of the dispersion of pollutants by AERMOD model has allowed study the contribution of different emissions of the combustion of natural gas on current and future scenario on levels of air quality on a domain of 40x40 km^2.

896. 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 two new future CCGT units)) on levels of CO, NO and NO2. SO2 and particulate matter are practically not emitted by the combustion of natural gas. Scenario 2 (future) is currently overestimated as existing units V and VI are planned to operate only as back-up units during maintenance operations of the CCGTs, therefore, the real situation would be represented by the operation of the two CCGTs only. The reason to include units V and VI is to assess the potential future worst case, as the current demand is expected to increase in the future (for 2020 the demand estimated is of 620 MW at maximum load, far below the maximal potential future load of 930 MW anyway).

897. For the scenario 2 the aim of the study was also to determine the optimum stacks height for the two new CCGT units. Stacks height for the two new CCGT units have been calculated based on the international practice recommended by the industry (GIIP), according to the document “Réf. US EPA: 40 CFR, partie 51.100 (ii)” resulting in 112.5.

898. In the time between the entrance into commercial operation of the CCGT1 and the CCGT2, the simultaneous operation of the CCGT1 and the blocks IV, V and VI is possible, however this scenario is not considered because:

- This situation will last only for three months,
- The maximum current demand (about 470 MW) is much lower than the available full capacity of the referred units (780 MW), and
- The emission level expected in this scenario (CCGT1 + blocks IV, V and VI) is covered by the considered scenario of CCGT1 + CCGT2 + blocks V and VI at full load (930 MW).

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

- Continuous operation with a 100%. Real operation is not going to be continuous as can be observed in the following table:

	Current indices		Future indices		
	III and IV	**V and VI**	**V and VI**	**CCGT 1**	**CCGT 2**
Installed capacity (MW)	310	420	420	254	254
TOTAL CAPACITY (MW)	730		930		
Operating hours (h)	3083	5525	1014	6912	6912

Continuous operation during the simulated year is considered in order to analyze all the possible hourly meteorological combinations to obtain hourly maximum results. Nevertheless, averaged daily, monthly and annually results will be higher than the real ones obtained with less operation hours.

- 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): NOx 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 considering all the NO2 as NOx, NO is overestimated also. In this way, it can be guaranteed than the considered emission values to simulate are the highest possible. For CO, a very conservative bibliographic data has been considered.

900. The simulation provides results in the area of study (40x40 km) and in specific receptors: air quality stations and sensitive areas. Air quality stations measurements are added to the results of the simulation In order to analyze if the air quality limits are being fulfilled. Air quality baseline data of years 2011 and 2012 from two air quality stations within the area of study have been analyzed and measurements show fulfillment of all the standards for all the pollutants (see "environmental baseline" chapter, point E.1.2.).

901. Sensitive receptors are analyzed in order to assess the contribution of the TPP to specific locations of Takhiatash city. These locations and the distance to the TPP are shown in the following picture.

Figure 52. Location of the sensitive areas

902. Due to the replacement of an obsolete technology (units III and IV) with an efficiently one (two new CCCT units), the emission rate per energy produced will be reduced and therefore it could mean an improvement in the air quality of the area. This impact is considered as **SIGNIFICATIVE** and assessed in the following paragraphs.

903. Characterization and incidence. The impact due to the release of flue gases to the atmosphere is direct and immediate (short-term) on air quality, permanent, as present over the lifetime of the facility, and negative.

904. It is reversible, because when the emission ends, over a short period of time the initial conditions naturally recover. It is recoverable, because corrective measures will be applied as planned (stacks height, NO_X low burners, etc.). The impact of occurring recurrently, it is thus periodic and continuous.

905. Being an impact whose severity increases if the action that generates it persists, it is considered cumulative. Finally, it is a synergistic impact because it promotes the action of other effects.

906. According to the methodology previously described, numerical values will now be assigned to the form taken by the attributes:

ATTRIBUTE	CHARACTERIZATION	NUMERICAL VALUE
SIGN	Negative	-
IMMEDIACY	Direct	3
ACCUMULATION	Cumulative	3
SYNERGY	Synergistic	3
TIMING	Short-term	3
PERSISTENCE	Permanent	3
PERIODICITY	Reversible	1
RECOVERABILITY	Recoverable	1
PERIODICITY	Periodic	3
CONTINUITY	Continuous	3
INCIDENCE (I=Inm + +2A + 2S + M + 2P + 2R + 2Rc + Pr + C)		34
NORMALIZED INCIDENCE ($I_S = I - I_{min}/I_{max} - I_{min}$)		0.71

907. Magnitude.

908. Conclusions regarding the modeling immission results are:

- For scenario 1 (current situation):
  - Maximum values: It has been observed annual maximum values of 2.02 µgm^{-3} NO_2 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 NO_2 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 NO_2 has been 61.64 µgm^{-3} (World Bank limit 200 µgm^{-3}). In any case, results are away from the legal standard. Contribution of the TPP to the legal standard ranges between 30.82% for hourly NO_2 to 0.008% for monthly CO.
  - Values at the sensitive areas: For NO_2 annual values range is 0.31-0.35 µg/m^3; monthly values range is 0.65-0.73 µg/m^3; daily values range is 4.35-5.57 µg/m^3; hourly values range is 26.11-30.41. For NO annual values range is 0.05-0.06 µg/m^3; monthly values range is 0.11-0.12 µg/m^3; daily values range is 0.71-0.91 µg/m3. For CO monthly value is 0.04 µg/m^3; daily values range is 0.25-0.33 µg/m3. In this sensitive areas, contribution of

the TPP to the legal standard ranges between 15.66% for hourly NO2 to 0.001% for monthly CO.

- For scenario 2 (future situation) it has obtained similar values, all far below the legal standards.
  - Maximum values: 1.63 µgm-3 NO_2 and 0.78 µgm-3 NO has been obtained for annual maximum values. For monthly results 3.79 µgm-3 has been observed as a maximum value of NO_2, 1.83 µgm-3 for NO and 0.79 µgm-3 of CO. In the case of NO2 has been observed 9.83 µgm-3 for daily maximum values, 4.81 µgm-3 NO and 2.11 µgm-3 CO. Finally, 55.91 µgm-3 of NO_2 has been obtained for hourly values. Contribution of the TPP to the legal standard ranges between 27.59% for hourly NO_2 to 0.022% for monthly CO.
  - Values at the sensitive areas: For NO_2 annual values range is 0.26-0.30 µg/m^3; monthly values range is 0.54-0.6 µg/m^3; daily values range is 3.47-4.31 µg/m^3; hourly values range is 24.14-28.56. For NO annual values range is 0.11-0.12 µg/m^3; monthly values range is 0.18-0.22 µg/m^3; daily values range is 1.61-2.07 µg/m^3. For CO monthly values range is 0.09-0.11 µg/m^3; daily values range is 0.7-0.9 µg/m^3. In this sensitive areas, contribution of the TPP to the legal standard ranges between 14.29% for hourly NO_2 to 0.003% for monthly CO.

909. Comparing contribution to air quality baseline between the current and future stages, it can be concluded that NO_2 inmissions will be decreased around 16%. (12)

910. Examination of the simulation maps leads to the conclusion that maximum hourly concentration maps, for scenario 1 and for each pollutant, shows spots located at the ESE and between 2,300 m to 5,500 m for NO_2, NO and CO from the plant. In the NNW direction appears other spots with not so high concentration values. On the other hand, for scenario 2 the spots affected are more variable, being situated along the E to S: between 1,100 m to 5,000.

Maximum daily concentration maps show for each scenario and pollutant that the spots affected by them are those located along the S and not farther than 2,000 m from the plant.

For maximum monthly and annual concentration maps the spots affected by the maximum concentration values are those located at the SW and respectively not farther than 2,000 m.

Due to the close distance to the Turkmen side, the dispersion plume of the TPP operation affects this area 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.

911. Conclusions regarding fulfillment of air quality legal standards are:

- It should be taking into account that results are being overestimated because of:
  - 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.
  - 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).

[12] Regarding NO and CO, we have to consider that the emission values included in the model for the two new CCGT units have been very overestimated and comparison with the existing situation (where emission values are fit to operation) would bring into not realistic conclusions.

Therefore, if we add the measurements of the air quality stations to the results of simulation on these stations we are doubling the existing unit's contribution. 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. In this regard, air quality measured in the stations cannot be compared with the simulation results as; the first one considers contribution of several sources (among them the TPP) and the second one considers just the contribution of the TPP.

- Even considering the above remarks, 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 (based on the WHO standards). Percentage of contribution of the TPP to the air quality legal standards at the air quality stations comparing current and future scenarios show a slight improvement for NO_2 and a slight deteriorate in the NO and CO. In this regard, contribution of the operation of the TPP is high for NO_2 short periods (hourly results) and not very significant for annual, monthly and daily averages. Nevertheless, for NO the contribution is almost no perceptible and for CO is insignificant.

912. Nevertheless, as air quality stations are in the area of influence but not in the area of maximum ground level concentrations of the simulation, a specific mitigation measure has been included to install in this area the fix air quality station included in the project at the earliest convenience (pre-construction phase) in order to gather as much air quality data possible prior to the construction of the stacks and to check if air quality standards are still being fulfilled.

913. The CCGT will be equipped with a continuous emission measuring system, whose task it is to ensure that the unit always remains within legal limits. In order to reduce atmospheric pollutant emissions as far as possible, the project includes a series of corrective measures: low NOx burners, stack of an adequate height to disperse gases, etc. In addition, there will be a monitoring and air quality control, ensuring that limit values for air quality in force are observed, or when necessary, reading off measures for that purpose.

914. Ultimately, the contribution brought by the operation of the new CCGT units to the background pollution will be decreased around 16% for NO_2, simulation results show low values and both national and international air quality standards are fulfilled. Therefore, the magnitude of the impact is assessed to be medium.

915. <u>Final impact assessment/Value.</u> This **POSITIVE** impact is medium in magnitude and high in incidence (0.71).

Potential increase in noise levels

916. Description. Much of the equipment in the new 2 CCGT units will create high noise levels during operation. In order to reduce noise levels both inside and outside the premises, there are several mitigation noise and vibration measures included in the project and described in the EMP chapter.

917. In the noise impact in the construction and decommissioning phase it was indicated the legal standards applied to the project and the noise campaign undertaken in order to gather noise background.

918. For the new 2 units, 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.

919. In order to calculate which could be the increase of noise due to the operation of new 2 CCGT units at the receptors, it has been supposed taking a very conservative hypothesis into account, that fourteen sources (seven for unit) of 80 dB(A) can be working at the same point. The sum of these sources would result in 91.46 dB(A)[13].

920. In addition, it will be considered that the noisiest sources are continuous and constant for 24 hours per day and the noise will be concentrated in a single point (center of 2 CCGT units).

921. For the receptors, the sound pressure level (SPL) deriving from the operation of the plant, can be estimated with the most adverse scenario (SPL_2 91.46 dB(A)) assuming that the sound wave is propagated through an atmosphere free of losses through attenuations.

922. Therefore the SPL can be defined by the following equation:

$$SPL_1 = SPL_2 - 20*\log_{10}(r_1/r_2)$$

SPL_2 being the sound pressure level due to the functioning of the 2 CCGT units (91.46 dB(A)) at a distance r_2 of 1 m and SPL_1 being the sound pressure level in the receptor at a distance of r_1 in m:

$$SPL_1 = 91.46 - 20*\log_{10}(\text{distance}/1)$$

923. The table below indicates the total noise levels compared to the standards set in reference legislation.

Table 95. Total noise levels compared to the standards

[13] SPLt = 10xlog (10 ^(SPL1/10)+…+ 10 ^(SPLn/10))

Point	Monitoring campaign results (dB(A))		Distance to the centre of the new Unit (m)	Equipment SPL at the measurement points (dB(A))	Total = Campaign SPL + Equipment SPL		Reference standard, by law (dB(A))		QUANTITATIVE ASSESSMENT = EQUIPMENT CONTRIBUTION (dB(A))		QUALITATIVE ASSESSMENT	
	Day	Night			Day	Night	Day	Night	Day	Night	Day	Night
P1	55	62	395	34	55	62	70	70	0	0	Without increase	Without increase
P2	54	60	400	38	54	60	70	70	0	0	Without increase	Without increase
P3	55	62	455	48	56	62	70	70	1	0	Without increase	Without increase
P4	51	44	386	36	51	45	70	70	0	1	Without increase	Without increase
P5	53	54	460	34	53	54	55	45	0	0	Without increase	Without increase
P6	58	64	300	45	58	64	55	45	0	0	Without increase	Without increase
P7	48	40	623	35	49	41	55	45	0	1	Without increase	Without increase
P8	45	43	555	34	46	44	55	45	0	1	Without increase	Without increase

924. As observed, points where standards are exceeded (marked in red), are exceeded because background noise is already over the limits. The contribution of the new 2 CCGT units in those points is 0 and in the rest of the points is less than 1 dB(A), therefore not perceptible.

925. We should point out that background level noise campaign includes contribution of units III and IV that will be decommissioned. Therefore, a noise campaign should be done after de decommissioning of units III and IV and operation of 2 CCGT units to assess real statement without the contribution of the old units. It is expected that the global background noise will decrease due to the replacement of old and noisy equipment by a new and less noisy one.

926. As indicated in the description project chapter "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 dB(A) above the norm". In this regard and as indicated in previous paragraphs, noise limit of the future facilities at 1 meter will be 80 dB(A) which means that new facilities will be less noisy that the existing ones. Because of the above reasons and necessary corrective measures will be taken to ensure the reference standards, this impact is assessed as **INSIGNIFICANT**.

IMPACTS ON SOIL AND GROUNDWATER

Potential increase of soil salinity due to the cooling towers steam plume deposition

927. Description. Small water droplet carry-over will occur due to the operation of the cooling tower. These water droplets, which can precipitate in the surroundings, contain concentrations of solids, especially dissolved salts that can potentially increase ground salinity.

928. The towers are equipped with droplet elimination systems to minimize droplet carry-over. These devices are placed inside the tower and prevent the droplets from exiting the stack with the air.

929. Most of the droplets evaporate in the surrounding air, giving rise to steam plumes. Only the largest droplets can avoid total evaporation and precipitate to the ground.

930. On the other hand, intense winds can cause interaction between the air, the structures and the cooling tower emissions that can cause three phenomena:

(1) Favor recirculation of the air emitted by the towers and subsequent low performance of the towers.
(2) Cause interaction between the emissions (plumes), nearby structures and the terrain.
(3) Produce whirlwinds, especially at the ends of the towers that can extract water through the tower air entries.

931. The three phenomena above can increase the precipitation of salty water and favour the formation of ground mist if the temperature and humidity conditions are adequate.

932. A series of measures will be taken in this regard (See EMP); the towers will be oriented to minimise air outlet recirculation phenomena, reducing loss of performance and avoiding possible increases in precipitations near the towers.

933. On the other hand, it should be noted that the composition of the soil in the area under study presents a high degree of saline content due to salt precipitation influenced by the Aral sea, located to the north of the area under study. As a result the use of the soil in the study area for agricultural purposes is very limited.

934. Considering all of the above, the type of cooling tower chosen and the measures taken into consideration, it is considered that the increase in salinity due to water droplet carry-over from the towers will be insignificant versus the current level of salinity present in the soils of the area; whereby the impact is estimated to be **INSIGNIFICANT**.

Potential soil and groundwater pollution by accidental spillages or improper waste management

935. Description. The areas of handling, storage and management of equipment lubricating and cooling oil, fuels, chemicals and generated waste are potential sources of contamination of soil and water, in case of non-compliance with minimum safety requirements.

936. The same kinds of solid waste as in the current operation will be produced after the commissioning of the CCGT at Takhtiatash. Nevertheless, for the construction of the 2 CCGT units asbestos will be not permitted as it use is forbidden by the good international practice. Therefore, waste asbestos will not be produced in the operation of the new units.

937. 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.

938. The current management of wastes of the TPP can be used but some of the procedures should be corrected to fulfill international good practices:

939. Non-hazardous wastes:

-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.

-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 in the operation of the existing units.

-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. An improvement of this landfill to avoid soil and groundwater pollution is advisable.

Figure 53. Location of Takhiatash city municipal landfills and WWT plant

940. Hazardous: 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).

- Recycle:

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.

- Dispose:

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, solution found for the construction and decommissioning phases can continue during operation phase.

941. The waste management for the future Takhiatash TPP should be adapted to international guidelines and those wastes considered by the Basel Convention to be hazardous will under no circumstances be dumped on the terrain. A general guideline on waste management will be included in the EMP.

942. In addition, during the operation of the power plant there could be accidental leaks from the oil tank which could lead to the contamination of the soil and subsoil. The tank will have the obligatory safety tank (or if undergrounded a double wall design), which will be enough to contain the total capacity of all the tanks. Any possible accidental spills will be collected in this safety tank. Therefore the possibility of the soil or waters becoming contaminated through fuel leaks is very slight.

943. In the same way, each of the storage tanks for chemical products for the treatment of the water supply, chemical treatment, etc. that will be installed will in every case have an obligatory safety tank.

944. A maintenance program to detect any structural or functional problem in the tanks will be implemented. Also, groundwater test will be undertaken to check the condition of the soil and subsoil to early detect any problem.

945. In conclusion, all the waste generated in the power plant will be adequately and appropriately managed. There will be no effect on the environment as a consequence of mismanagement. Through compliance with that established in the waste management system there will be no possibility of contaminating the soil or groundwater. Regarding leaks, the project will incorporate the necessary safety measures to avoid spillages into the environment. Therefore, given the safety and management measures planned, the impact is assessed as **INSIGNIFICANT**.

IMPACTS ON HIDROLOGY

Water resources intake reduction

946. Description. During the operation of the power plant the water necessary for the operation of the power plant will be taken from the Suenly Canal. Service and drinking water will be taken from pipeline supply system of Takhiatash city.

947. The following table summarize the current and future water requirements for the TPP according to their destination:

Table 96. Current and future technical water requirements from Suenly Canal

Parameter	Units	Current (before CCGT commissioning)		Future (after CCGT commissioning)		
Operating units	-	Units III-IV	Units V-VI	Units V-VI	CCGT 1	CCGT 2
Operating hours	h	3,083	5,525	1,014	6,912	6,912
Drinking and service water consumption (from pipeline supply system of Takhiatash city)	million m^3/yr	3.460		3.460		
Hourly water requirements for each unit	m^3/h	50,145	54,000	54,000	476	476
Total hourly water requirements for the TPP	m^3/h	104,145		54,952		
Annual water requirements						
Consumptive use	million m^3/yr	0	0	0	3.3	6.3
		0		6.6		
Non-consumptive use	million m^3/yr	154.6	298.3	54.8	0	0
		453.0		54.8		
Total	million m^3/yr	154.6	298.3	54.8	3.3	3.3
		453.0		**61.3**		
Water requirements reduction	million m^3/yr	-		391.7		

Note: It has been calculated to take into account the operation of units V and VI as backup (1014 h/year) and the operation of new 2 CCGT units (6912 h/y/unit).

948. Therefore, the annual water intake volume from Suenly Canal in the current situation amounts to 453.0 million m^3, whereas the future water requirements have been estimated at **61.3** million m^3. Therefore, the decommissioning of units III-IV, the operation of units V and VI only as back-up units during maintenance operations of the CCGTs and the commissioning of the new 2 CCGT units will lead to an annual reduction in the water intake from Suenly Canal estimated at 391.7 million m^3.

949. For drinking purposes the intake volume will not change as the number of workers will remain the same.

950. The change from the open once-through cooling system of units III-IV towards a closed circuit with cooling towers of the CCGTs and the operation of units V and VI only as back-up units during maintenance operations of the CCGTs, will lead to the reduction of the large water intakes and, at the same time, it will reduce the discharge of large amounts of warm cooling water to the canal and may also reduce the consumption and emission of chemicals. Therefore, this impact is assessed as SIGNIFICANT and is evaluated below.

951. Characterization. The water resources intake reduction has a direct and positive impact on the water resources. It is cumulative and synergistic, because the reduction in water intake has varying degrees of effect, some reinforcing the effects of others. It occurs in the short term, although it is permanent because the effect is indefinite. Equally, it is continuous as it occurs recurrently and constantly and non- periodic.

952. Following the methodology described, numerical values were assigned to the attributes:

ATTRIBUTE	CHARACTERIZATION	NUMERICAL VALUE
SIGN	Positive	+
IMMEDIACY (Inm)	Direct	3
ACCUMULATION (A):	Cumulative	3
SYNERGY (S)	Synergistic	3
TIMING (M)	Short-term	3
PERSISTENCE (P)	Permanent	3
PERIODICITY (Pr)	Non-periodic	1
CONTINUITY (C)	Continuous	3
INCIDENCE (I=Inm + +2A + 2S + M + 2P + 2R + 2Rc + Pr + C)		28
NORMALIZED INCIDENCE (IS=I-Imin/Imax-Imin)		0.5

953. Magnitude. Given the current reduction of the water intakes in 391.7 million m^3/yr due to the change from the open once-through cooling system of units III-IV towards a closed circuit with cooling towers of the CCGT and the operation of units V and VI only as back-up units during maintenance operations of the CCGTs, that suppose a reduction of 86%, the magnitude of the impact is assessed to be high.

954. Final impact assessment/Value. This **POSITIVE** impact is of high magnitude and has a medium incidence (0.5 points).

Potential effects on water resources due to the increase of water consumed for the new CCGT

955. Description. Regarding actual water consumption terms, the net technical water consumption of the TPP will increase due to make-up water needs for evaporation losses in the cooling towers of the CCGT. The explanation lies within the net water consumption of the current open cooling circuit, which is almost zero because all the intake water is subsequently discharged back to the canal.

956. Estimated water consumed in cooling towers due to evaporation would be 257 m^3/h for each CCGT unit (514 m^3/h for both CCGT units). Considering that the cooling towers could work with 3 concentration cycles (CC=3), total blow down flow rate would be 128 m^3/h per CCGT unit (256 m^3/h both CCGTs) and therefore, the water used for cooling purposes would be 385 m^3/h per CCGT unit (770 m^3/h in total, 0.21 m^3/s). Considering 6,912 operation hours for each CCGT, the total annual water consumed for cooling purposes would be 3.553 million m^3.

957. Suenly canal has a depth of 7 meters and a width of 20 meters. In a basic calculation, as Amudarya river speeds is 1.1 m/s and it is not supposed to increase when enters into Suenly canal as there is not a forced flow, Suenly canal would have a flow rate of 154 m^3/s. Comparing this flow rate with the consumption of the CCGT in evaporation process it would result a 0.09%. Even in the case that the water depth in Suenly canal would decrease to 1 m, percentage of consumed water would represent just a 0.63%.The maximum volume consumed (3.553 Mm^3/yr) represents just a 1.28% of the total volume flowing in the canal (277 million m^3/yr) also.

958. Furthermore, it must be noted that combined cycle technology consumes approximately one third of the water consumed by a thermal power plant with a steam cycle of equal power which is refrigerated by the same system. This helps achieve a more rational use of such a precious resource. In addition, the use of natural gas reduces the need for water and reduces the amount of effluent compared to power plants that use other fossil fuels.

959. Due to the very low consumed flue rate compared to the Suenly canal one, the impact is assessed as **INSIGNIFICANT**.

Potential alteration of the water quality as a consequence of effluent discharge

960. Description. The discharge of effluents generated from the exploitation of the new Units may degrade the quality of water through the presence of pollutants.

961. As discussed in the chapter on the Project Description, the expected effluents generated by operation of the new facilities of CCGT will be:

- **Domestic effluents:** Domestic wastewater or sanitary effluents is discharged though pipe line to the Takhiatash 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 2 CCGT units 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.
  Circulation system blowdown: in the open cooling water circuit a constant evaporation of the water takes place. As a result, the remaining water has a high concentration in solids and dissolved salts, what makes it necessary to bleed it periodically. Blowdown water from cooling tower is relatively clean so that it is directly discharged into the outlet channel with no treatment.

962. The water treatment for the cooling system of the new 2 CCGT units shall be designed with a biocide (sodium hypochlorite) dosage performed by a control and global 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.

963. Project includes automatic measurement of pH and temperature in the cooling water system. These measurements should be located at the intake and discharge points. Other parameters included in the effluent standards on the Thermal Power Plants EHS IFC guidelines (2008) area measured in a monthly basis.

964. In addition, the temperature of the effluent discharge from the cooling water would be decrease due to partial replacement of the open cooling water system (III and IV units) to a closed one (new 2 CCGT units).

965. Therefore, effluent treatment system and cooling water system of the new 2 CCGT units will be designed in order to fulfill new MAD for the CCGT and Thermal Power Plants EHS IFC guidelines (2008) effluent standards, 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.

966. In conclusion, all waste water is properly treated according to its nature, prior to final disposal, in order to meet the discharge standards set by the World Bank. Therefore, this impact is assessed to be **INSIGNIFICANT**.

IMPACTS ON FAUNA AND VEGETATION

Potential improvement of the aquatic ecosystems as a consequence of partial replacement of an open cooling water system to a closed one

967. Description. The discharge of effluent from the cooling due to the operation of the TPP could increase the ambient temperature, which may affect the ecological balance and the aquatic habitat in the area. The conservation of the ecological balance is achieved through many factors among which are, basically, temperature, nutrients, sunlight and water movement. The occasional variations of these parameters in the water ecosystem are generally assumable, given the existence of a dispersal area which varies according to the release.

968. An increase in temperature or in nutrients in the biological system may induce:

- An acceleration of certain biological processes (growth in fungi population, etc.) against others (disappearance of species that reproduce at a given temperature, etc.). Indirect changes may occur in the biotic factors of the environment in the area influenced by the discharge, due to changes in food chains of flora and fauna, which may alter the composition of the affected ecosystem and the exchanges between its various species.

- Compromising the ability of water to retain dissolved oxygen. At higher temperatures, the saturation level of oxygen in water decreases and the availability of oxygen to the process of respiration of fish and other living organisms are lower. Oxygen is also necessary for an effective bacterial decomposition of organic matter and chemical oxidation.

- Influence in the growth cycles of aquatic plants and in the growth and physiology of fish and other aquatic animals (reproductive rate, respiration rate, digestion, etc.), in the area under study.

969. However, in this project, partial replacement of an open cooling water system to a closed one will be undertaken:

- Existing situation: The cooling circuit existing is of the open type. After being used for the refrigeration of the condenser, cooling water increases its temperature (8-10 ºC) (see Figure 54) and is discharged into the Suenly canal. The effluent discharge from the open cooling water is 104,145 m^3/h (5,014 m^3/h for units III and IV + 54,000 m^3/h for units V and VI).

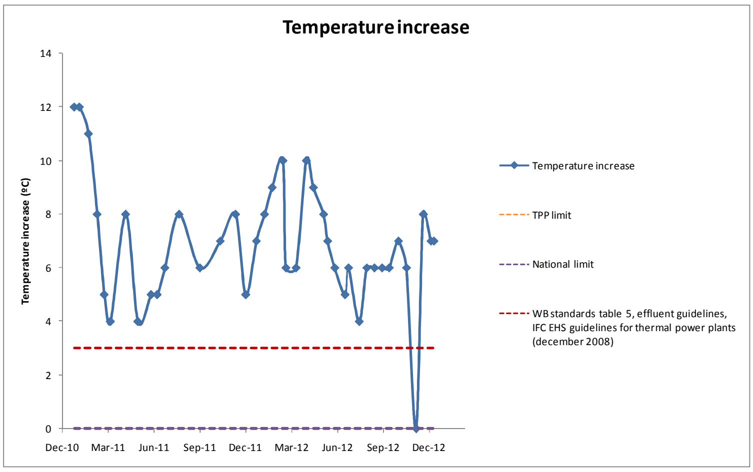


Figure 54. Delta T between intake and discharge

– Future situation: The effluent discharge from the open cooling water would be decreased from 104,145 m^3/h (before decommissioning of old units III and IV) to 54,952 m^3/h (after decommissioning of old units III and IV and the operation of the V and VI units as back-up). The estimated intake for the new 2 CCGT units of make-up water is 952 m^3/h, including 110 m^3/h for make-up water pre-treatment unit for auxiliaries, 770 m^3/h for replenishment of losses in water cooling tower for evaporation and blow down of circulatory system, and 72 m^3/h to makeup CCGT's water-steam cycle. Considering as an approximation a cooling tower cycles of concentration of 3.0, blow down flue rate would be 256 m^3/h. Effluent coming from the waste water treatment plan is discharged (once treated) to the cooling water canal and from there to Suenly canal. This flow will be 115 m^3/h.

970. The change from the open once-through cooling system of units III-IV towards a closed circuit with cooling towers of the 2 CCGT units will lead to the reduction of the large water intakes and, at the same time, it will reduce the discharge of large amounts of warm cooling water to the canal and may also reduce the consumption and emission of chemicals.

971. In order to find out the new temperature of the discharge a mathematical or physical hydrodynamic plume model is not required because the steam generating capacity <1,200 MWth[14]. Therefore, impact of thermal discharge can be estimated in accordance with the next thermal balance in the discharge point:

$$Q_{V,VI}{}^{*}T_1 + Q_{CCGT\ (blow\ down)}{}^{*}T_2 + Q_{CCGT(water\ treatment\ plant)}{}^{*}T_3 = (Q_{V,VI} + Q_{CCGT\ (blow\ down)} + Q_{CCGT\ (water\ treatment\ plant)}{}^{*}T_{discharge\ point}$$

[14] IFC EHS Thermal Power Plants guidelines (pag 10)

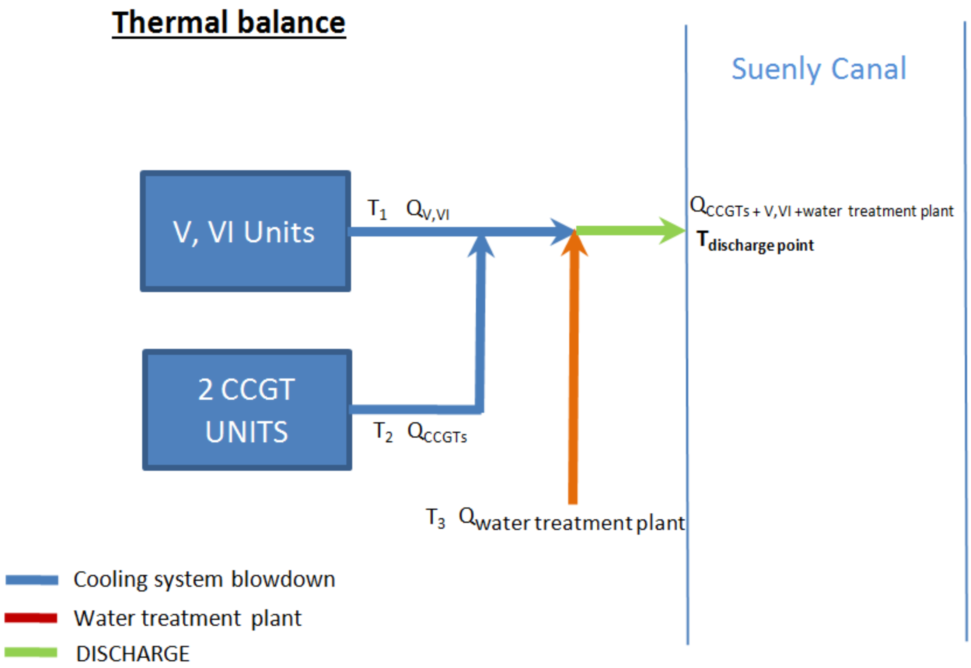


Figure 55. Thermal balance diagram

972. The following temperatures have been considered in order to consider worst case scenarios:

- For T2, the maximum air ambient temperature (45º C) has been introduced in the thermoflow software program in order to simulate which would be the blow down temperature for the water balance designed resulting 30,95º C.
- For T1 the highest discharge temperature measured in last two years (2011 and 2012) has been considered (see Figure 56)
- For T3, the correspondent T1 intake temperature has been considered.

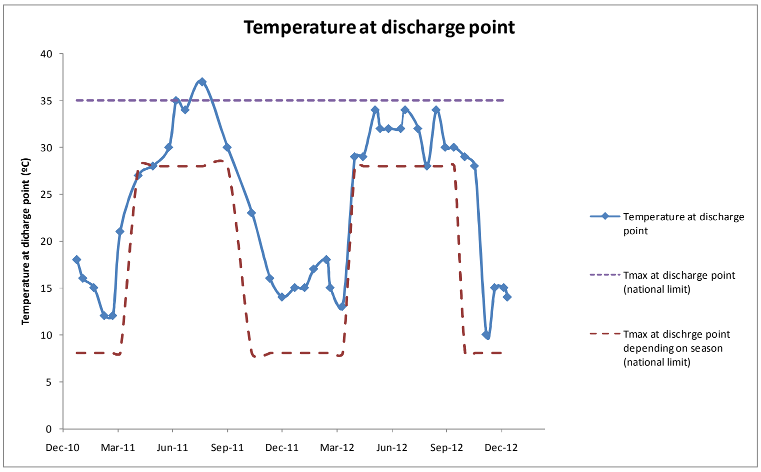


Figure 56. Absolute temperature at discharge point

973. In the following table 96, a summary of the flow rates and temperatures considered in the calculation are shown.

Table 97. Calculation data summary

Parameter	**Units**	**Current (before CCGT commissioning)**		**Future (after CCGT commissioning)**		
		Units III-IV	Units V-VI	Units V-VI	New CCGT units	
Cooling system	m^3/h	50,145	54,000	54,000	256 Blow down	115 Water treatment
Effluent temperature in the most adverse scenario	ºC	T_1=37	T_1=37	T_1=37	T_2=30.95	T_3=29

(54,000 t/h*37ºC+256 t/h*30.95ºC+115 t/h*29)=(54,000 t/h+256 t/h+115 t/h) *$T_{discharge\ point}$

$$\mathbf{T_{discharge\ point\ future}=36.95ºC}$$

$$\mathbf{\Delta T_{current\ vs.\ future}= 37\text{-}36.95ºC = 0.04}$$

974. The influence of the decrease in temperature in the discharge point, due to partial replacement of an open cooling water system to a closed one, will not be appreciated (0.04 ºC) because the huge difference between flow rate of the closed cooling system blowdown (2 CCGT units) and the opened cooling system effluent (V, VI units). However, the water of the effluent discharge from the open cooling water would be decreased from 104,145 m^3/h (29 m^3/s) to 54,371 m^3/h (15.10 m^3/s) in

almost a 48%, so the thermal effluent dispersion would be faster and the mixing zone would be extended over a smaller distance in the Suenly canal. Therefore, this impact is assessed as SIGNIFICANT and is evaluated below.

975. Characterization. The water discharge reduction has a direct and positive impact on the aquatic ecosystem. It is cumulative and synergistic, because the reduction in water discharge has varying degrees of effect, some reinforcing the effects of others. It occurs in the short term, although it is permanent because the effect is indefinite. Equally, it is continuous as it occurs recurrently and constantly and non-periodic.

976. Following the methodology described, numerical values were assigned to the attributes:

ATTRIBUTE	CHARACTERIZATION	NUMERICAL VALUE
SIGN	Positive	+
IMMEDIACY (Inm)	Direct	3
ACCUMULATION (A):	Cumulative	3
SYNERGY (S)	Synergistic	3
TIMING (M)	Short-term	3
PERSISTENCE (P)	Permanent	3
PERIODICITY (Pr)	Non-periodic	1
CONTINUITY (C)	Continuous	3
INCIDENCE (I=Inm + +2A + 2S + M + 2P + 2R + 2Rc + Pr + C)		28
NORMALIZED INCIDENCE (I_S=I-I_{min}/I_{max}-I_{min})		0.5

977. Magnitude. The project includes automatic continuous measurement of temperature in the cooling water system to control effluent discharge and the water treatment for the cooling system of the new 2 CCGT units shall be designed with a biocide (sodium hypochlorite) dosage performed by a control and global monitoring equipment with automatic dosage calibration.

978. 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.

979. If we compare estimated Suenly canal flue rate (154 m^3/s) with the discharged effluent, percentage will decrease from a 19% of the current situation to a 9.8%. The magnitude of the impact is assessed to be medium.

980. Final impact assessment/Value. This **POSITIVE** impact is of medium magnitude and has a medium incidence (0.5 points).

IMPACTS ON LANDSCAPE

Potential impact on landscape caused by the physical presence of the new CCGT

981. Description. The landscape in the immediate surroundings of the Plant can be defined as highly affected by human activity.

982. The new 2 CCGT units facility will add the following infrastructures to the previous Takhiatash, which may affect the landscape:

- A 112.5-metre high stack (for unit)
- A turbine building 40-metre height (for unit)
- A mechanical draft cooling tower with approximate dimensions of: 16 m high and a rectangular base measuring 16 m x 114 m (for unit)

983. The impact on the landscape depends on both the changes that are produced and the visible changes that are a result of those changes for the nearest receptors.

984. It should be taken into account that the location of the 2 CCGT units inside the existing installations of the Takhiatash TPP, and the small size of the former versus the latter, favor the integration of the new project in a medium with a high degree of human activity and accustomed to this large power infrastructure. The infrastructure already has the most visible elements, such as the 150-metre high stack of Units V and VI, the 20-metre high fuel oil (mazut) storage tanks and the buildings of the Takhiatash TPP (Units V and VI) that are 40 metres high (See image below).

985. On the other hand, it has to be considered that the buildings and facilities belonging to units III and IV, of the existing Takhiatash TPP, are going to be decommissioned and the buildings and the stack of units I and II are going to be demolishing too. This gains special importance when assessing the effect of removing the 80 meters high stack units III&IV and the 65 meters stack of units I&II, even if new two stacks are going to be built for the CCGT, these two are planned to be 112.5 meters, 32.5 meters taller. With the construction the new CCGTs units are going to get a better integration into the landscape: at first because the turbine building of the units III&IV and the buildings of units I&II are going to be demolishing and second because the new buildings of CCGT units are going to built with integrated modern structures.

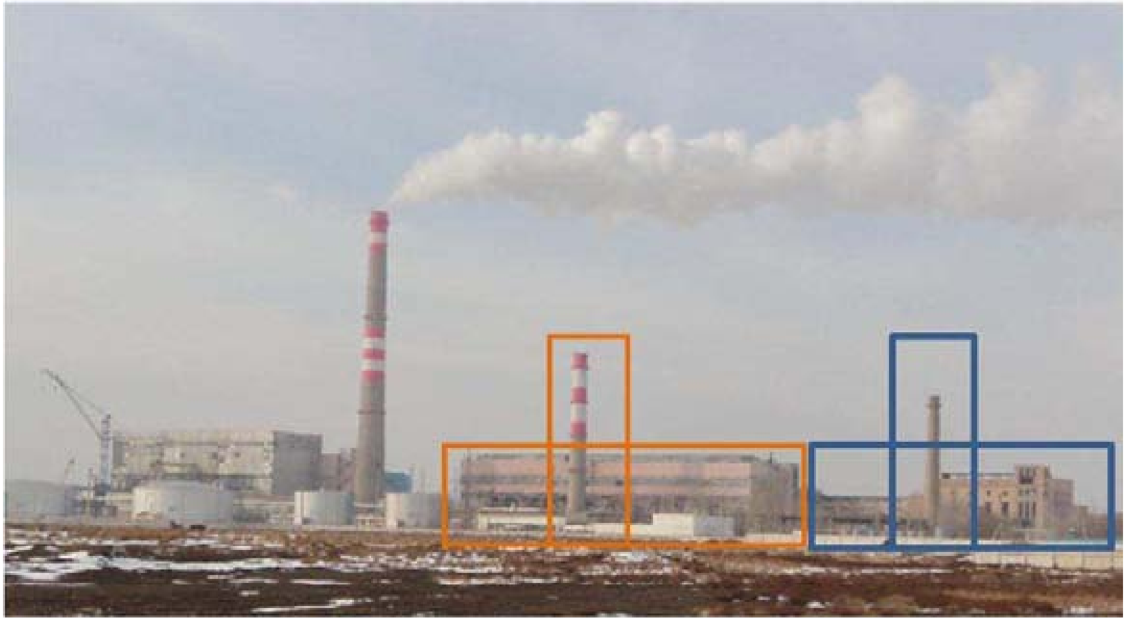


Figure 57. Stacks and turbine buildings of units I to IV to be demolished and decommissioned

986. The new gas pipeline will be an underground facility. Therefore, it will not affect the landscape.

987. As a result of this analysis, it can be concluded that the location chosen is the most suitable from the point of view of the landscape, since the area is highly affected by human activity and the quality of the landscape is poor. It is located on the industrial terrain of Takhiatash TPP, which already has large, very visible structures that will hide the 2 CCGT units structures halfway and thus not affect the industrial landscape, whereby the impact is considered to be **INSIGNIFICANT**.

Potential impact on landscape caused by the cooling water steam plume

988. Description. The operation of the mechanical draft cooling tower will produce water vapour carry-over which will cause the formation of steam plumes. These plumes could partially block the view of the project area.

989. Emissions of moist air from the cooling tower could occasionally form visible plumes due to water vapor condensation, which could alter the landscape and characterise cooling towers in industrial facilities. The visible dimensions of the plumes may vary according to the rate of operation of the Plant and the weather conditions at the site.

990. It is estimated that the largest steam plumes will be visible at dawn, especially on cold months, coinciding with periods of low ambient temperatures and high humidity.

991. Spatially, the impact of visible plumes is largest near the towers, where they develop vertically under normal circumstances and float over the plant site less frequently due to the effect of the wind.

992. The impact is considered to be **SIGNIFICANT** and is evaluated below.

993. Characterization and incidence. The impact is indirect and negative. The impact is simple and synergic. It is considered transient and continuous. It is reversible and recoverable, since the original conditions will reappear naturally when the Plant stops operating.

994. The impact is short-term, as soon as the Plant starts operation, and periodical.

995. Included below are the numerical values assigned to the attributes, according to the methodology presented:

ATTRIBUTE	CHARACTERIZATION	NUMERICAL VALUE
SIGN	Negative	-
IMMEDIACY	Indirect	1
ACCUMULATION	Simple	1
SYNERGY	Synergistic	3
TIMING	Short-term	3
PERSISTENCE	Temporal	1
PERIODICITY	Reversible	1
RECOVERABILITY	Recoverable	1
PERIODICITY	Periodic	3
CONTINUITY	Continuous	3
INCIDENCE (I=Inm + +2A + 2S + M + 2P + 2R + 2Rc + Pr + C)		24
NORMALIZED INCIDENCE ($I_S = I - I_{min}/I_{max} - I_{min}$)		0.36

996. Magnitude. Visible plumes are not formed during most of the year. In addition, the plumes will normally dissipate completely during the day and their visible dimensions will be only a few meters or negligible.

997. On the other hand, it should be noted that the operation of the Takhiatash TPP makes the presence of plumes in the area part of the normal landscape due to stack gas emissions.


Figure 58. Exhaust gas plume of stack 150 m height

998. Considering the occasional formation of plumes, their rapid dispersion, the distance they can be seen from and the nearest receptors being located at 400 meters, the magnitude can be considered medium.

999. Evaluation /Final Value of the Impact. The medium magnitude of the impact and its incidence (0.36) indicate that the impact should be considered **COMPATIBLE**.

IMPACTS ON NATURAL AREAS

Potential impact on natural areas

1000. Description. During the operation phase, the impact on the nearby natural spaces may be due to the effects that noise, air emissions, discharges, waste, and potential leaks are likely to have on it.

1001. As indicated in the correspondent impact in the construction and decommissioning phases, the nearest natural area is around 75 km.

1002. Due to the long distance to the closes protected area, this impact is assessed to be **INSIGNIFICANT**.

IMPACTS ON POPULATION

Potential hiring of personnel for operation of the new CCGT

1003. Description. During the operation phase of the new 2 CCGT units, new jobs will be created which will last over the life of these facilities. For normal operating conditions, the planned staff will be a fixed number of 110 people. Nevertheless, the major part of this workforce is expected to be covered by the staff of the decommissioned equipment of III-IV units of TPP; therefore, this impact is considered **INSIGNIFICANT**.

Development of the local and regional economy

1004. Description. Takhiatash TPP is the main power supply source for the Karakalpakstan and Khorezm regions with over 3 million people, located in the western part of Uzbekistan. The power demand outlook is strong with a number of industrial development projects envisaged for the region, exceeding currently available capacity. Furthermore, Takhiatash TPP not only provides the North-West region of the country with electricity but also heats water to supply the consumers in Takhiatash town and for its own needs.

1005. According to the baseline, regarding the percentage of population employed in different sectors, three major activity sectors can be distinguished: 61% other services (the economic activity in this sector is mainly focused on administration, internal affairs, community organizations and etc.), 11% in the industrial sector and 10% in agriculture.

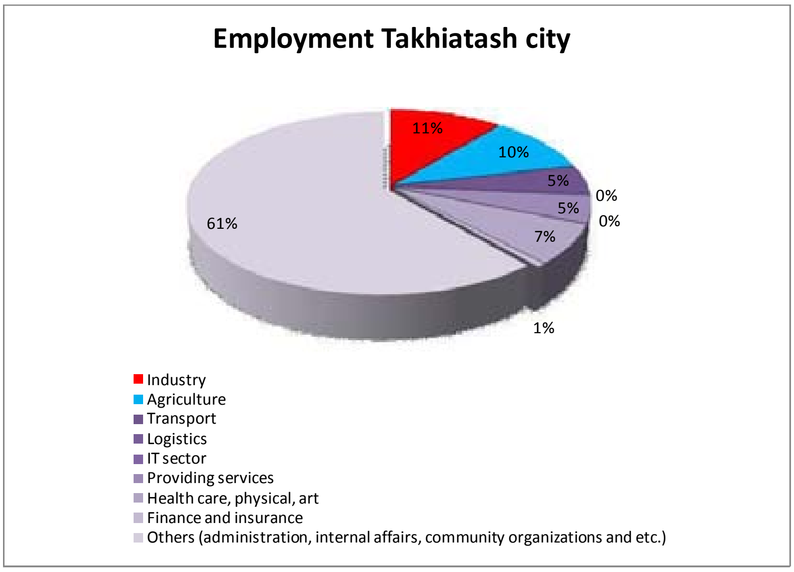


Figure 59. Employment Takhiatash city chart

1006. Thus, the analysis of the socio-economic aspects of the region shows that the implementation of the proposed activity is relevant and has a number of advantages in the social sphere of the Republic of Karakalpakstan in general. The impact is considered to be SIGNIFICANT and is evaluated below.

1007. Characterization. The effect is positive and direct on the economic environment, as well as cumulative.

1008. The impact is synergistic because it can promote the action of other effects, and permanent, throughout the life of the new 2 CCGT units.

1009. It occurs in the short term, is continuous, and non-periodic, because the alteration is constant during the operating time of the new 2 CCGT units.

1010. According to the methodology previously described, numerical values will be assigned to the form taken by the attributes, as shown below:

ATTRIBUTE	CHARACTERIZATION	NUMERICAL VALUE
SIGN	Positive	+
IMMEDIACY (Inm)	Direct	3
ACCUMULATION (A):	Cumulative	3
SYNERGY (S)	Synergistic	3
TIMING (M)	Short-term	3
PERSISTENCE (P)	Permanent	3
PERIODICITY (Pr)	Non-periodic	1
CONTINUITY (C)	Continuous	3
INCIDENCE (I=Inm + +2A + 2S + M + 2P + 2R + 2Rc + Pr + C)		28
NORMALIZED INCIDENCE (I_S=I-I_{min}/I_{max}-I_{min})		0.5

1011. Magnitude. The potential primary beneficiaries of the project would be the general population in urban and rural areas and industries from improved power supply reliability through the national grid, especially in the Karakalpakstan and Khorezm regions. In addition, more reliable power supply is expected to benefit firms and industries, which will provide increased economic and job opportunities for households, including the poor and socially excluded. Thus, the stable heat an electricity production will increase the small local businesses as well as service providers including schools and health clinics, the industrial sector development, living standards of people, residing in the capital of Karakalpakstan, in Tahkiatash town and directly of Takhiatash TPP staff.

1012. On the other hand the project supports gender equality. More reliable power supply to households positively affects women who are often the managers of household activities. Lighting for homes, businesses, streets and marketplaces is also critical for facilitating women's and girl's involvement in educational, entrepreneurial and community activities. The project will construct a community service center which is equipped with facilities including dry-cleaning, laundry, carpet cleaning for local community and the staff at Takhiatash TPP. The social service center will generate employment with at least 50% for women, and its facilities will reduce the burden on many women from time consuming household activities.

1013. Therefore, the magnitude of the impact is assessed to be medium.

1014. Final impact assessment/Value. This **POSITIVE** impact is of medium magnitude and has a medium incidence (0.5 points).

Potential health risk for the operation of the cooling towers

1015. Description. Legionella is an environmental bacteria capable of surviving in a wide range of physico-chemical conditions. It can reproduce at between 20 ºC and 45 ºC and can be destroyed at 70 ºC. Its optimal growth temperature is between 35 ºC and 37 ºC. Its natural ecologic niche are surface waters, such as lakes, rivers and pools, where it forms part of the bacterial flora.

1016. Water systems created by man are a very adequate habitat for this bacteria. These systems provide the conditions for the bacteria to expand and spread. It disperses in the air and penetrates respiratory systems, causing infections in humans. The prevention and control of legionella growth and spread in man-made facilities has become very important recently because of the various cases of legionella outbreaks in recent years. The spread of the bacteria in cooling towers takes place via carry-over microdroplets.

1017. It should be noted that most of the outbreaks have taken place in urban settings, and mainly in facilities equipped with small cooling towers. On the contrary, the absence of outbreaks in cooling systems located in large evaporation towers associated with power installations is remarkable. The possible causes include:

- Greater stability of the ecosystem in the cooling circuits and the difficulties posed for growth of legionella.
- Greater control of water quality using water treatments (i.e.: decarbonation, biocides, anti-corrosion agents) and continuous water purging which prevents accumulation of dirt in the condensers and fills of the tower basins.
- Location of the cooling systems far from population centres along with the altitude of tower emissions and the time needed for the aerosols (microdroplets) to reach long distances with the conditions of ambient humidity required for legionella to survive.

1018. However, it should also be noted that the fact that large towers have not been found to be the source of legionella outbreaks could also be due to the fewer number of large systems in operation.

1019. Given the characteristics of the impact and considering the prevention system to control legionella included in the project (see EMP), among which are adding a biocide, the estimated impact is assessed to be **INSIGNIFICANT**.

Potential hygienic risks for the health and safety of personnel and the surrounding population

1020. Description. During the operations phase, impacts likely to be generated by the operation of Takhiatash CCGT on the health of the population in the area may be due to the effects of air emissions, noise, discharges, waste, and potential leakages in the equipment. In this respect, the following should be considered:

- In the impact "Outdoor air quality improvement due to the emission reduction by the replacement of an obsolete with an energy efficient technology", it was analyzed whether the air quality standards for health are observed. It was concluded that NO_2 inmissions will be decreased by the replacement of an obsolete with an energy efficient technology up to a 16%.

- Regarding the noise, the proposed measures forecast an insignificant increase.

- Regarding the effluents and waste generated by the new power plant, they will be managed correctly which will ensure that no negative impacts occur on the surroundings.

1021. By the other hand, TPP personnel can handle hazardous materials or wastes. In order to avoid the risk associated, An Environmental, Health and Safety Plan will be developed for the operation phase (this mitigation measure has been included in the EMP). In the EHS Plan, personnel training on safety, use of PPE procedures, emergency plan, etc. will be included.

1022. Therefore, given the measures to reduce emission of pollutants included in the project and those considered with reference to air quality, noise, waste, and effluents, and the EHS Plan based on national and international standards that will be implemented the estimated impact is assessed to be **INSIGNIFICANT**.

IMPACTS ON COMMUNICATIONS AND INFRASTRUCTURES

Increase in installed electrical power

1023. Description. The total installed capacity for power generation in the country is about 12,400 MW. However, the available capacity is less than 10,000 MW. In 2010, Uzbekistan generated about 51,935 GWh of electric power.

1024. Uzbekistan's power generation plants are generally old and inefficient, requiring urgent **replacement and/or modernization**. More than 75% of the power plant units are over 30 years old, reaching or exceeding their economic life. Since 1991, only two power capacity expansion projects have been completed: (i) rehabilitation of two 300 MW steam cycle units at Syrdarya TPP and (ii) construction of an 800 MW steam cycle unit at Talimarjan TPP.

1025. In this respect, the installation of the new 2 CCGT units contribute to an increase in the country's electricity production, satisfying part of the anticipated demand and reducing losses deriving from the transportation of electrical energy. In addition, the technology used has the highest performance out of all the available fossil fuel based electricity generation technologies. Its performance is much higher (approximately 55%) than a conventional power plant (around 32%) The attraction of this new technology comes from its capacity to use heat, which would otherwise be lost, to generate additional electrical energy which represents a saving of fuel and a reduction in associated emissions.

1026. Replacing the existing power generation assets with the energy efficient CCGT technology is a key strategy for Uzbekistan in order to save energy, secure reliable power supply and mitigate climate change impacts.

1027. This impact is considered positive and **SIGNIFICANT** and is discussed below.

1028. Characterization. The effect is positive and direct on the economic environment, as well as cumulative.

1029. The impact is synergistic because it can promote the action of other effects, and permanent, throughout the life of the new power plant.

1030. It occurs in the short term, is continuous, and non-periodic, because the alteration is constant during the operating time of the new 2 CCGT units.

1031. According to the methodology previously described, numerical values will be assigned to the form taken by the attributes, as shown below:

ATTRIBUTE	**CHARACTERIZATION**	**NUMERICAL VALUE**
SIGN	Positive	+
IMMEDIACY (Inm)	Direct	3
ACCUMULATION (A):	Cumulative	3
SYNERGY (S)	Synergistic	3
TIMING (M)	Short-term	3
PERSISTENCE (P)	Permanent	3
PERIODICITY (Pr)	Non-periodic	1
CONTINUITY (C)	Continuous	3
INCIDENCE (I=Inm + +2A + 2S + M + 2P + 2R + 2Rc + Pr + C)		28
NORMALIZED INCIDENCE (I_S=I-I_{min}/I_{max}-I_{min})		0.5

1032. Magnitude. Power outcome of the project is summarized in the following table:

Table 98. Power outcome of the project

	Installed capacity (MW)	Annual Electricity output (GWh)
Existing plant	730	3,276
New 2 CCGT units	510	3,511
Decommissioning of III and IV units	(310)	(956)
V and VI units (backup)	420	426
Net change	200	661
After project	930	3,937

Note: It has been calculated to take into account the operation of units V and VI as backup (1014 h/year) and the operation of new 2 CCGT units (6912 h/y/unit).

1033. Taking into account the energy power generated in 2010, the project will allow an increase of 661 GWh/yr which would mean an increase at national level of 1.27%. Nevertheless, this project will generate more electricity with less gas, water, and GHG emission, thus contributing to climate change mitigation. In addition the implementation of this project will allow increasing the efficiency and the reliability of the energy supply to consumers, as well as improving the environmental quality in its area of influence according with the Government and ADB strategies. Therefore, the magnitude of the impact is assessed to be medium.

1034. Final impact assessment/Value. This **POSITIVE** impact is of medium magnitude and has a medium incidence (0.5 points)

Table 99. Impact Assessment Summary - Operation Phase

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 CCGT.	-	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 CCGT.	-	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 CCGT.	+	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	---

G. ENVIRONMENTAL MANAGEMENT PLAN

G.1. Overview

1035. The EMP compiles comprehensive information gathering together a succinct summary of impacts previously identified, the actions required to mitigate those impacts in accordance with the laws of Uzbekistan and the ADB safeguard policy, and the monitoring activities that are to be undertaken as part of the project in order to confirm that they have been effective in reaching their objectives.

1036. The EMP also details the institutional arrangements and capacities that currently exist, or that will be put in place during project implementation, to ensure that the EIA (including the EMP) has (i) comprehensively considered both Uzbek and ADB requirements for environmental protection, (ii) identified all likely environmental impacts, (iii) proposed appropriate mitigation measures, and (iv) put in place the necessary systems to ensure that effective procedures for environmental monitoring and control of the project impacts, and mitigation measures are implemented throughout the life of the project.

1037. Mitigation measures required to address the impacts identified by this EIA have been consolidated in the following draft EMP.

1038. In order to evaluate the actual impacts arising from the implementation of the project, and to monitor compliance with the requirements of this EIA and EMP, specific monitoring activities are required. The environmental monitoring plans detail the measurements needed, the locations where they are needed, the frequency with which they need to be made, and the responsibilities associated with each monitoring task.

1039. In accordance with the structure of the project, mitigation measures and their monitoring are proposed, as described further, and these are differentiated by their execution during the design and preconstruction, construction, demolition/decommissioning and operations phases.

1040. On top of that, Takhiatash TPP will put in place a grievance mechanism for recording and answering proposals, comments, suggestions, complaints, etc. that will be made available to the public throughout the life of the project.

G.2. Institutional Arrangements

Project Institutional Framework

1041. The project will be implemented by the Executing Agency (EA), Uzbekenergo. It will be under the control of a Project Management Unit (PMU), headed by a Project Director appointed by the EA.

1042. The PMU will work closely with the corresponding departments within the existing TPP organization to achieve the necessary coordination and integration of the two projects with the ongoing operation of Takhiatash TPP. In particular, the PMU will include a Safeguards Unit that will work closely with the existing environmental monitoring team of TPP to ensure consistency of approach and an appropriate level of understanding by the PMU team of existing conditions and systems within the TPP and its current impact on the surrounding area. The PMU will also ensure that the TPP environmental team understands the expected impacts of the CCGT and the systems that will be needed to mitigate them. The Safeguards Unit will include environmental, social and gender specialists to address the requirements of the project as detailed in the EMP.

1043. ADB will appoint (a) design and supervision consultant(s) (DSC), who will protect the interests of ADB and provide oversight of project implementation activities during the process of specification, tendering, tender evaluation, detailed design, construction, commissioning and acceptance testing, and initial commercial operation. The DSC will include environmental, social, and gender specialist(s), who will monitor the implementation of the project, and provide technical assistance and capacity building to the Safeguard Unit and TPP environmental monitoring team as required.

1044. The detailed design, construction and commissioning of the CCGT project and the detailed demolishing of already dismantled units I and II and decommissioning of the existing units III and IV will be undertaken through an EPC CCGT & decommissioning turnkey contract. The EPC CCGT & decommissioning contractor will have primary responsibility for ensuring compliance with the EMP during construction and demolishing/decommissioning, and for also ensuring that any significant changes to the design and processes are subject to environmental assessment to be reviewed by ADB.

Institutional Responsibilities

1045. The following responsibilities are allocated under this EMP.

1046. **Project Director.** The project director is the main responsible for the work of the whole PMU. Among the principal responsibilities is to ensure the effective implementation of the environmental and social safeguard policy guidelines and statutory requirements during project implementation.

1047. The **PMU** is responsible for the overall implementation for the CCGT project in accordance with all project technical and safeguard requirements. The organization of the PMU will be clearly defined in the chart underneath.

1048. **Power Plant Project Safeguard Unit**. The Safeguard Unit within the PMU has to deal with the following obligations:

- Ensuring that all environmental and social safeguard requirements and all statutory requirements of the Republic of Uzbekistan, are incorporated into relevant specifications.
- Ensuring that tenders for the EPC CCGT & decommissioning contract include appropriate commitments to comply with safeguard and statutory requirements.
- Ensuring that the EPC CCGT & decommissioning contractor complies with all safeguard and statutory requirements during construction, and specifically the EMP, through a

comprehensive program of monitoring the EPC CCGT & decommissioning contractor's activities and performance.

- Undertaking monitoring according to the EMP or ensuring that monitoring is undertaken by the EPC CCGT & decommissioning contractor or other agency, as required.
- Reviewing the results of all monitoring programs to identify non-compliance issues or adverse trends in results, and putting in place programs to correct any problems identified.
- Cooperate to ensure that the future environmental management systems and procedures are made consistent across the existing units as well as the new CCGT.
- Preparing procedures for the environmental management and monitoring of the new CCGT to ensure ongoing compliance with the requirements of this EMP.

1049. TPP Environmental Monitoring Team (EMT). The TPP EMT is responsible for:

- Ongoing monitoring of units V and VI operations during construction of the new CCGT.
- Undertaking monitoring of CCGT construction activities where appropriate for the Safeguards Unit.
- Undertaking monitoring of demolishing of units I and II and decommissioning activities of units III and IV where appropriate for the Safeguards Unit.
- Collaborating with the Safeguards Unit to ensure that a future environmental management systems and procedures are made consistent across all the units.
- Integrating the monitoring of the CCGT into units V and VI monitoring programs following commissioning of the new plant.
- Ongoing environmental management and monitoring of existing units V and VI and future CCGT during lifetime operation

1050. Design and supervision consultant (DSC). The DSC is responsible for protecting the interests of the Bank by providing technical engineering, environmental and social expertise to oversee and assist the activities of the PMU on behalf of the ADB, and providing capacity building and other technical assistance to the PMU in accordance with ADB policies and programs.

1051. DSC environmental, social, and gender specialists (ESGS). The DSC environmental, social, and gender specialists will:

- oversee the activities of the PMU,
- ensure that the appropriate safeguard and statutory requirements are incorporated into the EPC CCGT & decommissioning specification (it will have to check all the claims from contractor before payment), including the requirement to prepare an EMP and requirements for environmental performance guarantees on relevant equipment,
- oversee the EPC CCGT & decommissioning tender evaluation process to ensure that appropriate commitments regarding environmental and social safeguards are included, and in particular ensure that the contractor prepares a construction EMP for approval by the Safeguard Unit, and
- review the results of the PMU Safeguards Unit's monitoring of the EPC CCGT & decommissioning contractor's performance against the requirements of the EMP.

1052. EPC CCGT & Decommissioning Contractor. The EPC CCGT & Decommissioning Contractor will be required to:

- Prepare a construction & decommissioning EMP conforming to this draft EMP, the EPC CCGT & Decommissioning specifications and any relevant statutory requirements.
- Comply with all commitments made in the construction & decommissioning EMP, and ensure that all subcontractors similarly comply.
- Undertake periodic monitoring and monthly reporting to the PMU of performance against the construction & decommissioning EMP and this draft EMP.
- Complete all environmental performance guarantee testing required under the EPC CCGT & decommissioning contract to demonstrate the capability of the plant to meet environmental guidelines and limits.

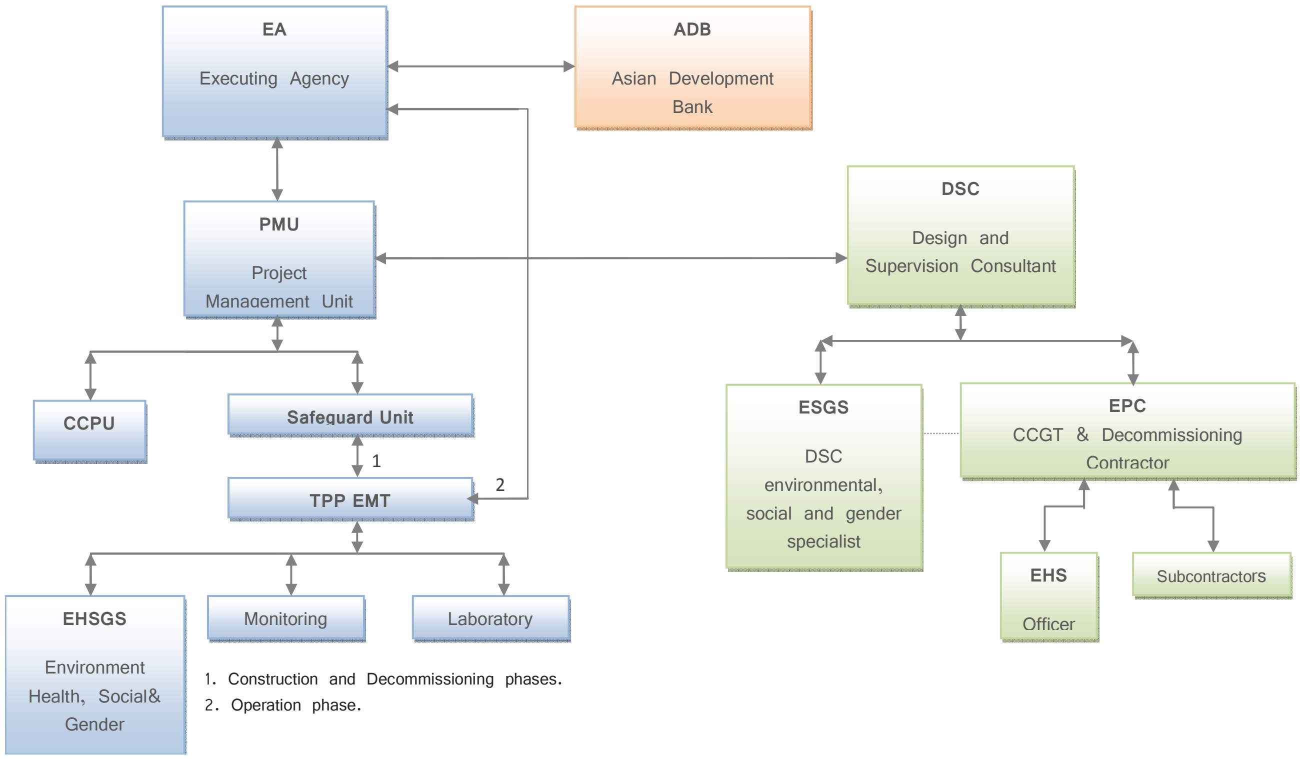


Figure 60. Organization of the PMU.

1053. The TPP EMT within Uzbekenergo will be strengthened by building staff capacity through technical support, equipment, and financial resources. The capacity building will:

- assist TPP EMT in supervising and implementing the EMP, which will comprise supervision and evaluation of the work to be undertaken by or on behalf of the EA, with respect to mitigation measures and monitoring requirements;
- provide on-the-job training to TPP EMT officials to build technical expertise on environmental and social aspects of environmental management;
- instruct TPP EMT personnel on proper techniques of project inspection, monitoring, use of field monitoring equipment, and data collection; and
- assist TPP EMT in coordinating and consulting with other government agencies, local communities, NGOs, and other stakeholders concerned with environmental aspects of the project.

1054. To ensure public disclosure and maintain the right of involvement on decisions and control of the appropriate implementation of the EMP and monitoring, a nongovernment organization (NGO), Independent Ecological Expertise, should work in close cooperation with other parties.

1055. The TPP EMT will include an environmental management expert as project manager with overall responsibility for implementation and monitoring of all proposed measures. The project manager, who will enforce the EMP through project implementation, will be assisted by an environmental management and public health specialist (EHSGS) and laboratory staff.

G.3. Mitigation Measures

1056. After identifying and evaluating significant impacts that produces the project on the environment, it is necessary to consider the required preventive and corrective measures.

1057. These measures are intended to prevent, reduce or compensate as far as possible, adverse effects, in order to reach levels which may be considered compatible with the maintenance of environmental quality. Preventive measures are always preferable over corrective ones, both in terms of environmental and economic standpoint.

1058. These measures were developed during the design, construction, operation phases of the new CCGT, demolishing of already dismantled units I and II and decommissioning phase of the old units III and IV according to the time of their application. In this sense, some protective measures are intended to avoid or minimize impacts during the operational phase, however, their construction or installation is done during the design or construction phase, and they are also included in this phase. Specific measures included in this EMP will need to be updated prior to expiring the life time of the facility as it is considered more appropriate to conduct a specific study for this phase (final decommissioning) when the time comes so as to incorporate the most recent advances as far as material recycling and waste management available at that time. To this respect, a specific measure is included.

1059. Regarding gas pipeline construction phase, as indicated in the Project Description chapter, the track is not defined yet. It could be parallel to the existing gas pipeline or a new path could be needed. In the last case, in order to take into consideration the best and more environmental friendly practices, the following measures should be take into account:

- Avoid affection of natural protected areas (if is the case)
- Minimize vegetation affection
- Avoid archeological areas (if is the case)
- Water bodies crossing minimizing aquatic flora and fauna affection by means of selection the best technology (e.g. Directed Drilling) and location
- Shorter track length design criteria

1060. It turns out to be advisable the implementation of an Integrated Management System in the existing Takhiatash TPP as well as in the new CCGT 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.

1061. 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.

1062. Moreover, an effective management system bring many benefits to the organization:

- More efficient resource use
- Improved risk management
- Increase customer satisfaction
- Lower costs

1063. 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)

1064. As an option, the municipal landfill could include the following improvement measurements that are recommended:

- Location of the municipal landfill further than 250 m to residential areas and following location recommendations of the IFC guidelines.
- Soil cover material, with base and side slopes designed to 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

1065. The mitigation measures proposed for the project are presented in Appendix I of this volume.

G.4. Monitoring and Reporting Program

G.4.1. Monitoring

G.4.1.1. Takhiatash TPP current monitoring program

1066. Currently, Takhiatash TPP EMT monitors/calculate the following output:

- ✓ Annual amount of emissions discharged into the atmosphere: NO_X, NO_2, NO, CO, SO_2, Benzopyrene
- ✓ Water use and effluents:
  - ✓ Monthly distribution of water intake and discharge (m^3/year) from and to Suenly canal.
  - ✓ Annual consumption of drinking water from municipal water supply system and amount of sewage water discharged to the municipal waste water treatment plant.
  - ✓ Annual amount of re-used water at the TPP (treated and reused water at the water treatment plant).
  - ✓ Water quality at intake and discharge points every 15 days of the following parameters: TPP, Fe, oil and grease, pH, temperature, mineralization, Cl^-, SO_4^{2-}, NO_3^-, NO_2^-, NH_4^+, BOD_5.
- ✓ Groundwater quality: a piezometric network formed by 57 wells-piezometers is deployed at the TPP. Some of them are inactive and require reconstruction. Nine parameters are analyzed: content of cations (Ca^{2+}, Mg^{2+}, Na^+), chlorides (Cl^-), sulphates, carbonates (HCO^{3-}), pH, hardness and temperature
- ✓ Annual amount of disposed hazardous and non hazardous wastes disposed at the municipal landfill.
- ✓ Annual financial report on environmental taxes calculated in accordance with Resolution of Cabinet Ministry of RUz #199 dated 2003 “On improvement of payment system for environment pollutions and wastes disposal at the territory of Republic of Uzbekistan”.

1067. In parallel, Goskompriroda conducts monitoring of:

- ✓ Monthly air emissions samples of exhausted gases from TPP and analysis at the Goskompriroda “Air monitoring” laboratory. Based on the results of these analyses annual discharge of pollutants from TPP is calculated.
- ✓ Soil analysis two times per year at the places, which have been defined as a potentially polluted. These points are located in the vicinities of the fuel tanks, at 10, 50, 100 and 150 m of distance from the tanks. The sampling depth ranges from 0 to 30 m. The analyzed parameters are: content of humus, pH, dry residual, nitrates, phosphates, oil products and three metals (copper, zinc and manganese)
- ✓ Water quality monitoring at the discharge canal: According to the National Regulation on Conducting of Environmental Monitoring, every 5 years surface water monitoring is revised. If during a monitoring period, pollution of water courses have not been observed, during the next 5 years there is no need to continuous with the monitoring. Due to the above reason, Goskompiroda is not monitoring water quality currently.

G.4.1.2. Takhiatash TPP future monitoring program

1068. The current monitoring program of the TPP should be extended and adapted to include the new CCGT operation. For category A projects, qualified and experienced external experts or qualified NGOs must verify monitoring findings.

1069. Monitoring program should apply national or international methods for sample collection, preservation and analysis, such as those published by the International Organization of Standardization (ISO). National methods will be always recognized on condition that they comply with quality and strictness of the international methodological standards. Samplings should be conducted by, or under, the supervision of qualified personnel. Analysis should be conducted by entities permitted or certified for this purpose.

1070. In order to control and improve the trustworthiness of all the data gathered by the monitoring system all the automated and manual equipment will be strictly calibrated in accordance with exactness and requirements of international standards and maintained properly and periodically through a **plan of calibration and maintenance**.

1071. **Sampling and analysis Quality Assurance/Quality control (QA/QC) plans** should be applied and documented to ensure that data quality is adequate for the intended data use. Monitoring reports should include QA/QC documentation.

1072. As mentioned above, and respecting the structure of the EIA, the Monitoring Program has been developed following the same framework: construction phase, operation phase and decommissioning activities.

1073. With the exception of general information, the most exhaustive and specific instructions to clarify how to implement the monitoring program are provided in the Appendix 2 of this volume. There, several matrices will gathered all details about monitoring methods to be used, parameters, thresholds or performance indicators, locations, frequency, responsibility, etc. In this monitoring plan, only quantitative items have been included as it is understood that in the final EMP visual or other qualitative monitoring would be included in order to check the proper management and implementation of the mitigation measures.

1074. Prior to monitoring tasks are defined for construction phase, it turns out necessary that the activity areas shall be supervised, including the verification of proper marking and signage of all the work areas and any ancillary areas and access routes that support the work.

G.4.2. Reporting

G.4.2.1. Takhiatash TPP current reporting

1075. The Takhiatash TPP EMT annually submits two kinds of reports:

1076. 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.

1077. 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.

G.4.2.2. Takhiatash TPP future reporting

1078. The report monitoring results to internal (project management) and external (authorities, local people, ADB) audiences is required to verify compliance with regulatory and other requirements. For projects which category is A, semi-annual reporting is required as a minimum during construction or decommission and annually during operation. In these report compliance of the TPP is to be undertaken. During the second public consultation, a representative of the State Protection Committee of the Republic of Karakalpakstan requested to increase this frequency to a quarterly basis during the construction and decommissioning phases, therefore, environmental reports during these phases should be undertaken on a quarterly basis. Monitoring reports will be made available for public consultation at the TPP Medical Service (200 meters outside of the TPP gate)

1079. Details of the actions, including timeframe for completion, taken as part of the project in order to rectify noncompliance, if any, will be presented in a Corrective Action Plan.

1080. The annual report of the operation phase shall include aspects such as:

- Significant environmental impacts.
- Greenhouse gases control.
- Air quality control: air quality and conformity of stack emissions.
- Water quality control: effluents.
- Soil quality control
- Groundwater control.
- Waste management.
- Noise level control.
- Health & Safety control
- Grievance mechanism findings

1081. In order to improve the current environmental reporting, collection of data and redaction of reports should be in electronic format.

H. INFORMATION DISCLOSURE, PUBLIC CONSULTATION AND PARTICIPATION. GRIEVANCE MECHANISM AND REPORTING TO THE POPULATION

H.1. Overview

1082. This section outlines the information disclosure, consultation and participation activities that have been undertaken as part of the EIA process and the outcomes of these activities, as well as those planned throughout the lifecycle of the Project.

1083. The section consists of the following items:

- Relevant host country laws and regulations
- Methodologies/means used to inform and involve the public in the environmental assessment process
- Discussion of issues raised by various stakeholders
- Response to affected people on how the project might address their concerns raised during consultation
- Documentation of public meetings including dates, names, topics and summary details of discussion, and important outcomes
- Establish measures for continuous consultation during the environmental management program;

H.2. Principles of Consultation

1084. Early and ongoing consultation, disclosure and meaningful stakeholder engagement is a key requirement for projects financed by the ADB. The EIA will be informed by the outcomes of consultation activities.

1085. Specific objectives of the public disclosure and consultation are:

- Ensure all legal and international finance requirements related to consultation are addressed;
- Involve a full range of stakeholders in the planning of the project to improve the acceptability of the project design, implementation and monitoring;
- Encourage an open dialogue with local neighboring communities and especially project affected persons where the project is located;
- Keep all interested and affected stakeholders informed of project progress; and
- Provide a grievance mechanism to raise complaints that are appropriately addressed by the Project.

1086. The public disclosure and consultation is underpinned by the principles that community engagement should be free of external manipulation, interference, coercion and intimidation and conducted on the basis of timely, relevant, understandable and accessible information.

Consultation activities should always be well planned and based on principles of respectful and meaningful dialogue.

H.3. Consultation Requirements

1087. This sub-section provides an overview of the consultation, disclosure and stakeholder engagement requirements of the ADB and the national requirements contained within the Uzbek EIA procedures.

H.3.1. ADB Consultation Requirements

1088. ADB's Safeguard Policy Statement (2009) explains that the ADB is committed to working with borrowers/clients to put meaningful consultation processes into practice. For policy application, the ADB see meaningful consultation as a process that:

i. Begins early in the project preparation stage and is carried out on an ongoing basis throughout the project cycle;
ii. Provides timely disclosure of relevant and adequate information that is understandable and readily accessible to affected people;
iii. Is undertaken in an atmosphere free of intimidation or coercion;
iv. Is gender inclusive and responsive, and tailored to the needs of disadvantaged and vulnerable groups; and
v. Enables the incorporation of all relevant views of affected people and other stakeholders into decision making, such as project design, mitigation measures, the sharing of development benefits and opportunities, and implementation issues.

1089. ADB requires borrowers/clients to engage with communities, groups, or people affected by proposed projects, and with civil society through information disclosure, consultation, and informed participation in a manner commensurate with the risks to and impacts on affected communities.

1090. ADB's Safeguard Requirement (SR) 1: Environment, specifies that projects must:

- Carry out meaningful consultation with affected people and facilitate their informed participation;
- Ensure women's participation in consultation;
- Involve stakeholders, including affected people and concerned nongovernmental organizations, early in the project preparation process and ensure that their views and concerns are made known to and understood by decision makers and taken into account;
- Continue consultations with stakeholders throughout project implementation as necessary to address issues related to environmental assessment;
- Establish a grievance redress mechanism to receive and facilitate resolution of the affected people's concerns and grievances regarding the project's environmental performance;

- Disclose a draft environmental assessment (including the EMP) in a timely manner, before project appraisal, in an accessible place and in a form and language(s) understandable to affected people and other stakeholders;
- Disclose the final environmental assessment, and its updates if any, to affected people and other stakeholders; and
- Implement the EMP and monitor its effectiveness. Document monitoring results, including the development and implementation of corrective actions, and disclose monitoring reports.

1091. Public consultation needs to be carried out during the early stage of EIA preparation and throughout the project implementation to address any environmental issues that affect the local communities, NGOs, governments, and other interested parties. For all Category A projects, the Environmental Policy requires public consultation at least twice.

H.3.2. National Consultation Requirements

1092. There are two non-mandatory mechanisms for public participation in the EIA assessment procedure: the public environmental review (PER) and public hearings. While the Law stipulates that PER might be organized by independent expert groups, its outcomes are non-mandatory. There are no legal provisions for public hearings, though the EIA assessment procedure Manual provides some procedural guidance. It recommends the organization of public hearings in the course of draft EIA preparation and suggests some forms of organizing them and potential participants. Even the existing limited opportunities for public involvement in the EIA process are not used because of the absence of strict legal provisions for public participation in EIA.

1093. Provision # 6 of Law on Environmental Expertise (2000) states, that "The promoter of a project who undertakes an EIA assessment procedure could publish an announcement informing of this fact. In this case, after finishing the EIA, the conclusions or results should be published in a month period time at the latest. The list of the projects which should conduct publish announcement as a mandatory request it is meant to be defined in the legislation but there is not a specific legislation that gather this information or procedure.

1094. In accordance with the requirements of Uzbekistan (Decree of the Cabinet of Ministers of Uzbekistan on Approval of the Regulations on the State Environmental Expertise in the Republic of Uzbekistan No.491 of 31.12.2001 as amended on 05.06.2009) results of public hearings and disclosure of information should be included in the set of documents, presenting for review and getting clearance from Glavgosekoexpertisa).The 'Statement on Environmental Consequences' should detail, among other items, the comments received through the public hearings if undertaken.

1095. The approach to planning the public meetings for the Project has been guided by typical local practice and international best practice embodied by the standards summarised below.

H.4. Project stakeholders

1096. Stakeholders are defined as persons and entities who are interested in, are affected by, or can affect the outcome of the Project.

1097. The public disclosure activities have included meetings with the following groups of stakeholders to inform of the public consultations to be hold:

- Representatives from State Nature Protection Committee (SNPC) of the Republic of Karakalpakstan,
- Representatives from state institutions (water supply organization “Vodocanal”, gas supply “Gas trest” and electricity network “Electroset”)
- Specialists of the main body of “Uzbekenergo”, its entities and local branches
- Non-Government Organizations (“Intellekt”, Nimfogo”, “Resources Centre”)
- Representatives of local Hokimiyat
- Residents of the local communities/civil society

1098. These stakeholder groups were invited to the public consultations through various media and other means in the most appropriate way in each case so as to attain the greatest possible dissemination as indicated in the following point.

H.5. Information disclosure

1099. The public consultations were preceded by extensive dissemination of this event and were disclosed via:

- Official invitations:

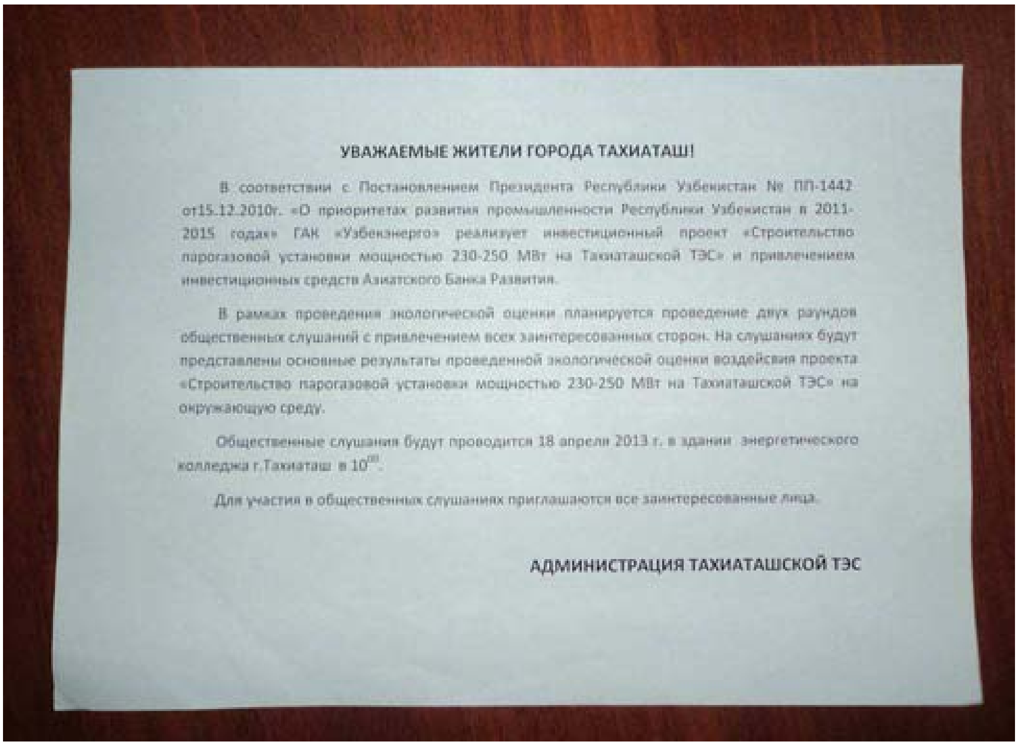
1100. As part of the public consultations preparation, a letter with information on planning activities on the project’s disclosure was sent to the Takhiatash city’s governmental authority (Khokimiyats), State Nature Protection Committee and Non-Government Organizations located in the Karakalpakstan Republic. Appendix 1 of Annex VII includes de information letters from the Takhiatash TPP to these institutions. In these letters Takhiatash TPP request collaboration in the dissemination of the public consultations of the project between the communities.

- Information to the local population:

1101. The Takhiatash Khokimiyat, worked closely with the smallest administrative units (makhallas) to disseminate the information on public consultations from makhalla’s to residents of Takhiatash city. The project consultants informed of the planning activities of public consultations to the residents living close to the TPP.

- Announcements signs:

1102. Moreover, around 10 announcements were placed at public places such as market, shops, bus stops, etc.



УВАЖАЕМЫЕ ЖИТЕЛИ ГОРОДА ТАХИАТАШ!

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 проведения экологической оценки 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.

Общественные слушания будут проводится 18 апреля 2013 г. в здании энергетического колледжа г.Тахиаташ в 10^{00}.

Для участия в общественных слушаниях приглашаются все заинтересованные лица.

АДМИНИСТРАЦИЯ ТАХИАТАШСКОЙ ТЭС

Figure 61. Announcement about the 1st Public Consultation placed into different public places in Takhiatash city

Announcement placed at the city market (Takhiatash city)

Announcement placed at the bus station (Takhiatash city)

Figure 62. Announcement places at different places in Takiatash city

- Public in newspapers:

1103. Announcement on public consultations were published into the local newspaper “Erkin Karakalpakstan” on local language (Karakalpak) on 13 April 2013 for the 1^{st} public consultation round (hold on the 18 April 2013) and on Karakalpak and Russian languages on the 27 April 2013 for the second round (hold on the 29 April 2013). Announcement on third public consultation was published into the “Erkin Karakalpakstan” on Karakalpak language and into the “Vesti Karakalpakstana” on the Russian language on 6 July 2013. In Appendix 2 of Annex VII are shown newspaper announcements.

H.6. Public Availability

1104. During the 1st round of public consultation, an initial version of the Environmental Management Plan (EMP) in Uzbek was distributed among the participants. During the 2nd public consultation the updated version of EMP including suggestions and recommendations proposed by 1st public consultations participants was also distributed. These two public consultations presented the project considering one CCGT. In the meanwhile, it was decided to extend the project with a second CCGT unit. In order to disclose the changes involved in the EIA because of these extension, a 3rd public consultation was held on the 8^{th} of July of 2013. In the 3^{rd} public consultation a reviewed EMP, which includes modifications required from 1 to 2 CCGT units, was again distributed among the participants.

1105. In order to disseminate the project information, copies of the EIA in Russian were made available in the 2nd public consultation. One copy of the final EIA will be also available to the public for consulting at the Takhiatash TPP through the life of the project. The place in where the EIA can be consulted is at the medical services of the TPP (200 meters outside of the TPP entrance).


Figure 63. Medical services of the Takhiatash TPP

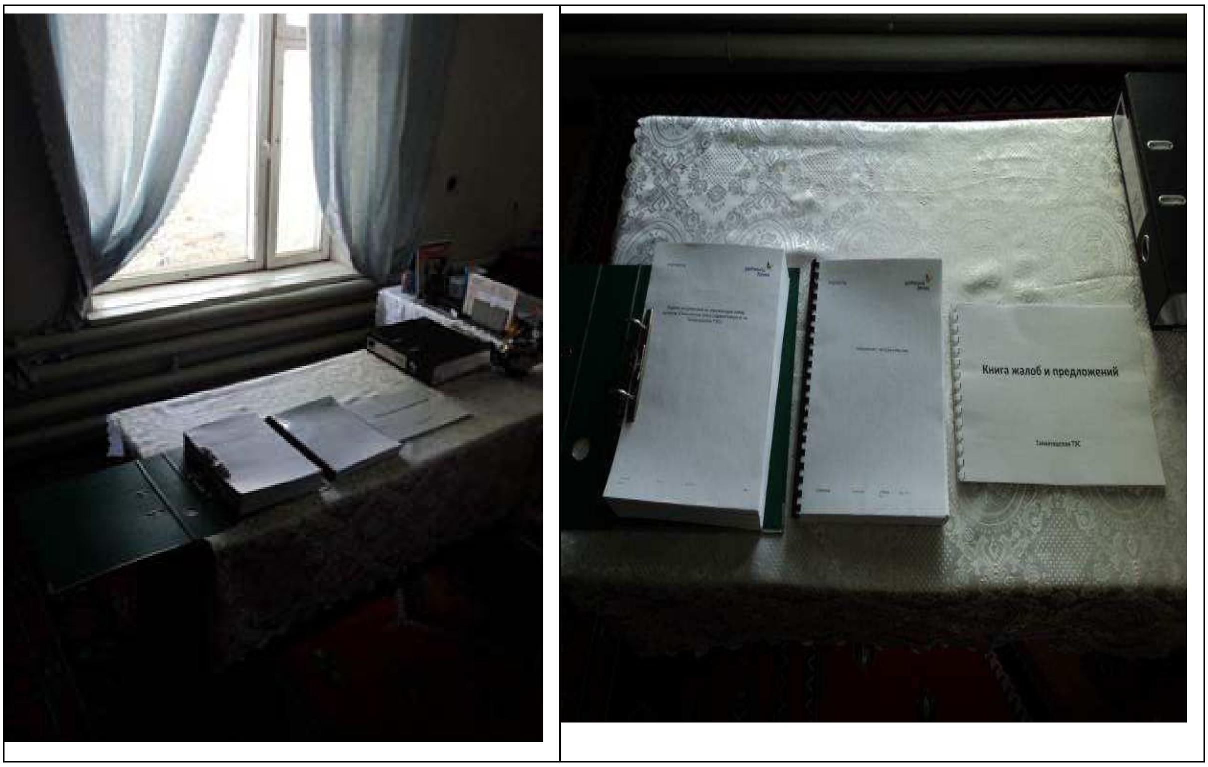


Figure 64. Place within the Medical Service in where the EIA and Grievance logbook are located

1106. Three hard copies of EIA have been delivered to the Takhiatash TPP's manager, Nature Protection Committee of Republic Karakalpakstan and Takhiatash city government authority.

1107. Moreover, final version of EIA will be published on the Uzbekenergo (Russian and English versions) and ADB's websites (English version) no later than 120 days prior to the Board considerations. The electronic EIA version will be also made available to interested parties upon request through download procedure.

H.7. Public presentation and consultation

1108. After having announced the days of the public consultations of the project in the media and at the appropriate frequency for the population characteristics, as part of the environmental assessment process for the project, three public consultations took place on 18 and 29 April and on 8th July 2013 at the Energy college of Takhiatash (at the door, announcement of public consultation can be observed).

Figure 65. Energy College entrance and announcement placed on the entrance

1109. These consultations were an opportunity to associate all of the parties involved and stakeholders concerned to the project: provincial and local authorities, non-central government services, NGOs and civil society, especially representatives of the local population.

1110. These consultations were also an opportunity to disseminate pertinent information which helped the general public understand the project risks, impacts and opportunities. In addition, the public consultations organized were a time for: (i) all of the stakeholders involved to express their opinions on the project risks, impacts and mitigation measures and (ii) Takhiatash TPP to study and respond to them.

1111. The procedure carried out consisted of an initial registration of the people who attended (Appendix 3 of Annex VII: list of participants) after which a dossier was handed out which included the initial version of EMP in the 1st public consultation and a reviewed version of the EMP in the 2nd and 3rd public consultations.

	
Folders with notebook, pens and EMPs have been distributed to each PC participant	All participants were registered

Figure 66. Registration process

1112. As can be verified by the attendance records, 32 people participated in the 1st public consultation and 56 in the 2nd public consultation including local community leaders, representatives of public institutions, nature protection committee, politicians, the press, NGOs, etc. More than half of them were females in the 1st public consultation and almost the half of them in the 2nd public consultation. 57 participants attended 3rd Public Consultation. Even most part of participants have participated in the first two PC, representatives of communities located next to the TPP also participated in the 3rd round of PC.

1113. After all people attending were registered, the opening remarks were given by Tagekeev A., representative of Takhiatash TPP who emphasis, that this Project is very important for the economical development and electricity supply of the region.

1114. Amaya Yoldi, International Environmental Expert and EIA project manager, then took the floor to underline the importance of the project, the importance of its environmental assessment and the purpose of the consultation in an effort to consider environmental issues through a participatory approach encouraging everyone present to participate. In the 3rd round of public consultation Dewi Utami Safeguard Officer from Uzbekistan Resident Mission of ADB gave short speech on general requirements of national and ADB's safeguard requirements, importance of involving of national Nature Project Committee in project preparation and monitoring process on the project implementation stage.

1115. Further, Madina Khalmirzaeva, the National Environmental Expert and part of the EIA team, presented the main findings of the EIA in a Power Point in Uzbek language. She informed those present that they could communicate their remarks at the meeting. The English version of the presentation is attached to this report (Appendix 4 of Annex VII).

Figure 67. From left to right: Madina Khalmirzaeva, Amaya Yoldi and Tagekeev A.

Figure 68. Madina Khalmirzaeva giving the oral presentation of the EIA

1116. During the presentation, the public was told that Takhiatash TPP has put in place a process for recording proposals, comments, suggestions, complaints, etc. that will be made available to the public throughout the life of the project. Public were informed that the grievance logbook and the EIA are accessible at the medical service of the Takhiatash TPP (200 meters outside of the entrance to the TPP, see Figure 64).

1117. Finally, the public was informed that the results of the annual environmental report (which include the grievance mechanism findings) will be made available for public consultation through the aforementioned means.

1118. The floor was then given to those present who asked several questions and made remarks and comments on the project. Several questions, remarks, comments and suggestions related to the project EIA were also expressed.

1119. In Appendix 5 of Annex VII a photographic report of the public consultations is included.

1120. What follows is a summary of the questions and answers at the three public consultations.

Table 100. Table of questions and answers and arised during Public Consltations

1st PUBLIC CONSULTATION (18 APRIL 2013)			
Quest. No.	**Speaker**	**Questions**	**Responses given by environmental team**
1	Gandullaeva M.	Currently we use water from Suenly canal for irrigation. Will the new unit impact on the quality of water into the Suenly canal? Could we use this water for irrigation as we do it now?	The replacement of the old units with the new CCGT will not change water quality of Suenly canal. In any case, thermal effluent will be reduced due to implementation of close cooling water system instead open system that is being used currently.
2		Is possible to plant trees at the area surround to the Takhiatash TPP?	The Project does not cover this type of activity. Proposed EMP includes measures which have to be undertaking to recover soil after finishing construction works, but this activity will be done within TPP territory. (Note: after clarification with Takhiatash TPP they agree to include a green area on the vicinity of the TPP terrains. Therefore, this community suggestion has been incorporated into the EMP (mitigation measure nº 46)
3	Babajanova, Makhalla leader	Will it be any resettlement within this project? If yes, has any economic compensation included?	There is not expected any resettlement as the territory for the new CCGT is attached to the existing TPP in industrial area. Anyway, the Project includes the consultancy of an independent expert who will work on resettlement issues. In any case, there is a special ADB's Safeguard Policy (2009) which describes the requirements on this issue. All activity related with resettlement will be implemented in accordance with local legislation and ADB's requirements.

1st PUBLIC CONSULTATION (18 APRIL 2013)			
Quest. No.	**Speaker**	**Questions**	**Responses given by environmental team**
4	Ataniyazova Sapargul, State nature Protection Committee, air quality monitoring department	Your project is very important for our region. Also I am glad that you are talking about decreasing on 40% the contribution of the TPP to NO_2 pollution. I understood that it's planning to conduct monitoring of different pollutants in air. Are you going to measure during construction stage level of soot, heavy metals, SO_2?	Emission of these kind of pollutants is insignificant in construction. The main air pollutant at this phase normally is dust and we have included the necessary measures to mitigate this type of pollution into the EMP as watering of dusty surfaces and areas, proper maintenance of the equipment and machinery in order to reduce emissions at the minimum, etc.
5	Gumamuratova M., Representative of Hokimiyat	There is an energy college preparing experts for energy production into the Takhiatash city. You explain that an Automatic Control System is going to be implanted in the new CCGT. Which is the impact on the TPP as source of employment for our graduated students?	We will clarify Uzbekenergo employment policy regarding graduated students with the PIU and will answer back on the 2nd Public Consultation. (Note: after clarification with the PMU we can conclude that the 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 also to hire around 30 students per year this policy will continue on going.)
6	Tagekeev A. Takhiatash TPP, leader of "Kamolot" young generation union	I am also concerning about people who currently work at Units III and IV. Decommissioning of these units is planned also. What is going to be done with the staff working on these Units after decommissioning?	There is a special training program within the project to update these people in order them to work at the new CCGT. Dismissal of current workers is not expected as they will be moved from the old to the new units.

1st PUBLIC CONSULTATION (18 APRIL 2013)			
Quest. No.	**Speaker**	**Questions**	**Responses given by environmental team**
7		What about emissions of CO? Are they expected?	In any fuel combustion process CO_2 is emitted. When the combustion is not perfect emission of CO is also produced. In this case, emission of CO expected will be lower than the one produced in the old units to be replaced as the technology is more efficient and provides a better combustion process. CO emissions have been simulated with an atmospheric dispersion model getting to the conclusion that CO ambient air quality levels are low and always further under the national standards.
8		How much water the new unit will take from the Suenly canal and how you are going to monitor quality of water discharged into the canal?	Water intake and discharge flue rate will be significantly reduced due to the replacement of part of the existing open cooling water system for a closed one for the new CCGT. In accordance with suggested environmental monitoring plan, water quality monitoring into the water intake and water discharge canals will continue but in expended format. Some of the parameters will be monitored in a continuous and automatic way and other parameters will be monitored manually at the laboratory. For this last item, several new parameters (which normally are controlled in international standards) have been included. The philosophy of the measurement of the water quality parameters is to control the fulfillment of national and international parameters and to make sure that there is not a decrease of the baseline water quality.

1st PUBLIC CONSULTATION (18 APRIL 2013)			
Quest. No.	**Speaker**	**Questions**	**Responses given by environmental team**
9	Gapakova G, Resources Center of National Association of Non-governmental organizations of Republic Karakalpakstan	Republic of Karakalpakstan locates at the downstream of Amudarya river. Water quality in this river significantly impacts on the health of people especially of women. Will you Project impact on the water quality in the Seunly canal?	Water from Suenly canal is used mainly for cooling system which means that the water returned has the same characteristics as the water intake but with a thermal increase. In this respect, as mentioned before, thermal effluent will be reduced due to implementation of close cooling water system instead open system that is being used currently. Water used for other uses within the power generation process will be treated to fulfill the most stringent standards between the national and international ones. Waste water treatment plant design requirements have to fulfill with these standards. As a conclusion, there not will be an impact on the water quality due to the implementation of the new project.
10		There are fan energy cutoffs during the whole year in our region. Could we expect that after the Project implementation these energy cutoffs will not happen?	We can confirm that after CCGT commissioning energy production will increase and as consequence energy supply will improve as well. Nevertheless, the completely stop of the energy cutoffs cannot be guarantee. In this sense, Uzbekenergo is trying to improve energy supply but this procedure is going to be implanted step by step.

1st PUBLIC CONSULTATION (18 APRIL 2013)			
Quest. No.	**Speaker**	**Questions**	**Responses given by environmental team**
11		How the work with the non-governmental organizations sector will be organized?	In the presentation we have provided contact details (persons in charge, address, telephone number, email) in where suggestions, proposals, concerns, complaints can be send. During the life of the project, environmental annual reports will be available to the public. ADB's environmental policy encourage to the Takhiatash TPP to have a more open and transparent communication with local communities. In that sense, we are expecting your involvement both into the project implementation and along the operation phases.
12		We are concerned about the conditions of the roads We have experienced than after a Project completion the used roads become in a very bad condition which created a lot of difficulties to the local communities.	Mitigation measures on road maintenance are included into the EMP. In accordance with proposed measures, the condition of the used roads should be at least at the same level as it was before construction and decommissioning works were started.
13	Madreimova G. Makhalla #6	Is it possible to use the steam produced from the new CCGT for heating greenhouses?	No, it is not technically possible. All the steam produced will be used into the closed CCGT system.
14		As an expert, what do you about the possibility to grow citrus fruits in our climatic conditions?	Well, to get to a conclusion about this subject a specific study about the conditions of soil, water and climate for this purpose should be undertaken. Unfortunately, the project ongoing is nothing to do with this matter and therefore these item has not been studied in the EIA..

1st PUBLIC CONSULTATION (18 APRIL 2013)			
Quest. No.	**Speaker**	**Questions**	**Responses given by environmental team**
15	Hojanazarov A. Chief editor of the "Aqmagat" local newspaper	Will installation of the new CCGT impact on the heating water produced at the TPP?	After CCGT commissioning, heating water supply will remain with the same capacity.
16		Do you have experience working in other similar projects? If yes, what is the main difference between these projects and Takhiatash?	Yes, "GasNatural fenosa" has a wide experience on implementation this kind of technology, but not in Uzbekistan. The national environmental expert worked at the Talimarjan CCPP Project in 2010. The main difference between both projects is that Takhiatash Project has a decommissioning phase that will require a special procedure.

Table 101. Table of questions and answers and raised during Public Consultations

2nd PUBLIC CONSULTATION (29 APRIL 2013)			
Quest. No.	**Speaker**	**Questions**	**Responses given by environmental team**
1	Berdiev Z. State Protection Committee of the Republic Karakalpakstan	It was mentioned during the presentation that the project passed Stage II ('Statement on Environmental Impact') of the national EIA process. What kind of 'Statement on Environmental Impact' has been conducted? Public or private?	A public (Government) EIA procedure has been conducted for this project. The endorsement from State Nature Protection Committee was received in November 2013. Private EIA procedure has not been conducted.
		What kinds of analyses or surveys have been conducted during your EIA and Environmental Audit to gather information about the environmental baseline?	The following analysis have been conducted within this EIA: surface water quality from intake and discharges points, soil quality and a noise measuring campaign. Analyses itself were conducted in Tashkent city.
		State Nature Committee on Nature Protection would like to request providing environmental monitoring reports during construction phase on a quarterly basis	As it is required by ADB procedure, the environmental monitoring reports will be submitted on a semiannual basis. As per your request we can increase this frequency to a quarterly basis. We will include this request in the EMP.
		EMP includes monitoring on water, soil and air quality. Some of the analyses need to be done in 2 - 6 hours. It would be better to conduct those analyses into the Nukus laboratory.	We agree that these analyses can be done into the local laboratories if they have the required facilities and equipment needed to conduct the specific analysis indicated into the EMP.

2nd PUBLIC CONSULTATION (29 APRIL 2013)			
Quest. No.	**Speaker**	**Questions**	**Responses given by environmental team**
		Takhiatash city is located in an environmentally impacted area due to due to the drying out of Aral Sea which caused an ecological crisis in the region. Is it possible to include within the project the construction of a new clinic to improve the health condition of the local population?	The implementation of this project will improve the environmental quality in its area of influence (as we are replacing old equipment by new and more efficient one). Unfortunately, the construction of a clinic is not covered within the project.
2	Jumaniyazov K., Student of Takhiatash energy college	What kind of pollutants will be emitted to the air from the proposed cooling towers?	Cooling towers emissions, being used to refrigerate the cooling water used In the condenser to convert steam again into water, just emit water vapor (steam)..
3	Tursinbaev A, Student of Takhiatash energy college	There is a hospital in Takhiatash city. I am concerned that during construction and operation phases noise impact will increase and negatively influence on the patients, especially on pregnant women.	Some increasing of noise level is expecting during the construction phase but just in the close vicinity. Noise rapidly decreases with distance. The EMP defines several measures to mitigate this issue (e.g. use noisy equipment only during the daytime, etc.). Regarding the operation phase and as it has been explained in the presentation, it is expected that global background noise will decrease due to the replacement of old and noisy equipment by a new and less noisy one.
4	Tursinbaev A. Resident of Takhiatash city	Could we expect that in the operation phase we will not have shortage of energy supply and electricity cuts offs?	We couldn't promise that you will not have electricity cuts offs. As we told before, the energy production will increase and therefore the energy supply will improve.

2nd PUBLIC CONSULTATION (29 APRIL 2013)			
Quest. No.	**Speaker**	**Questions**	**Responses given by environmental team**
5	Kaliyeva M. secondary school #12	Did you check heating water quality supplied for the Takhiatash city?	No within this EAI we didn't check quality if this water.
6	Tajekeev A. Takhiatash TPP	I participated at the first public consultation. Question that I made during this first public consultation have been included and answered in this second public consultation. Several colleagues and myself we've searched combined cycle power technology and we agree that this is the best technology for now among conventional technologies. We really support this Project and we are waiting for its earliest implementation.	

2nd PUBLIC CONSULTATION (29 APRIL 2013)			
Quest. No.	**Speaker**	**Questions**	**Responses given by environmental team**
7	Otajonov R. Takhiatash TPP	I am concerned about water quality into Suenly canal. There is a settlement close to Takhiatash TPP which uses water from the canal for irrigation and drinking purposes. I think that water is polluted because the TPP is discharging the boiler washing waste water to Suenly canal.	We have assessed measurements of the discharge to Suenly canal done by the TPP every 15 days for the last two years (2011 and 2012). They don't show any additional pollution caused by the operation of the TPP. Water quality in the intake and discharge points is similar except for temperature which is increased after being used in the open water cooling system. In accordance with existing water scheme provided by the TPP, the only effluent discharged into Suenly canal is water from the cooling system. This water is not polluted within the process of refrigeration (just un increase of temperature). The developed EMP includes monitoring of water quality into the Suenly canal on a permanent base and, if bad practices as boiler washing waste water discharged to Suenly canal are undertaken these will be detected and corrected to fulfill national and international standards. If water from Suenly canal do not have the required quality for irrigation and drinking purposes it should not be used. The solution of this issue is related with other kind of projects like safe water supply for the area. Anyway, the implementation of the project, as mentioned in the presentation, will not decrease the water quality of Suenly canal. Actually, an improvement is expected because of the reduction of the amount of warm water discharged to the canal.

Previous to the 2nd public consultation, a meeting with some representative staff of Takhiatash city hokimiyats was hold. In the following table a summary of the questions and answers of the meeting is included:

Meeting with the Takhiatash city hokimiyats (29 April 2013)			
Quest. No.	**Speaker**	**Questions**	**Responses given by environmental team**
1	Gumamuratova, F Women committee	Should we expect a decrease in the number of staff working at the TPP? New technology will require higher qualified staff.	We have clarified this question from the PMU. There is a special training program within the project to update these people in order them to work at the new CCGT. Dismissal of current workers is not expected as they will be moved from the old to the new units.
2		Your EMP mentions about hazardous materials. How these materials will impact on the people living close to the TPP area?	During conducting EIA, a special attention was paid to waste management issues. The proper measures have been included in the EMP to provide safe work condition for workers and residents living on the surround area. Waste management will be adapted to international standards in order to avoid any pollution to the environment. TPP Mazut storage locatd at 35 km of the TPP will be conditioned to be used as an storage for hazardous materials (such as asbestos of the old units III and IV to be decommissioned). As an option, additional improvement of municipal landfill is advised to storage non-hazardous materials.

3	Deputy Governor of Takhiatash city	I live almost in the center of Takhiatash city. Even there I feel noise impact from TPP. What will be happened after new unit installation?	In accordance with conducted noise measurements, just close residents can feel noise caused by the current operation of the TPP. Noise decrease rapidly with distance and it is improbable that noise from the operation of the TPP can be notice at 3 km distance (which is the distance between the TPP and the center of the city of Takhiatash). In any case, it is expected that global background noise will decrease due to the replacement of old and noisy equipment by a new and less noisy one.
4		In a previous meeting with the project social expert, the construction of a laundry and sauna service center was proposed. Is it possible to locate this service center at the area close to the center of Takhiatash city? In this case the center will provide services not only for residents living on the vicinity to the TPP area but for all Takhiatash city population.	We will forward your concern to our social expert for taking this suggestion into account.
5	Head of Takhiatash city "Vodokanal"	In addition, for the location of the proposed laundry you have to take into account the existence of sewage network. I think there is not a sewage network at area located close to the TPP.	We will forward your concern to our social expert for taking this suggestion into account.

Table 102. Table of questions and answers and raised during 3rd Public Consultation

3rd PUBLIC CONSULTATION (8th July 2013)			
Quest. No.	**Speaker**	**Questions**	**Responses given by environmental team**
1	Representative of Khamza makhalla director of school # 39, living next to Takhiatash TPP	Will construction of new CCGT and further operation of this installations impact on water quality in Suenly canal? We use this water for irrigation purposes and caused by construction activity water quality degradation could lead to crop losses.	Appropriate mitigation measures are included in the EMP to prevent water pollution during construction activity. Moreover during the impact assessment we have conducted external analyzes of water quality in Suenly canal. As results showed, water quality in the canal complies with national requirements for irrigation water. During the operation stage water from the Suenly canal will be used only for cooling purposes and on close cycling base.
		How operation of new installation will impact on water quantity in Suenly canal? We need water for irrigation	The net technical water consumption of the TPP will increase due to make-up water needs for evaporation losses in the cooling towers of the CCGT units. The explanation lies within the net water consumption of the current open cooling circuit, which is almost zero because all the intake water is subsequently discharged back to the canal.
2	Representative of Takhiatash TPP, women committee member	Did you conduct analyses of water in Suenly canal in term of using for drinking purposes?	No, we did not conduct such analysis. The Suenly canal is defined as an irrigation canal we've checked general parameters, applicable for irrigation water
3	Representative of NGO Gapparova G.	Please take in account our opinion that water availability and its quality is very important for local population	

4	Representative of makhalla #8 living next to Takhiatash TPP	Whether any houses resettled or forced to move?	As it was presented during the presentation, new CCGT will require acquisition of 40 ha. Conducted within this FS social survey showed that one factory and 1 house will be displaced. An appropriate compensations will be paid to the factory and house owners.

1121. Additional consultation will be conduct by the TPP as needed from time to time (e.g. if there is any change on the plan, prior to starting construction works when the detailed designs are ready, during the project construction, etc.)

H.8. Grievance Mechanism

1122. The Takhiatash TPP includes a process for recording and answering suggestions, complaints, proposals, etc. The register set up via a physical logbook register which is available at the medical service of the Takhiatash TPP (200 meters outside the entrance of the TPP) throughout the life of the project. The structure of the logbook (Russian language and translation into English) is included in Appendix 6 of Annex VII.

1123. Grievances received and responses provided should be documented and reported back to the complainant. Response time will extend up to one month. The complainant can ask for reconsideration by a higher authority if not happy with the outcome.

1124. In this regard, 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

1125. 1st level of the organization can be also employ to communicate complaints instead the physical register located at the TPP medical service if the complainant consider this way more suitable.

H.9. Monitoring and reporting

1126. The result of the Grievance Mechanism will be included in the environmental and social surveillance plan follow-up reports which will be prepared annually during the TPP operation. These reports will be made available to the public at the medical service of the Takhiatash TPP (200 meters outside of the entrance of the TPP).

I. CONCLUSIONS

1127. The project of the construction of two 255 MW Combine Cycle Power Units (CCGT), the demolishing of already dismantled units I and II and the decommissioning of the 310 MW existing units III and IV at Takhiatash TPP is a priority project identified by Uzbekenergo, which is the national company in charge of the electricity sector.

1128. Takhiatash TPP, with the installed capacity of 730 MW, is the main power supply source for the Karakalpakstan and Khorezm regions with over 3 million people located in the western part of Uzbekistan. The power demand outlook is strong with a number of industrial development projects envisaged for the region, exceeding currently available capacity. Furthermore, operational lifetime of the Takhiatash TPP's equipment is 22-43 years, resulting in its degradation and the increasing in the probability of accidental risk with potential negative consequences for the environment.

1129. In this respect, power generation from burning gas in a CCGT is the cleanest method of generation using fossil fuels. The CCGT turbines burning natural gas produce significantly less greenhouse gases than traditional coal or oil fired thermal power stations, as a result of both the less greenhouse intensive nature of natural gas and the greater inherent energy conversion efficiency of CCGT technology. Replacing the existing power generation assets with the energy efficient CCGT technology is a key strategy for Uzbekistan in order to save energy, secure reliable power supply and mitigate climate change impacts. The project will increase energy efficiency from 20-30% to 50-60% increasing the power output from 3276 GWh/year to 3937 GWh/year.

1130. This project will allow cutting operational expenses, increasing the efficiency of energy transformation and the reliability of supply of energy to the consumers, and improving the environmental situation in its area of influence according with Government and ADB strategies.

1131. Because the project is planned attached to the existing Takhiatash TPP, the overall environmental impact will be far less significant than it would be had the project been set in a pristine area, taking into consideration the fact that it is the power station's existing infrastructure that will be used (natural gas supply, water intake and discharge canals, transmission line, etc).

1132. In compliance with the Cabinet Ministers' Decree of the Republic of Uzbekistan (RUz) No. 491, thermal power stations with capacity of 300 MW and more belong to Category 1 and therefore must undertake national EIA procedure.

1133. The present Environmental Impact Assessment was drawn up by GAS NATURAL FENOSA ENGINEERING Company on behalf of the Asian Development Bank (ADB). This EIA present the information from the original Russian EIA and includes some additional sections required to meet ADB environmental policy requirements. With reference to ADB's Safeguard Policy Statement SR1 on Environment, this Project is considered to be a 'Category A' project and therefore a complete EIA is requested.

1134. Throughout the project (starting from design, construction, demolishing, decommissioning and through to unit operation) all requirements in RUz environmental legislation and ADB's safeguards policy statement, including World Bank Group Environmental, Health and Safety guidelines (specific guides concerning thermal power stations published in December 2008, and general guides published in April 2007) and international conventions were incorporated into the study.

1135. It should be pointed out that limit values concerning gas emissions, noise, waste, air quality etc, were based on [whichever was] the more restrictive of the two regulation sources (national or international).

1136. For purposes of incorporating all necessary measures so as to stay within emission limits, the following environmental elements have been taken into account for the design of the project:

- Use of low NO_X emission burners so as not to exceed World Bank 51 mg/Nm^3 standard (15% O_2, dry base)
- Building two 112.5 m stack, in accordance with calculation made on the basis of the international practice recommended by the industry (GIIP), according to the document "Réf. US EPA: 40 CFR, partie 51.100 (ii)".
- Installing noise attenuation devices to comply with national and international standards
- Installing an effluent treatment system (a system for separating greases, oils and chemical pollutants from effluents assuring compliance with national and international standards)
- Installing an optimized chemical dosing system for cooling water treatment and control for a minimum requirement of chemical additives, achieving a minimum concentration at discharge with consequent environmental benefits
- Safety tanks for retaining any leaks that may occur from any storage tank for hazardous materials or wastes.

1137. After detailed analysis of the project and environmental baseline status of the area of interest, we conclude than the environmental and social benefits from the project implementation are:

- Reduction of natural gas consumption on 300 million m^3/year
- 16% emission reduction of CO_2 (greenhouse gas) to the atmosphere, which will contribute to climate change mitigation
- 27% emission reduction of NO_X to the atmosphere
- In accordance with the result obtained from the dispersion model of pollutants in the atmosphere using the EPA's "AERMOD" it can be stated that:
  - A 16% reduction of NO_2 in ambient air quality is achieved
  - Current and future scenarios comply with air quality standards both at national and international level
- The change from the open cooling system of units III and IV towards a closed circuit of the CCGT will lead to:
  a) 86% reduction of water intake
  b) Almost a 50% reduction of thermal effluent returned to the canal which will allow a better and faster dispersion. This fact would probably improve the environmental condition of the aquatic ecosystem.

c) Increase of 514 m^3/h of water consumption to replace evaporated water and blow down in the cooling towers. This is a negative impact but the magnitude is insignificant as it would represent less than 1% of Suenly canal flow rate.

- Decrease of accidental risk by means of using Automatic Control System;
- Increase in power supply will promote industrial development projects envisaged for the region; Consequently this will promote socio-economic development
- During the construction phase workforce demand will be highly increased

1138. **Environmental Management Plan (EMP)** includes 59 mitigation measures and a specific monitoring plan to control the implementation and effectiveness of these mitigation measures. A summary of the most representative aspects of the EMP are presented as follows:

- Development of an Environmental, Health and Safety Plan for the construction, demolishing/decommissioning and operation phases.
- As far as possible and depending on availability, work position created by the project will be filled by local personnel.
- Implementation of a CEMS (Continuous Emissions Monitoring System) which will guarantee that emissions are always within legal limits, and which will analyse and record pollutants on a continuous and automatic basis: SO_2, NO, NO_2, CO, O_2, temperature, pressure and water vapour.
- Yearly quantification and monitoring of Greenhouse Gases emissions in accordance with internationally recognized methodologies (IPCC, etc.)
- Implementation of air quality and meteorological monitoring stations on a continuous basis of SO_2, NO_2, NO, TSP, PM_{10}, $PM_{2.5}$, CO; wind speed and direction, atmospheric pressure, relative humidity and temperature, which ensures observance of air quality limit values in force.
- Yearly campaign for measuring noise levels using a sound level meter.
- Extension of the current monitoring system for water intake and discharge points in order to comply with national and international effluent standards:
  d) Continuous monitoring of: Temperature, pH, conductivity, and total residual chlorine.
  e) By-month basis monitoring of: suspended solids, mineralization, Cl^-, SO_4^{2-}, NO^{3-}, NO_2^-, NH_4^+, Fe, BOD_5 and oil products; the project will extend monitoring to heavy metals: cadmium, cobalt, copper, chromium, lead, nickel, zinc, arsenic, mercury
- Extension of the current monitoring system for subterranean water: quarterly monitoring of: pH, Ca^{2+}, Mg^{2+}, Na^+, Cl^-, SO_4^{2-}, HCO^{3-}, hardness, temperature; the project will extend monitoring to pH, oil products, heavy metals (cadmium, cobalt, copper, chromium, lead, nickel, zinc, arsenic, mercury), organochloride pesticides and phenols. Wells network will be extended also to include areas which could mean risk on the quality of groundwater and soils as sludge ponds, oil and chemicals storage tanks, hazardous waste storage.
- Yearly campaign for measuring soil salination along the area in which deposition of steam plum from the cooling towers is more likely to occur.
- Soil monitoring campaign twice per year
- Waste management adapted to good international practices and standards: Prevention, reduction, reuse, recovery, recycling, removal and finally disposal; segregation and separate management of hazardous and non-hazardous wastes with the inclusion of a proper final landfill or storage.

1139. As part of the environmental assessment process, Takhiatash TPP organised three rounds of **public consultations** on 18 and 29 of April 2013 and on 8th July 2013 at the Energy college of Takhiatash. These consultations were an opportunity to associate all of the parties involved and stakeholders concerned to the project: provincial and local authorities, non-central government services, NGOs and civil society, especially representatives of the local population, etc.

1140. This consultation was also an opportunity to disseminate pertinent information which helped the general public understand the project risks, impacts and opportunities. In addition, the public consultation organised was a time for: (i) all of the stakeholders involved to express their opinions on the project risks, impacts and mitigation measures and (ii) Takhiatash TPP to study and respond to them.

1141. The public consultations meeting were mainly based on:

- prior communication of useful and pertinent information (concise, well-developed environmental assessment documents prepared up to that date) via dissemination of the EMP and EIA,
- a focus on the social and environmental risks and impacts and on the measures and actions planned to reduce and mitigate them,
- **public continued consultation and information** period throughout the duration of the project via a grievance log and via public access to the annual and the environmental monitoring report (which includes result of the **Grievance Mechanism** put in place) made permanently available to Takhiatash TPP at the medical services, 200 meters outside of the TPP gate.

1142. In conclusion: In view of the Environmental Impact Assessment concerning the construction of two 255 MW Combine Cycle Power units, the demolishing of the already dismantled units I and II and the decommissioning of the 310 MW existing units III and IV at Takhiatashs TPP, and after having analysed all the types of impact that may be generated by the project, we find that **the project will produce an overall positive environmental and social impact** that will be compatible with, controllable by, and that fits perfectly into, the sustainable development policy framework maintained by the Uzbek authorities and the ADB environmental requirements policy.

1143. The entire project can therefore be considered to be viable on condition that the Environmental Management Plan as laid out in the present assessment will be implemented. Therefore, if there is any change in the design of the project, the EMP needs to be updated.

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: An asbestos specialist must prepare an asbestos management plan consistent with international guidelines and including survey and investigation of structural elements with asbestos, assessment of volume and form, removal, storage and disposal plan, requirements for PPE, training of workers, and supervision and reporting protocols. In this regard, special attention should be paid to the handling and management of asbestos materials that 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:

MITIGATION MEASURE N° 1	
	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 Cement Products). EHS will include an emergency or contingency plan and rescue operations.
ORGANISATION RESPONSIBLE FOR ITS MANAGEMENT	Safeguard unit of the PMU by means of consulting the TPP staff (construction and decommissioning phases). TPP EMT (operation phase)
PERIOD AND DOCUMENT IN WHICH IT IS SPECIFIED	EHS construction plan implemented before starting of the construction EHS decommissioning plan implemented before starting of the decommissioning: it must be developed before bidding announcement for the turnkey contract. This plan should be satisfactory to ADB and has to be incorporated in the bidding document. EHS operation plan implemented before starting of the operation phase.
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 including the demolishing of the dismantled units I and II.
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 demolishing/decommissioning. - Description of the location of the project. - Description of all the existing facilities to be decommissioned/ demolished. - Scope of the Decommissioning and Demolition Plan. - Decommissioning/demolishing 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. • 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. 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-

MITIGATION MEASURE N° 2	
	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 mitigation measure nº 32)
ORGANISATION RESPONSIBLE FOR ITS MANAGEMENT	Safeguard unit of the PMU
PERIOD AND DOCUMENT IN WHICH IT IS SPECIFIED	Before bidding announcement for the turnkey contract. This plan should be satisfactory to ADB and has to be incorporated in the bidding document.
PRECAUTIONS FOR IMPLEMENTATION AND MANAGEMENT	The Plan will be updated during detailed design
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 CCGT & 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	Pre-construction phase 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 CCGT. 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

MITIGATION MEASURE N° 5	
	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 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.

MITIGATION MEASURE N° 6	
	• 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 two 112,5 m stacks (one per each CCGT).
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 two 112,5 m stacks, in accordance with the result calculated with the Good International Industry Practices (GIIP) formula and in accordance with the Environmental Protection Agency (EPA) atmosphere pollutant dispersion model (AERMOD). If the ground level concentration gather in the pre-construction phase by the fix air quality station to be installed and located in the maximum ground concentrations is in excess, mitigation measures, including increasing stack height, should be adapted (see mitigation measure # 11) The stacks will be provided with sampling doors, platforms, access routes, lighting and supports, etc. placed at correct height for manually sampling emission gases. Particularly stacks 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.
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). At national level, emissions are approved by SNPC licenses on "Maximum allowed discharge of pollutants in air".
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	In case the national standards published prior to the commissioning of the facilities have some impact in the design of the facilities they shall be modified to comply with the corresponding requirement.
MAINTENANCE	Regular maintenance of installations.
COST	Included in the project. The cost of potential modification depending on the national project standards cannot be anticipated

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..
DEFINITION OF THE MEASURE	Installation of a Continuous Emissions Monitoring System (CEMS) and recording equipment.

MITIGATION MEASURE N° 10	
OBJECTIVE	Monitoring and continuous recording of atmospheric emissions produced by the CCGT 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. In case the national standards published prior to the commissioning of the facilities have some impact in the design of the facilities they shall be modified to comply with the corresponding requirement.
MAINTENANCE	Maintenance and calibration specified by the manufacturer of the equipment.
COST	Included in the project The cost of potential modification depending on the national project standards cannot be anticipated

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 stacks. Assessment of the data recorded will be used to check if the height of the stacks complies with air quality standards. In case of exceeding air quality standards, mitigation measures should be undertaken (e.g. stacks 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

MITIGATION MEASURE N° 11	
	Operator of the Republic of Uzbekistan).
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	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 CCGT.
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

MITIGATION MEASURE N° 12	
	aerodynamic noise - Air ventilation chamber structures installed in buildings with low permissible noise level, will be covered with heavy sound 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 CCGT, 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.

MITIGATION MEASURE N° 13	
DEFINITION OF THE MEASURE	Double-walled composite for underground storage tanks.
OBJECTIVE	Avoid contamination or alteration of groundwater and soil from spills of oil.
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

MITIGATION MEASURE N° 14	
	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 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 CCGT
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 CCGT will in accordance with the closed cooling water system. Therefore, the option for open cooling water system for the new CCGT 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.

MITIGATION MEASURE N° 17	
DEFINITION OF THE MEASURE	Design of effluent treatment system to fulfill discharge standards.
OBJECTIVE	Avoid surface water contamination.
ESCRIPTION OF THE MEASURE / ISSUES THAT IT INCLUDES	The effluents generated by operation of the new facilities of CCGT are: ▪ **Domestic effluents** Domestic wastewater or sanitary effluents is discharged, without treatment, though pipe line to the Takhiatash Municipal Waste Water Treatment Plant. If his plant does not fulfill sewage effluent standards of the general IFC EHS guidelines (2007), 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 CCGT 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 CCGT will be designed in order to fulfill new MAD for the CCGT 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	In case the national standards published prior to the

MITIGATION MEASURE N° 17	
IMPLEMENTATION AND MANAGEMENT	commissioning of the facilities have some impact in the design of the facilities they shall be modified to comply with the corresponding requirement.
MAINTENANCE	Regular maintenance of installations.
COST	Included in the project The cost of potential modification depending on the national project standards cannot be anticipated

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 CCGT. 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 CCGT shall be designed with a biocide (sodium hypochlorite) dosage performed by a control and global 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 0,3 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 CCGT.
DEFINITION OF THE MEASURE	Landscape design for the new CCGT 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 CCGT, Demolishing of units I and II 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 supervised by the DCS
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 CCGT as well as the demolishing of units I and II and 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.

MITIGATION MEASURE N° 23	
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 and the 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	EPC CCGT & 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

MITIGATION MEASURE N° 25	
	• 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 CCGT & Decommissioning contractor Supervised by the DCS
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 CCGT, 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

MITIGATION MEASURE N° 26	
	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. 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 CCGT & 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	EPC CCGT & Decommissioning contractor Supervised by Safeguard unit of the PMU, DCS and 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	EPC CCGT & Decommissioning contractor Supervised by Safeguard unit of the PMU, DCS and 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. 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	EPC CCGT & Decommissioning contractor Supervised by Safeguard unit of the PMU, DCS and 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.

MITIGATION MEASURE N° 30	
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 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	EPC CCGT & Decommissioning contractor Supervised by Safeguard unit of the PMU, DCS and 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.
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 CCGT 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. - Normal and restricted gas pipeline track should be marked with beacons - 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	EPC CCGT & Decommissioning contractor Supervised by Safeguard unit of the PMU, DCS and 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	Waste management

MITIGATION MEASURE N° 32	
MEASURE	
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 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

MITIGATION MEASURE N° 32	
	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. 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

MITIGATION MEASURE N° 32	
	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 If Municipal landfill is not improved for the non hazardous wastes, the EPC CCGT & Decommissioning contractor will be responsible to properly design (estimate the required area, identify the potential site, etc.), permit, develop and operate a landfill.
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. 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

MITIGATION MEASURE N° 32	
	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. 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

MITIGATION MEASURE N° 33	
	transport vehicles), as required - Provide the required emergency response on call 24 hours/day.
ORGANISATION RESPONSIBLE FOR ITS MANAGEMENT	EPC CCGT & Decommissioning contractor
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.
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.

MITIGATION MEASURE N° 34	
	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	EPC CCGT & Decommissioning contractor
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 CCGT, 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	EPC CCGT & Decommissioning contractor

MITIGATION MEASURE N° 35	
MANAGEMENT	
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	EPC CCGT & Decommissioning contractor
PERIOD AND DOCUMENT IN WHICH IT IS SPECIFIED	EMP construction Construction plan.
PRECAUTIONS FOR IMPLEMENTATION AND MANAGEMENT	None
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.

MITIGATION MEASURE N° 37	
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. If in the final track of the gas pipeline Suenly canal must be crossed, the most environmental friendly construction technics should be implemented (e.g. Directional Drilling) in order to minimize suspended solids.
ORGANISATION RESPONSIBLE FOR ITS MANAGEMENT	EPC CCGT & Decommissioning contractor
PERIOD AND DOCUMENT IN WHICH IT IS SPECIFIED	EMP construction Construction plan.
PRECAUTIONS FOR	Checking the efficiency of these systems during the

MITIGATION MEASURE N° 38	
IMPLEMENTATION AND MANAGEMENT	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	EPC CCGT & Decommissioning contractor and supervised by the 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. Minimize the surface affected by works.
DESCRIPTION OF THE MEASURE / ISSUES THAT IT	Development of a traffic management plan, to mitigate impact on local traffic conditions during construction.

MITIGATION MEASURE N° 40	
INCLUDES	• 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	EPC CCGT & Decommissioning contractor
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 CCGT: 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	EPC CCGT & Decommissioning contractor 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 PCR 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 CCGT facility as well as the decommissioning of the existing units III and IV and demolishing of dismantled units I and II, 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

MITIGATION MEASURE N° 44	
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	All the temporary structures required in the course of construction (including gas pipeline track) operations and

INCLUDES	decommissioning, or their vestiges will be removed as soon as the works are over. Final condition of areas occupied by units I to IV shall be free of any waste material, piece of equipment and old structure even above or below ground. The land shall be left filled to level. Definitive interfaces shall be arranged making provision of the future use of the land. Potential contamination of the soils shall be assessed. If contamination is detected, the next step would be the land remediation to natural condition. Remediation of contaminated sites such as soil, groundwater, sediment, or surface water for the general protection of human health and the environment should be undertaken. After that the following steps will be undertaken: • Respread saved topsoil • Revegetate areas • Complete stabilization before onset of rains The target is to leave the terrain as a green field. It is recommended to include a green area in the vicinity of the TPP terrains as an offset for the reposition of the trees affected in the expansion of the TPP terrains and gas pipeline construction (see Land Acquisition and Resettlement Plan). 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	EPC CCGT & Decommissioning contractor
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 (39000 $US estimated in total) Green area at the vicinity of the TPP: 20000$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. The necessary budgetary and human resources should be included in order to fully implement the EMP. At least one social and environmental expert should be hired.
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.

MITIGATION MEASURE N° 48	
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 CCGT. This will ensure that highly qualified staff will take over the 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 with collaboration of the Safeguard unit of the PMU.
PERIOD AND DOCUMENT IN WHICH IT IS SPECIFIED	Training should be undertaken prior to the commissioning. 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

MITIGATION MEASURE N° 49	
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
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 stacks emission testing
OBJECTIVE	To have direct measurement of emission levels to counter check the CEMS.
DESCRIPTION OF THE MEASURE / ISSUES THAT IT INCLUDES	At least an annual stacks emission testing will be carried out.

MITIGATION MEASURE N° 50	
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 stacks 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.
COST	Currently on going in the boiler. This practice could be extended to the stacks 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	Organize periodic servicing in accordance with predetermined

MITIGATION MEASURE N° 51	
IMPLEMENTATION AND MANAGEMENT	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 CCGT.
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.
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.

MITIGATION MEASURE N° 54	
	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. 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,

MITIGATION MEASURE N° 54	
	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). -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.

MITIGATION MEASURE N° 54	
	- 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. 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

MITIGATION MEASURE N° 54	
	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 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.

MITIGATION MEASURE N° 55	
	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
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 CCGT 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.

Countervailing measures:

COUNTERVAILING MEASURE N° 59	
IMPACT CONCERNED	
DEFINITION OF THE MEASURE	Build a community social service center.
OBJECTIVE	Create employment opportunities (with at least 50% for women), and commercial facilities, contributing to improving welfare of the community and gender equality (it will reduce the burden on many women from time consuming household activities).
EFFICIENCY	High.
DESCRIPTION OF THE MEASURE / ISSUES THAT IT INCLUDES	The community social center is called “prophylactorium and center of social services” in the Russian language. This center will provide the following services to the employees of TPP and residents of Takhiatash City: Prophylactic medical services which include preventive healthcare and regular check-up procedures and supporting healthcare facilities (physical exercise gym); laundry services, dry –cleaning and carpet cleaning.
ORGANISATION RESPONSIBLE FOR ITS MANAGEMENT	EA
PERIOD AND DOCUMENT IN WHICH IT IS SPECIFIED	Prior to the commissioning of the CCGT II
PRECAUTIONS FOR IMPLEMENTATION AND MANAGEMENT	Location adjacent to Takhiatash TPP and staff housing
MAINTENANCE	Ordinary maintenance of the center (cleaning, repairing, etc.).
COST	3500000 $US

In the following tables a table sum up to the cost of the mitigation measures during the different phases of the project is included.

Mitigation measures				
Phase	**Nº**	**Description**	**Fix cost**	**Variable cost/year**
Design & Pre-construction Phase	1	Development of an Environmental, Health and Safety (EHS) Plan for the construction, operation and decommissioning phases	90,000 USD	- USD
	2	Design a Decommissioning Plan for the existing units III and IV and de dismantling of decommissioned units I and II at Takhiatash TPP.	97,500 USD	- USD
	3	Contractual environmental requirements	- USD	57,000 USD
	4	Institutional strengthening program	- USD	5,000 USD
	5	Carbon financing	- USD	- USD
	6	Structural safety of the buildings	- USD	- USD
	7	Installation of transformers without PCB	- USD	- USD
	8	Construction of two 112.5 m stacks	- USD	- USD
	9	Use of low NOx emission technology	- USD	- USD
	10	Installation of a Continuous Emissions Monitoring System (CEMS) and recording equipment	- USD	- USD
	11	Air quality levels will be controlled by means of an air quality and a meteorological station	25,000 USD	- USD
	12	Building and/or Installing noise attenuation devices	- USD	- USD
	13	Double-walled composite for underground storage tanks	- USD	- USD
	14	Hazardous materials and wastes storage design to avoid spillages or overflowing	- USD	- USD
	15	Design of a closed cooling water system for the new CCGT	- USD	- USD
	16	Cooling tower design.	- USD	- USD
	17	Design of effluent treatment system to fulfill discharge standards.	- USD	- USD
	18	Implementing an effluent continuous control system	- USD	- USD
	19	Implementation of an optimized chemical dosing system for cooling water treatment and control	- USD	- USD
	20	Water intake system environmental design	- USD	- USD
	21	Landscape design for the new unit and auxiliary installations.	- USD	- USD
TOTAL			**212,500 USD**	**62,000 USD**

Mitigation measures				
Phase	**Nº**	**Description**	**Fix cost**	**Variable cost /year**
Construction and Decommissioning Phases	22	Controls performed which ensures the implementation of the mitigation measures	- USD	- USD
	23	Continuous execution of the EHS plan for construction and decommissioning phases	- USD	- USD
	24	Implementation of the Decommissioning Plan for the existing units III and IV and the dismantling of decommissioned units I and II at Takhiatash TPP	- USD	- USD
	25	Contractor's grievance mechanism development	- USD	- USD
	26	Determining the necessary measures for dealing with potential risks arising from soil contamination	- USD	- USD
	27	Topsoil stripped and safely stockpile where it is available for re-use	- USD	- USD
	28	Dust control	- USD	- USD
	29	Control of gas emissions generated by construction and decommissioning vehicles	- USD	- USD
	30	Mitigation of noise emissions	- USD	- USD
	31	Marking off and beaconing of activity areas	- USD	- USD
	32	Waste management	125,000 USD	- USD
	33	Proper transporting methods for hazardous materials	- USD	- USD
	34	Spill prevention measures and arrangement of impervious areas for fueling, maintenance and repair of machinery	15,000 USD	- USD
	35	Proper oil management existing transformer to be moved	- USD	- USD
	36	A washing area will be provided for concrete truck chutes with mobile equipment for cleansing and containing waste	18,000 USD	- USD
	37	Black waste water generated by the workers will be controlled through the installation of adequate sanitation systems	- USD	5,000 USD
	38	Controlling suspended solids to surface waters	- USD	- USD
	39	Verifying sources of materials of the site	- USD	- USD
	40	Traffic management plan	- USD	- USD
	41	Noise measurement campaign	15,000 USD	2,000 USD

	42	Extension of the current water quality monitoring	57,000 USD	12,000 USD
	43	Archaeological follow-through during construction phase	- USD	- USD
	44	Economic impact on the municipality and the region affected by the project	- USD	- USD
	45	Restoring the original conditions of services and easements affected by the construction or decommissioning phases, especially roads and paths. Any services interrupted or modified will be returned to their initial status	390,000 USD	- USD
	46	Removal of temporary installations and revegetation when construction and decommissioning phases are over	79,000 USD	- USD
TOTAL			**699,000 USD**	**19,000 USD**

Mitigation measures				
Phase	**Nº**	**Description**	**Fix cost**	**Variable cost /year**
Operating Phase	47	Continuous execution of the EMP Plan during operation phase	- USD	30,000 USD
	48	Continuous execution of the EHS Plan during operation phase	- USD	30,000 USD
	49	Greenhouse gases annual quantification	- USD	- USD
	50	Annual stacks emission testing	- USD	- USD
	51	Maintain good state of preservation of the sludge ponds, fuel, oil or other chemicals storages/containers	- USD	- USD
	52	Monitoring of soil salination levels at spray locations coming from the cooling towers plume steam	- USD	4,000 USD
	53	Control of the composition of the cooling water treatment additives	- USD	- USD
	54	Management of waste generated by operation of the plant	- USD	- USD
	55	Extension and improvement of the existing groundwater monitoring network	- USD	3,600 USD
	56	Specific storage of chemical products	- USD	- USD
	57	O&M program for the cooling towers in order to prevent legionella	- USD	- USD
TOTAL			**- USD**	**67,600 USD**

Countervailing measures		
Nº	**Description**	**Fix cost**
59	Community social service center	3,500,000 USD

MITIGATION MEASURES SUMMARY COST			
		FIX COST	VARIABLE COST/YEAR
Mitigation measures	Design & Preconstruction	212,500 USD	62,000 USD
	Construction and decommissioning	699,000 USD	19,000 USD
	Operation	-	67,600 USD
Countervailing measures		3,500,000 USD	
TOTAL		**4,411,500 USD**	**148,600 USD**

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/dm^3</th><th>MAC
mg/dm^3</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 stacks 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 CCGT. 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>Stacks of the new CCGT</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>Stacks 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 CCGT. 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>Stacks of the new CCGT</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>
<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 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/m³</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>PM1 0</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 CCGT 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 CCGT. 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/dm^3</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>

<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>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.</td><td>Total residual chlorine</td><td>Currently, Maximun Allowed Concentration (MAC) has not been determined for the new CCGT. 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/dm^3</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.</td><td>Discharge point to Suenly canal</td><td>Continuous</td><td>Plant engineers</td><td>Included in the project (see mitigation measure nº 19)</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>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 CCGT. 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/dm^3</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

ENVIRONMENTAL MONITORING SUMMARY COST	
Description	**Variable cost/year**
Periodic audit of the EHS operation plan	40,000 USD
Audit to ensure performance and adherence to the overall EMP operation plan	30,000 USD
TOTAL	**70,000 USD**

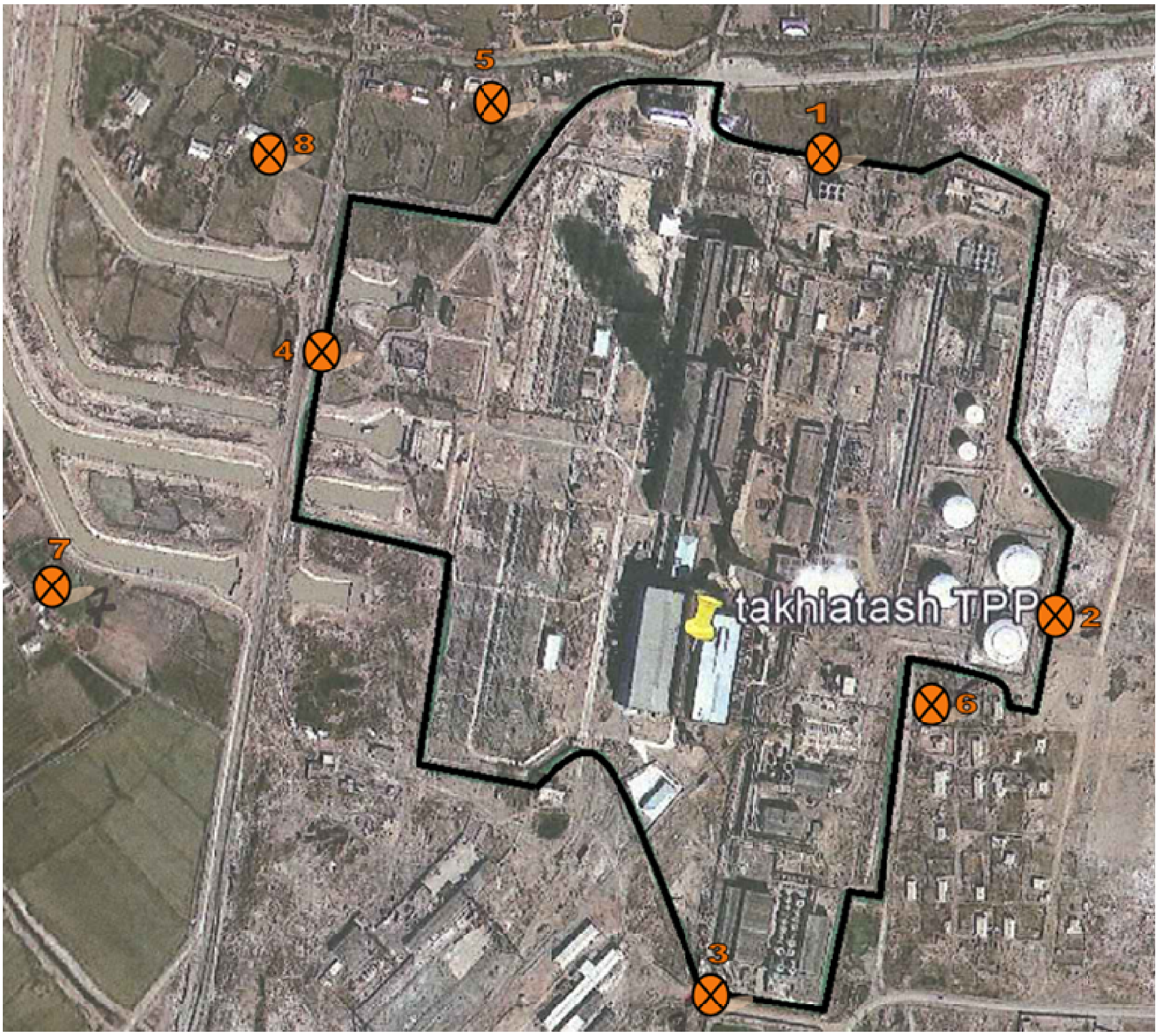


Figure 1: location of noise measuring points

engineering

gasNatural fenosa

Environmental Impact Assessment
VOLUME 4/4
ANNEXES

July 2013
Version: 2

UZB: TAKHIATASH POWER PLANT EFFICIENCY IMPROVEMENT PROJECT

This EIA is prepared by the consultants for the Uzbekenergo of the Republic of Uzbekistan and for the Asian Development Bank (ADB)

Table of contents

ANNEX I: PLANS AND DRAWINGS

Appendix 1: Takhiatash TPP. 2 x CCGT 255 MW. General plan and transport. Dismantled building and constructions plan

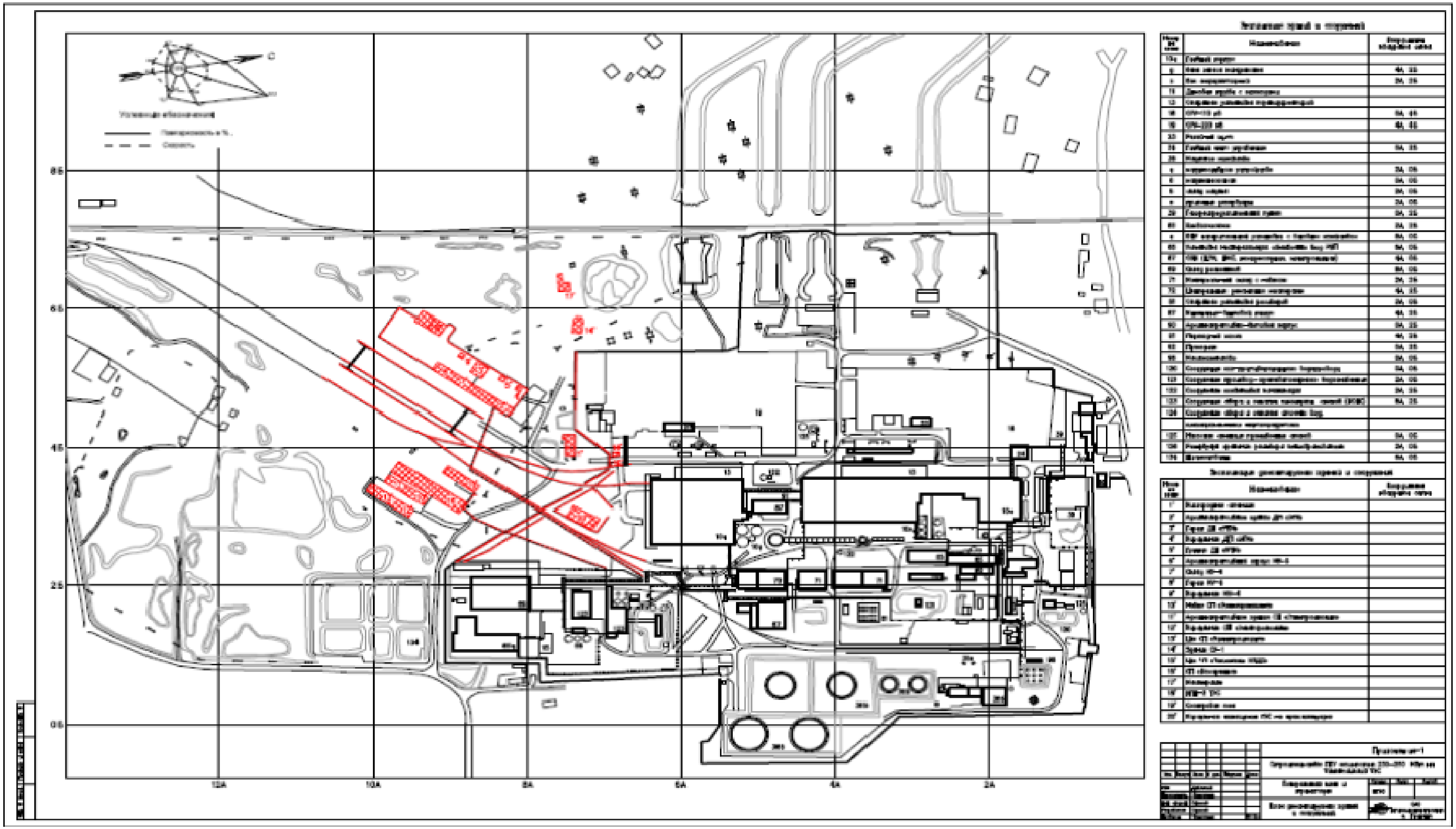
Buildings and constructions legend

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



8Б
6Б
4Б
2Б
0Б
12А
10А
8А
6А
4А
2А

Appendix 2: Takhiatash TPP. 2 x CCGT 255 MW. General plan and transport

Buildings and constructions legend

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	
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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
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67	Integrated support complex (Central repair shops, central good shed, compressor plant, electrolysis plant)	4A, 0Б
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72	Central repair shops	4A, 2Б
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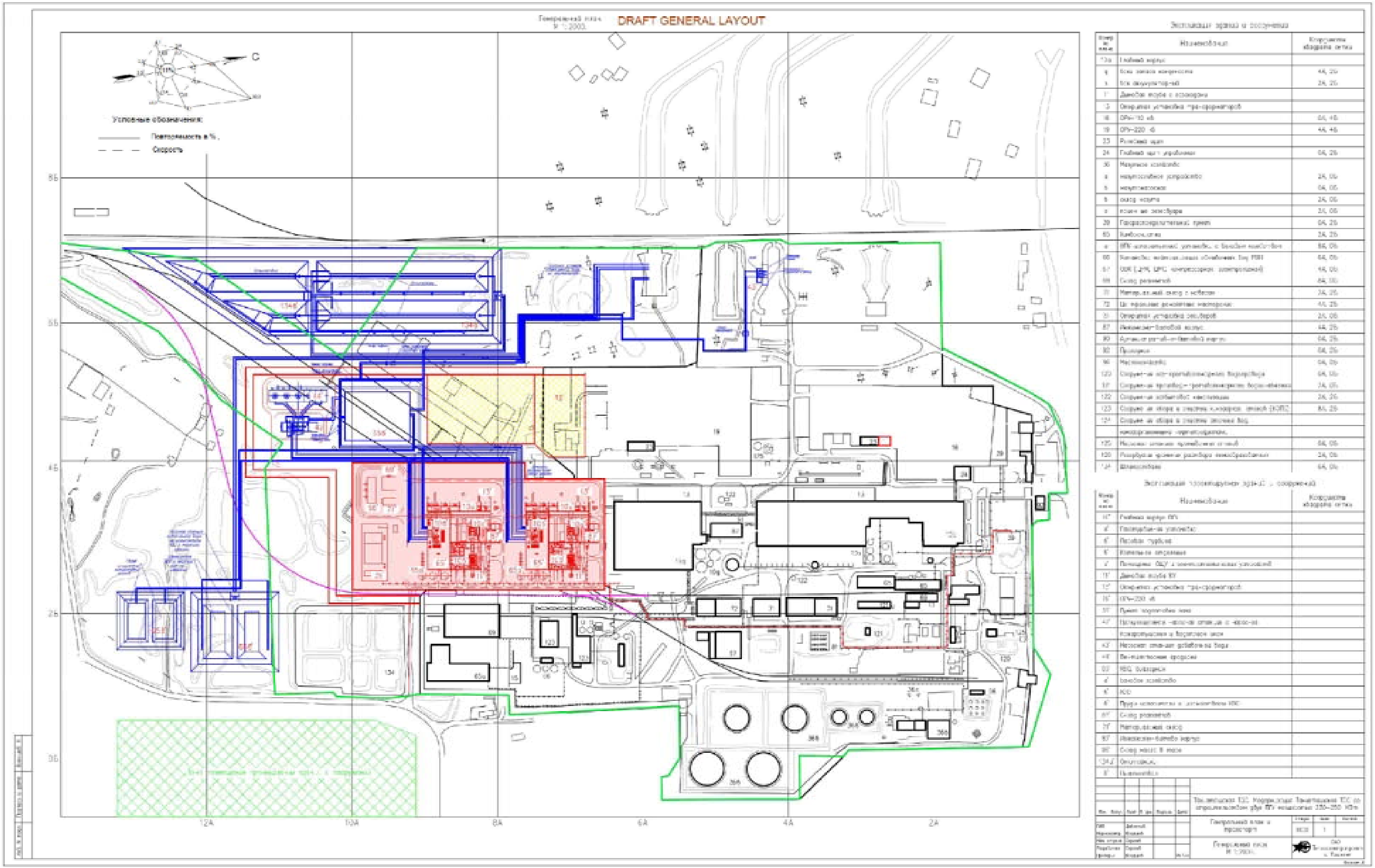
90	Administrative building	0A, 2Б
91	Runway	4A, 2Б
92	Entrance	0A, 2Б
96	Mineral-oil facilities	0A, 0Б
120	Fire protection and utility water pipeline facilities	0A, 0Б

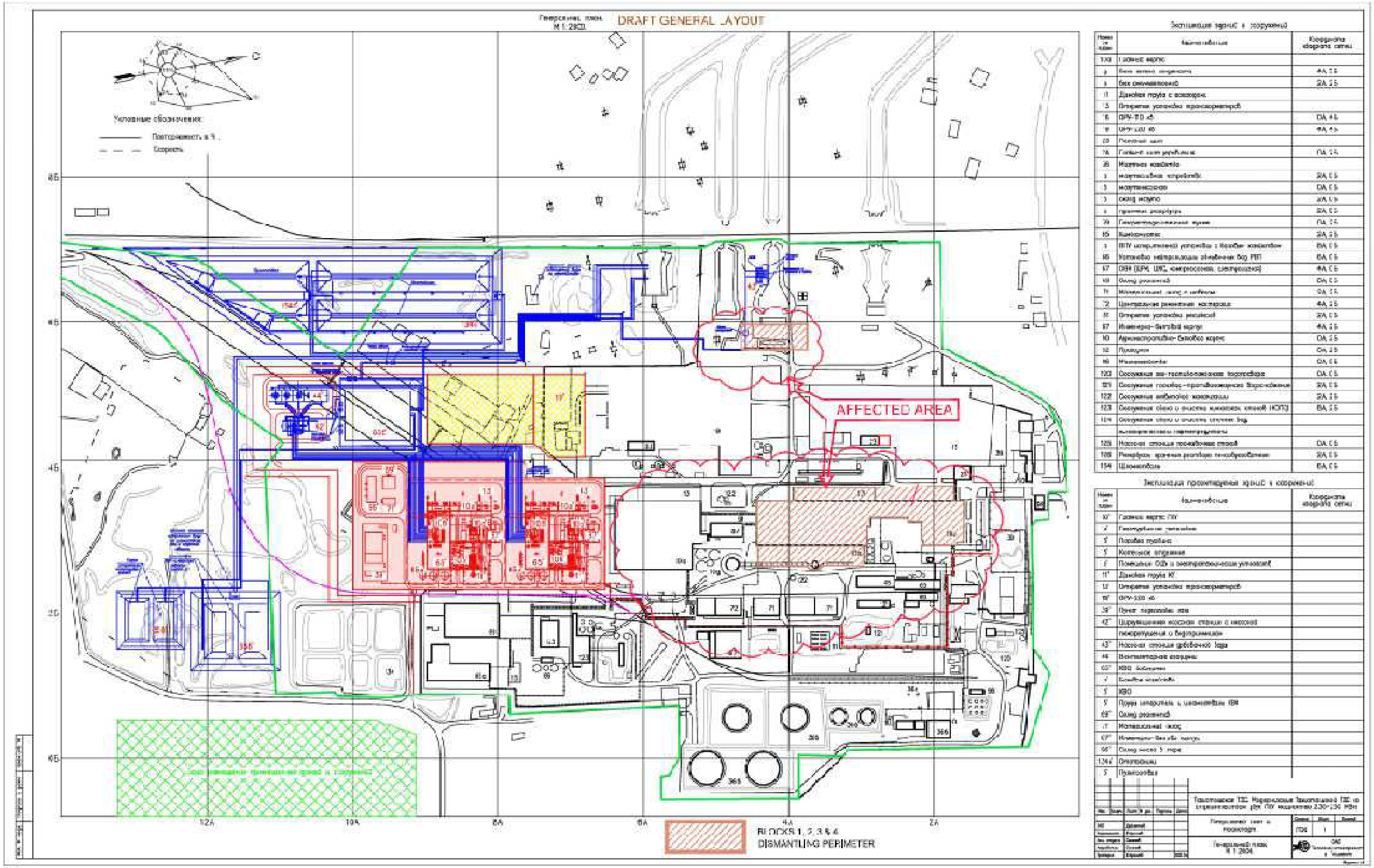
121	Fire protection and process water supply facilities	2А, 0Б
122	Domestic sewage system facilities	2А, 2Б
123	Chemically contaminated flows collection and treatment facilities	8А, 2Б
124	Collection and treatment facilities for waste water chemically contaminated by oil products	
125	Pump station for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

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	


DRAFT GENERAL LAYOUT
С
Условные обозначения:
Повторяемость в %
Скорость
12A
10A
8A
6A
4A
2A
8Б
6Б
4Б
2Б
0Б

Appendix 3: Takhiatash TPP. 2 x CCGT 255 MW. Decommissioning perimeter



ANNEX II: PHOTOGRAPHIC REPORT

Pictures taken on the site visit on 18th January 2013

1. General view

Photograph nº 1: General view from the east area

Photograph nº 2: General view from the east area

Photograph nº 3: Closer houses to the TPP at the southeast area

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)

Photograph nº 6: Blue building is the turbine building of units V and VI that will remain

Photograph nº 7: Substation

2. Stacks

Photograph nº 8: First stack is the remaining stack of the dismantled units I and II. Second stack is the stack of units III and IV to be decommissioned. Third stack is the stack of units V and VI that will remain.

Photograph nº 9: Units V and VI 130 meters height stack

3. Hazardous materials storages

Photograph nº 10: Mazut tanks

Photograph nº 11: Mazut secondary containment material is soil. No impervious material.

Photograph nº12: Mazut spot over the soil basement.

Photograph nº 13: Mazut secondary containment concrete walls are in bad condition. Basement still made of soil.

Photograph nº 18: Impervious secondary containment for chemical tanks

Photograph nº 19: Chemical containers in the Hazardous materials storage


Photograph nº 20: Hazardous material storage roof with a ventilation device.

4. Water intake and discharge from and to Suenly canal

Photograph nº 21: Water intake area from Suenly canal

Photograph nº 22: Water intake area from Suenly canal

Photograph nº 23: Suenly canal depth at the water intake area


Photograph nº 24: Oil spot at the discharge to Suenly canal.

5. Waste water treatment

Photograph nº 25: Complex industrial waste water treatment

Photograph nº 26: Industrial waste water neutralization system.

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

6. Evaporation ponds

Photograph nº 28: Oily waste water evaporation pond

Photograph nº 29: Oily waste water evaporation pond

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

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

7. Wastes management

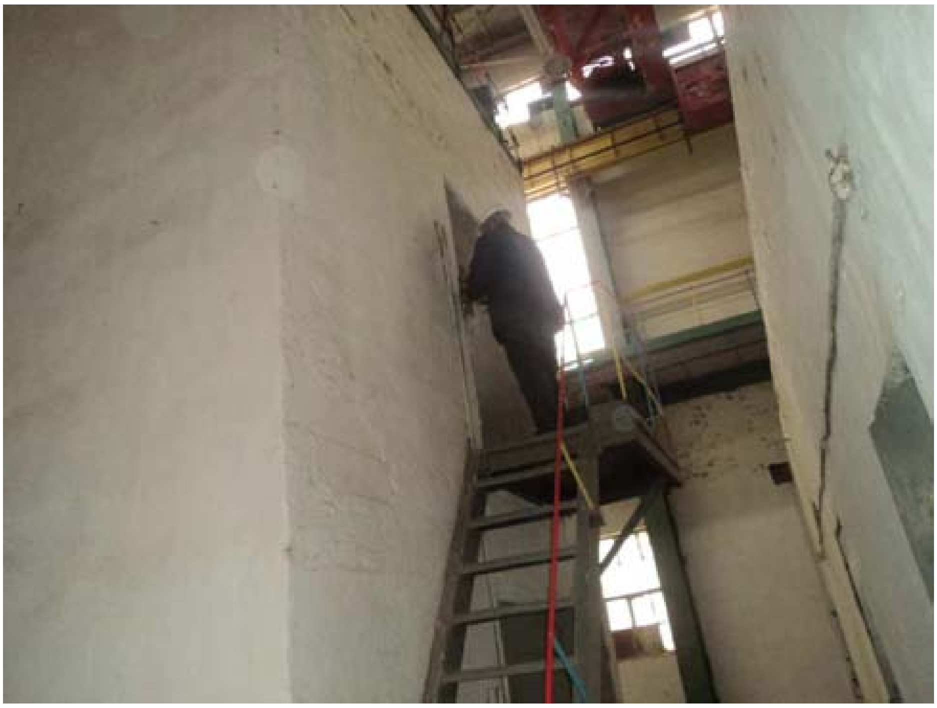
Photograph nº 33: Bin for communal wastes


Photograph nº 34: Bin for communal wastes

Photograph nº 35: Wood debris storage

Photograph nº 36: Bin for oiled rags

Photograph nº 37: Used oil bin



Photograph nº 38: Room for lump storage – view outside

Photograph nº 39: Room for storage lamps – view inside

Photograph nº 40: Used batteries storage – view outside


Photograph nº 41: Used batteries storage – view inside


Photograph nº 42: Used rubber storage – view inside

Photograph nº 43: Municipal landfill used by the TPP for its solid waste disposal. Landfill doesn’t include an impervious layer or other prevention pollution measures. Close distance to the TPP can be observed

Photograph nº 44: Municipal landfill.

8. Asbestos

Photograph nº 45: Bad condition of the pipe asbestos isolation that is exposed to the open.

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

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

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

9. Terrains of the new CCGT units

Photograph nº 49: Train line that must be demolished for the construction of the new CCGT units

Photograph nº 50: Buildings to be dismantled for the construction of new CCGT units

Photograph nº 51

Photograph nº 52: Area where the new CCGT units' power island is planned, close to the existing units V and VI building.

ANNEX III: ATMOSPHERIC DISPERSION SIMULLATION

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1. Introduction

1.1. Scope

The scope of the present document is to determine pollutant inmission 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 two new CCGT units 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 two new CCGT units.

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 inmission 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 air 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).

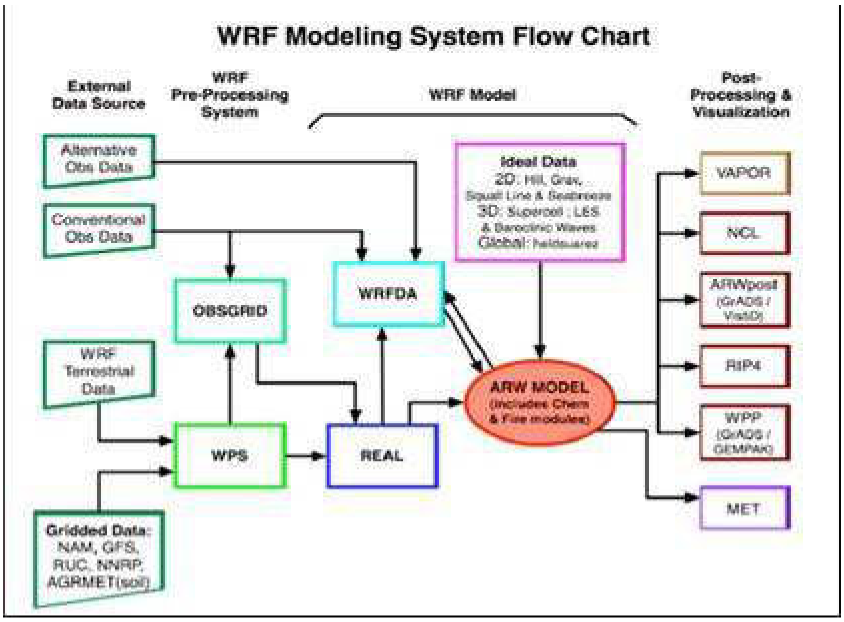


Figure 1. WRF main structural and functional outline
Source: http://www.mmm.ucar.edu/wrf/users/docs/user_guide_V3/contents.html

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.

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

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

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

Stack height calculation will be made on the basis of the international practice recommended by the industry (GIIP), according to the document "Réf. US EPA: 40 CFR, partie 51.100 (ii)", as recommended by the IFC EHS general guidelines (2007), to avoid excessive ground level concentrations due to downwash, wakes and eddy effects and to ensure reasonable diffusion to minimize impacts.

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.

In this regard, air quality measured in the stations cannot be compared with the simulation results as; the first one considers contribution of several sources (among them the TPP) and the second one considers just the contribution of the TPP.

1.3. Scope of the survey

The area under consideration in the survey is rectangular, measuring 40 km 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 table below is a summary of the main emission source parameters in the existing situation.

Table 2. Emission sources' main parameters

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

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 new two CCGT units.

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 new two CCGT units through two 112.5 m high stacks. The height of the future stacks 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 two CCGT units (see Appendix 3).

Table 3. Main parameters of emission sources

Parameters	Stack 2 (V and VI units)	Stack 3 (new CCPP I)	Stack 4 (new CCPP II)
Stack diameter (m)	7.2	6.3	6.3
Gas output speed (m/s)	21.2	21.0	21.0
Flow rate (m^3/s)	650.41	643.40	643.40
Temperature (ºC)	191	125	125
Stack height (m)	150	112.5	112.5

In the following table a description of the MW and operation hours of the different current and future units is shown:

Table 4. Operation hours and capacity

	Current indices		Future indices		
	III and IV	**V and VI**	**V and VI**	**CCGT 1**	**CCGT 2**
Installed capacity (MW)	310	420	420	254	254
TOTAL CAPACITY (MW)	730		930		
Operating hours (h)	3083	5525	1014	6912	6912

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.

Table 5. MAE for the operation of the TPP

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

For the two future CCGT units, 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).

Table 6. Emission rates estimated for the future CCPU

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

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 NO_x emitted is basically composed both of NO_2 and NO. On top of that, an 84% of NO_x has been considered to be emitted as NO but, as we are taking all the NO_2 as NO_x, 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 two CCGT units with about 510 MW capacity, also operating at full load. This scenario is currently overestimated as existing units V and VI are planned to operate only as back-up units during maintenance operations of the CCGTs, therefore, the real situation would be represented by the operation of the two CCGTs only. The reason to include units V and VI is to assess the potential future worst case, as the current demand is expected to increase in the future (for 2020 the demand estimated is of 620 MW at maximum load, far below the maximal potential load of 930 MW anyway)

In the time between the entrance into commercial operation of the CCGT1 and the CCGT2, the simultaneous operation of the CCGT1 and the blocks IV, V and VI is possible, however this scenario is not considered because:

- This situation will last only for three months,
- The maximum current demand (about 470 MW) is much lower than the available full capacity of the referred units (780 MW), and
- The emission level expected in this scenario (CCGT1 + blocks IV, V and VI) is covered by the considered scenario of CCGT1 + CCGT2 + blocks V and VI at full load (930 MW).

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:

Table 7. NO_2 National Standards

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

According to the World Bank IFC guidelines 2007 air quality reference values, limits set for NO2 are as follows:

Table 8. NO_2 World Bank Group IFC guidelines 2007 air quality standards

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

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

Table 9. NO National Standards

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

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

Table 10. CO National Standards

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

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).

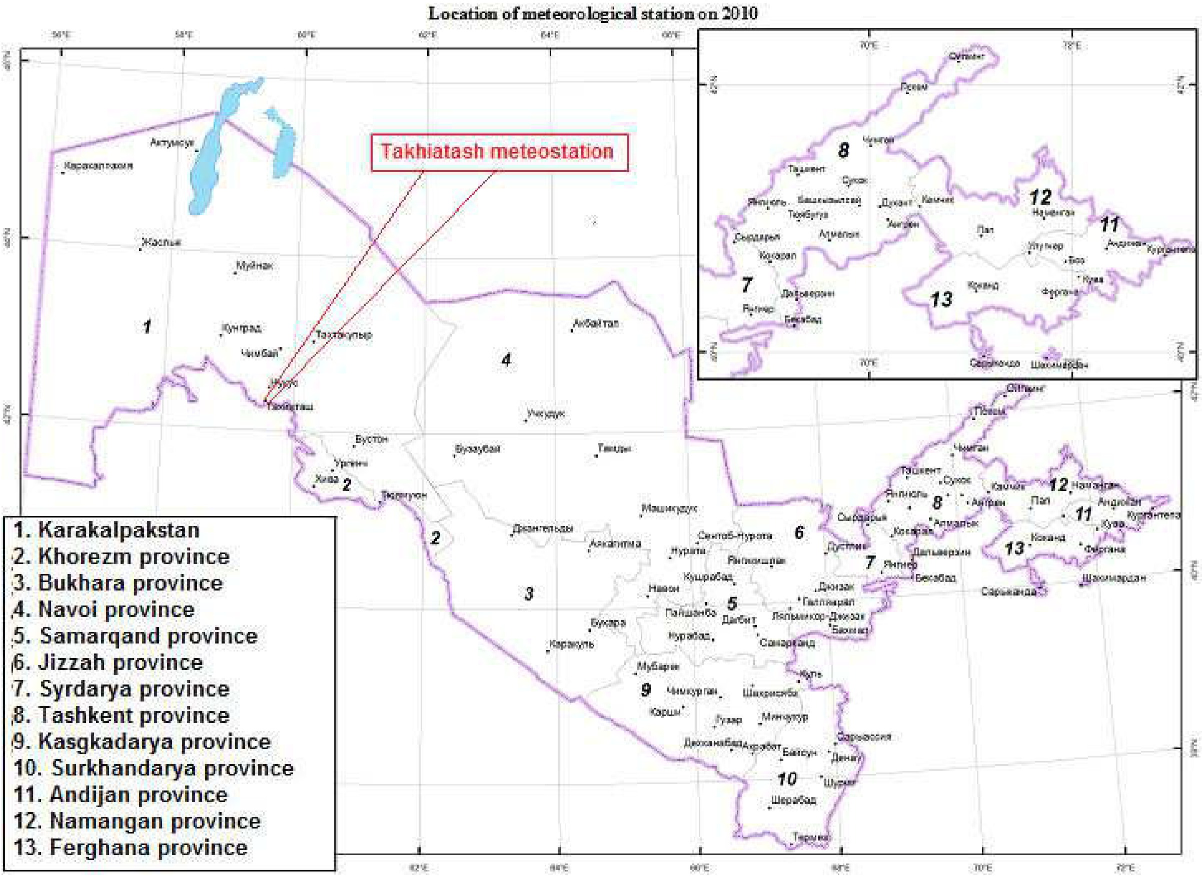


Figure 4. Location of meteo-station

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

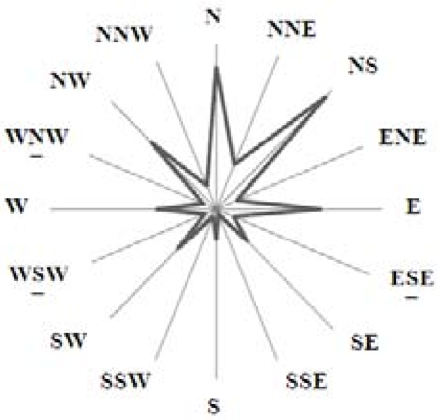


Figure 5. Takhiatash city wind rose

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 ms^{-1} as values statement.

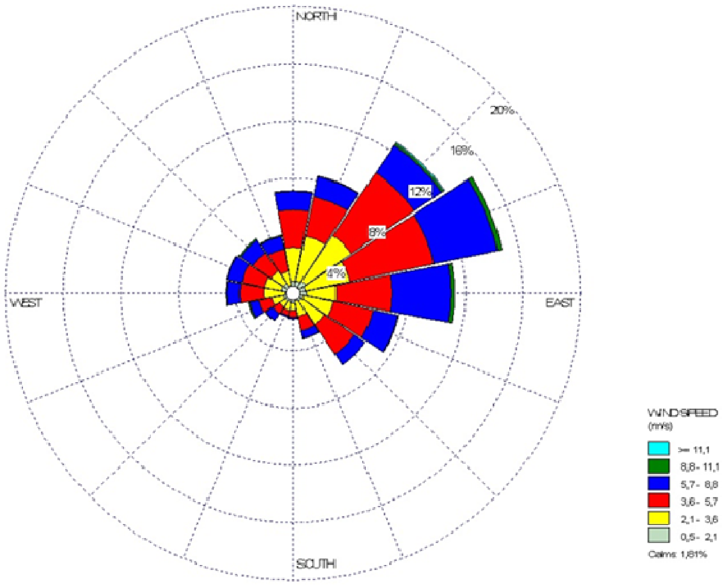


Figure 6. Compass rose corresponding to the 2012 period in nearest point to CCGT unist from the WRF simulation at 1km grid resolution.

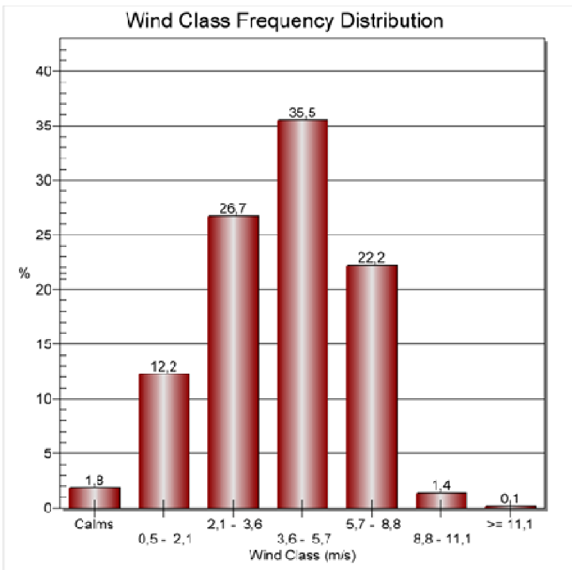


Figure 7. Histogram of frequencies corresponding to the 2012 period in nearest CCPU point from the WRF simulation at 1km grid resolution.

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 inmission forecasts of the two new two CCGT units.

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

Table 11. 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, SO_2, NO_2, NO, Phenol
# 7	42°23'24.74"N 59°38'29.88"E	Dust, SO_2, NO_2, CO Phenol

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

Table 12. 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

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

- NO_2:

Table 13. World Bank values recorded for NO2 (µg/m3).

VALUES RECORDED FOR NO_2 (µg/m^3) **WORLD BANK GROUP IFC GUIDELINES 2007**			
Measuring points	Year	Annual mean value (Limit value: 40 µg/m^3)	Hourly value (Limit value: 200µg/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 14. National Standards for Air Pollutants values recorded for NO2 (µg/m3)

VALUES RECORDED FOR NO_2 (µg/m^3) 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

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

- NO:

Table 15. National Standards for Air Pollutants values recorded for NO ($\mu g/m^3$)

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

No national or international standards are exceeded for NO.

- CO:

Table 16. National Standards for Air Pollutants values recorded for CO ($\mu g/m3$).

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

As for NO_2 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.

Table 17. Parameters of the Takhiatash emissions to the atmosphere for scenario 1.

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

- Scenario 2:

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

Table 18. Parameters of the Takhiatash emissions to the atmosphere for scenario 2

Emissions-generating milieu parameters			
	Values per unit (III and IV)	**Values per CCGT- I**	**Values per CCGT-II**
Stack diameter (m)	7.2	6.3	6.3
Gas output speed (m/s)	21.2	21.0	21.0
Flow rate (m3/s)	650.41	643.40	643.40
Temperature (ºC)	191	125	125
Stack height (m)	150	112.5	112.5
NO2 emission rate (g/s)	83.381	20.74	20.74
NO emission rate (g/s)	13.549	17.63	17.63
CO emission rate (g/s)	4.238	8.13	8.13

Characterising the sensors

The simulation with the AERMOD dispersion model was performed on a domain of 40x40 km^2 and 200 m 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.

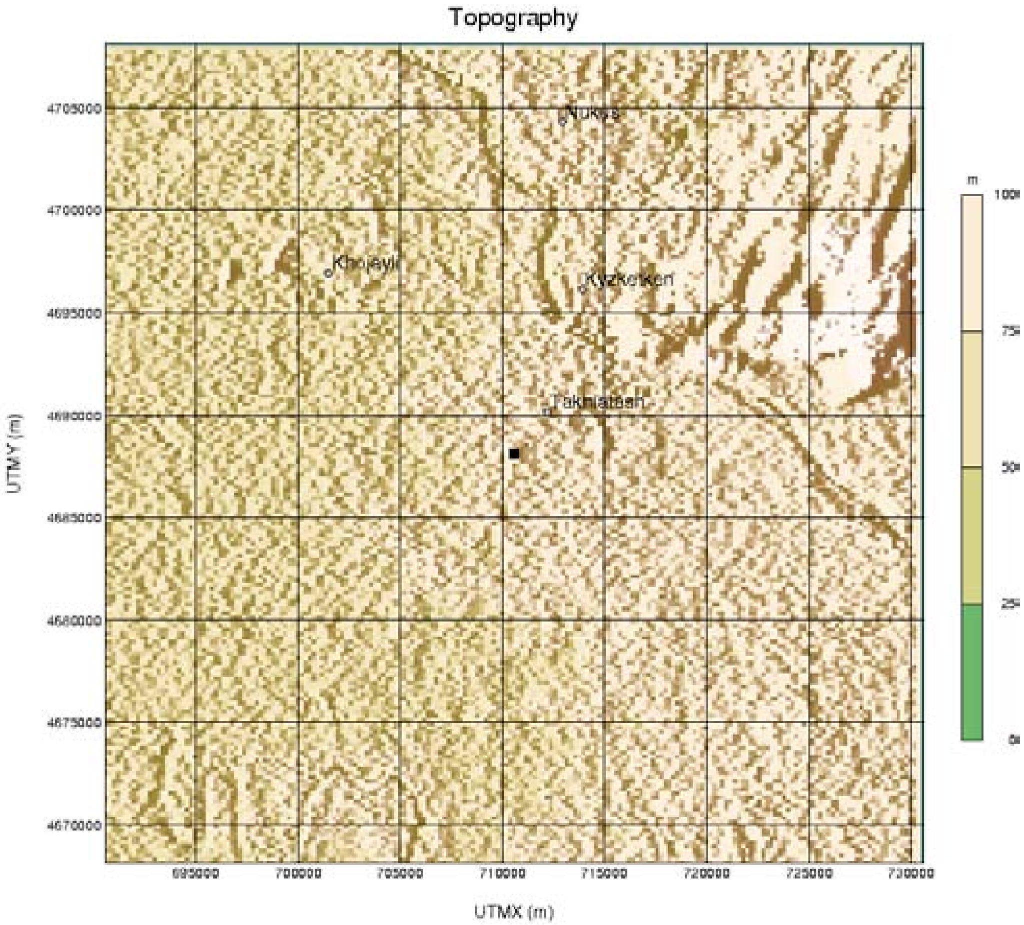


Figure 9. Domain simulation and topography of the area. The coordinates are referred to as Area 40 and WGS-84 Black Point determines the location of the center speaker.

The area under consideration in the survey is rectangular, measuring 40km along its side, with the Takhiatash TPP 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:

Table 19. Location of discrete sensors

Location of discrete sensors				
	X Coordinate (UTM zone 40)	**Y Coordinate (UTM zone 40)**	Elevation (m)	Distance from the plant (m)
SENSITIVE AREAS				
Secondary School	710973	4689679	77	1590.3
Kindergarten	711928	4689465	79	1887.3
City Hospital	712264	4689437	80	2121.7
College	712338	4689684	76	2336.4
AIR QUALITY MONITORING STATIONS				
# 5	714122	4704154	79	16403.2
# 7	717439	4696482	76	10797.7

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 Weather Research and Forecasting (WRF-ARWv3.3.) modeling system at a 1 km resolution for Uzbekistan, and extracting data for the closest point to the project localization.

WRF is a non-hydrostatic meteorological new generation model developed by the National Center for Atmospheric Research (NCAR). For the meteorological modeling year WRF model uses the initial and boundary data conditions provided by the Climate Forecast System Reanalysis (CFSRv2) which is a meteo-oceanic database that covers from 1979 to the present. The CFSR is a global database of high numerical modeling resolution that uses instrumental data. This constitutes an extensive database continuous in space and time. These data are reanalysis and are consistent and representative with the meteorology of the area.

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 CCGT units

This chapter gathers results from the calculation aimed at determining the height of the stacks for the two future units at the Takhiatash TPP.

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.

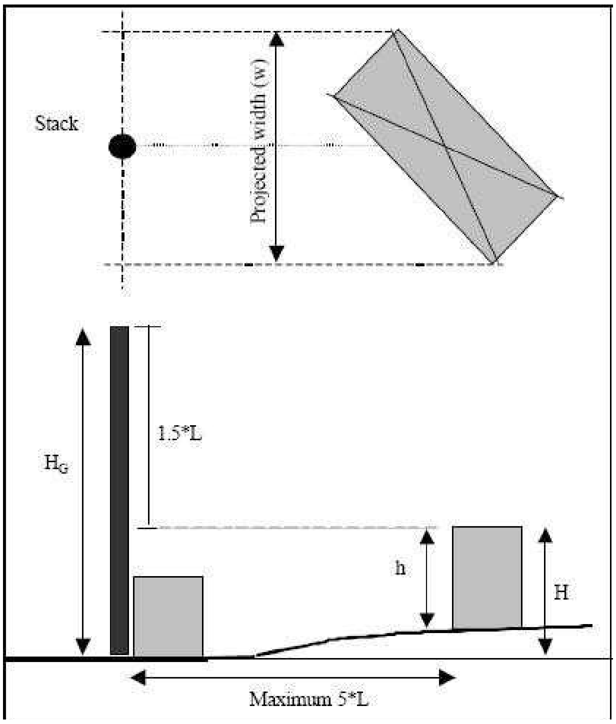


Figure 11. Calculating stack height

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.

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.

Maximum result of the area as well as the results obtained in the air quality stations and in the sensitive receptors are include. Results are given in two ways: absolute value and percentage of contribution of the value to the correspondent air quality standard.

7.1. Inmission 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 inmission 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 inmission levels, where applicable, recorded in the area under survey.

Table 20. Maximum annual contribution to the background inmission generated by the current Takhiatash CCPP in the scenario 1.

ANNUAL MAXIMUM INMISSION MODELLING				
	NO_2		NO	
	μgm^{-3}	% contribution to the air quality standard	μgm^{-3}	% contribution to the air quality standard
National Standards for Air Pollutants	40		60	
World Bank Group IFC Guidelines 2007	40			
Maximum of the area of study	2.02	5.05%	0.33	0.55%
AIR QUALITY MONITORING STATIONS				
# 5	0.06	0.15%	0.01	0.016%
# 7	0.09	0.225%	0.02	0.03%
SENSITIVE AREAS				
Secondary School	0.34	0.85%	0.06	0.1%
Kindergarten	0.35	0.875%	0.06	0.1%
City Hospital	0.34	0.85%	0.06	0.1%
College	0.31	0.775%	0.05	0.083%

Table 21. Maximum monthly contribution to the background inmission generated by the current Takhiatash CCPP in the scenario 1.

MONTHLY MAXIMUM INMISSION MODELLING						
	NO_2		NO		CO	
	mgm-3	% contribution to the air quality standard	mgm-3	% contribution to the air quality standard	mgm-3	% contribution to the air quality standard
National Standards for Air Pollutants	50		120		3500	
Maximum of the area of study	4.71	9.42%	0.77	0.64%	0.27	0.008%
AIR QUALITY MONITORING STATIONS						
# 5	0.15	0.3%	0.02	0.02%	0.01	0.0003%
# 7	0.18	0.36%	0.03	0.03%	0.01	0.0003%
SENSITIVE AREAS						
Secondary School	0.65	1.35%	0.11	0.09%	0.04	0.001%
Kindergarten	0.73	1.46%	0.12	0.10%	0.04	0.001%
City Hospital	0.69	1.38%	0.11	0.09%	0.04	0.001%
College	0.65	1.3%	0.11	0.09%	0.04	0.001%

Table 22. Maximum daily contribution to the background inmission generated by the current Takhiatash CCPP in the scenario 1.

DAILY MAXIMUM INMISSION MODELLING						
	NO_2		NO		CO	
	mgm-3	% contribution to the air quality standard	mgm-3	% contribution to the air quality standard	mgm-3	% contribution to the air quality standard
National Standards for Air Pollutants	60		250		4000	
Maximum of the area of study	12.54	20.9%	2.04	0.82%	0.72	0.018%
AIR QUALITY MONITORING STATIONS						
# 5	1.07	1.78%	0.17	0.07%	0.06	0.002%
# 7	1.49	2.48%	0.24	0.10%	0.08	0.002%
SENSITIVE AREAS						
Secondary School	4.35	7.25%	0.71	0.28%	0.25	0.006%
Kindergarten	5.57	9.28%	0.91	0.36%	0.33	0.008%
City Hospital	5.33	8.88%	0.87	0.35%	0.31	0.008%
College	4.99	8.32%	0.81	0.32%	0.29	0.007%

Table 23. Maximum hourly contribution to the background inmission generated by the current Takhiatash CCPP in the scenario 1

HOURLY MAXIMUM INMISSION MODELLING		
	NO_2	
	μgm^{-3}	% contribution to the air quality standard
World Bank Group IFC Guidelines 2007	200	
Maximum of the area of study	61.64	30.82%
AIR QUALITY MONITORING STATIONS		
# 5	21.35	10.67%
# 7	13.72	6.86%
SENSITIVE AREAS		
Secondary School	29.22	14.61%
Kindergarten	26.11	13.05%
City Hospital	31.33	15.66%
College	30.41	15.20%

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.

Table 24. **Contribution of the current operation of the TPP to the air quality stations**

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	NO_2			
	-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	NO_2			

CONTRIBUTION OF THE EXISTING TPP TO THE AIR QUALITY STATIONS				
	-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

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 CCGT units) contribution to daily, monthly and annual maximum inmission 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 inmission levels, where applicable, recorded in the area under survey.

Table 25. Maximum annual contribution to the background inmission generated by the two new Takhiatash CCGT units in the scenario 2

ANNUAL MAXIMUM INMISSION MODELLING				
	NO_2		NO	
	µgm^{-3}	% contribution to the air quality standard	µgm^{-3}	% contribution to the air quality standard
National Standards for Air Pollutants	40		60	
World Bank Group IFC Guidelines 2007	40			
Maximum of the area of study	1.63	4%	0.78	2.1%
AIR QUALITY MONITORING STATIONS				
# 5	0.05	0.125%	0.02	0.03%
# 7	0.08	0.2%	0.03	0.05%
SENSITIVE AREAS				
Secondary School	0.28	0.7%	0.12	0.2%
Kindergarten	0.28	0.7%	0.12	0.2%
City Hospital	0.30	0.75%	0.13	0.22%
College	0.26	0.65%	0.11	0.18%

Table 26. Maximum monthly contribution to the background inmission generated by the two new Takhiatash CCPP in the scenario 2.

MONTHLY MAXIMUM INMISSION MODELLING						
	NO_2		NO		CO	
	mgm-3	% contribution to the air quality standard	mgm-3	% contribution to the air quality standard	mgm-3	% contribution to the air quality standard
National Standards for Air Pollutants	50		120		3500	
Maximum of the area of study	3.79	7.58%	1.83	1.52%	0.79	0.022%
AIR QUALITY MONITORING STATIONS						
# 5	0.12	0.24%	0.05	0.04%	0.02	0.0006%
# 7	0.15	0.3%	0.06	0.05%	0.03	0.0009%
SENSITIVE AREAS						
Secondary School	0.54	1.08%	0.22	0.18%	0.09	0.003%
Kindergarten	0.6	1.2%	0.26	0.22%	0.11	0.003%
City Hospital	0.58	1.16%	0.26	0.22%	0.11	0.003%
College	0.56	1.12%	0.24	0.20%	0.1	0.003%

Table 27. Maximum daily contribution to the background inmission generated by the two new Takhiatash CCGT units in the scenario 2.

DAILY MAXIMUM INMISSION MODELLING						
	NO_2		NO		CO	
	mgm-3	% contribution to the air quality standard	mgm-3	% contribution to the air quality standard	mgm-3	% contribution to the air quality standard
National Standards for Air Pollutants	60		250		4000	
Maximum of the area of study	9.83	16.38%	4.81	1.92%	2.11	0.052%

AIR QUALITY MONITORING STATIONS						
# 5	0.93	1.55%	0.38	0.15%	0.16	0.004%
# 7	1.29	2.15%	0.52	0.21%	0.22	0.006%
SENSITIVE AREAS						
Secondary School	3.47	5.78%	1.61	0.64%	0.7	0.018%
Kindergarten	4.05	6.75%	1.71	0.68%	0.73	0.018%
City Hospital	4.31	7.18%	2.07	0.83%	0.9	0.023%
College	4.18	6.97%	1.81	0.72%	0.77	0.019%

Table 28. Maximum hourly contribution to the background inmission generated by the two new Takhiatash CCGT units in the scenario 2.

HOURLY MAXIMUM INMISSION MODELLING		
	NO_2	
	μgm^{-3}	% contribution to the air quality standard
World Bank Group IFC Guidelines 2007	200	
Maximum of the area of study	55.91	27.95%
AIR QUALITY MONITORING STATIONS		
# 5	18.23	9.11%
# 7	12.31	6.15%
SENSITIVE AREAS		
Secondary School	24.73	12.36%
Kindergarten	24.14	12.06%
City Hospital	28.59	14.29%
College	24.64	12.32%

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.

For current scenario, contribution of the TPP to the legal standard ranges between 30.82% for hourly NO_2 to 0.008% for monthly CO. For future scenario these values range between 27.59% for hourly NO_2 to 0.022% for monthly CO. In the sensitive areas, contribution of the TPP to the legal standard ranges between 15.66% for hourly NO_2 to 0.001% for monthly CO in the current scenario and between 14.29% for hourly NO_2 to 0.003% for monthly CO in the future scenario.

Generally speaking, contribution of the TPP has more influence in NO_2 short term periods than in NO or CO short or long terms periods.

7.2. Geographical distribution of inmission levels

On the basis of the modeling, maps have been created showing hourly, daily, monthly and annual maximum inmission levels for NO_2, NO and CO. Appendix 1 brings together these data and in appendix 2 brings also together tables with the 50 maximum inmission concentration values for hourly, daily and monthly period and the 10 maximum inmission concentration values the entire year of study with the coordinates and distance to the TPP where they are located. A summary of the coordinates of the maximum results for every air quality limit and pollutant is included.

		Inmision (µg/m3)	**UTMX**	**UTMY**	**Distance to the TPP**
Scenario 1 (current situation)					
NO_2	Hourly	61.64	713988	4687136	3544
	Daily	12.54	709388	4687536	1342
	Monthly	4.71	709788	4687536	1000
	Yearly	2.02	709788	4687736	894
NO	Daily	2.04	709388	4687536	1342
	Monthly	0.77	709788	4687536	1000
	Yearly	0.33	709788	4687736	894
CO	Daily	0.72	709388	4687536	1342
	Monthly	0.27	709788	4687536	1000
Scenario 2 (future situation)					
NO_2	Hourly	55.91	713588	4687136	3162
	Daily	9.83	709388	4687336	1442
	Monthly	3.79	709788	4687336	1131
	Yearly	1.63	709588	4687336	1281
NO	Daily	4.81	709588	4687336	1281
	Monthly	1.83	709788	4687336	1131
	Yearly	0.78	709788	4687336	1131
CO	Daily	2.11	709588	4687336	1281
	Monthly	0.79	709788	4687336	1131

For both scenarios the atmospheric pollution dispersion has a behavior that depends on the seasonal representation of the study and scenario.

Maximum hourly concentration maps, for scenario 1 and for each pollutant, shows spots located at the ESE and between 2,300 m to 5,500 m for NO_2, NO and CO from the plant. In the NNW direction appears other spots with not so high concentration values. On the other hand, for scenario 2 the spots affected are more variable, being situated along the E to S: between 1,100 m to 5,000.

Maximum daily concentration maps show for each scenario and pollutant that the spots affected by them are those located along the S and not farther than 2,000 m from the plant.

For maximum monthly and annual concentration maps the spots affected by the maximum concentration values are those located at the SW and respectively not farther than 2,000 m.

Due to the close distance to the Turkmen side, the dispersion plume of the TPP operation affects this area 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 inmission values

Future inmission levels will be the result of replacing old units III and IV with the two new CCGT units.

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 inmission increase that the changes will represent.

Table 29. Annual, monthly, daily and hourly maximum inmission for NO_2 µgm^{-3}

ANNUAL MAXIMUM INMISSION FOR NO_2 (µgm^{-3})			
Stations and Sensitive areas	**Scenario 1**	**Scenario 2**	**Difference in %**
# 5	0.06	0.05	-17
# 7	0.09	0.08	-11
Secondary School	0.34	0.28	-18
Kindergarten	0.35	0.28	-20
City Hospital	0.34	0.30	-12
College	0.31	0.26	-16
Maximum of the area of study	2.02	1.58	-22
MONTLHY MAXIMUM INMISSION FOR NO_2 (µgm^{-3})			
Stations and Sensitive areas	**Scenario 1**	**Scenario 2**	**Difference in %**
# 5	0.15	0.12	-20
# 7	0.18	0.15	-17
Secondary School	0.65	0.54	-17
Kindergarten	0.73	0.60	-18
City Hospital	0.69	0.58	-16
College	0.65	0.56	-14
Maximum of the area of study	4.41	3.61	-18

DAILY MAXIMUM INMISSION FOR NO_2 (μgm^{-3})			
Stations and Sensitive areas	**Scenario 1**	**Scenario 2**	**Difference in %**
# 5	1.07	0.93	-13
# 7	1.49	1.29	-13
Secondary School	4.35	3.47	-20
Kindergarten	5.57	4.05	-27
City Hospital	5.33	4.31	-19
College	4.99	4.18	-16
Maximum of the area of study	12.54	9.55	-24
HOURLY MAXIMUM INMISSION FOR NO_2 (μgm^{-3})			
Stations and Sensitive areas	Scenario 1	Scenario 2	Difference in %
# 5	21.35	18.33	-14
# 7	13.72	12.31	-10
Secondary School	29.22	24.73	-15
Kindergarten	26.11	24.14	-8
City Hospital	31.33	28.59	-9
College	30.41	24.64	-19
Maximum of the area of study	61.64	46.74	-24

NO_2 inmissions will be decreased around 16%. Regarding NO and CO, we have to consider that the emission values included in the model for the two new CCGT units 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.

Table 30. Air quality reference limit values for NO_2 (National standards for air pollutants) for scenario 1

NO_2 (μgm^{-3})				
WORLD BANK GROUP IFC GUIDELINES 2007				
Hourly maximum value				
Station	Hourly mean limit value	PLANNED INMISSION: Air quality (2011/2012 hourly mean maximum) + modeling (2012 hourly mean maximum)	current % of air quality standard	% current TPP contribution to the air quality standard
# 5	200.00	50.00 + 21.35 = 71.35	35.7%	10.67%
# 7		50.00 + 13.72 = 63.72	31.9%	6.86%
National standards for air pollutants				
Daily maximum value				
Station	Daily mean limit value	PLANNED INMISSION: Air quality (2011/2012 daily mean maximum) + modeling (2012 daily mean maximum)	current % of air quality standard	% current TPP contribution to the air quality standard
# 5	60.00	36.67 + 1.07 = 37.74	62.9%	1.78%
# 7		36.67 + 1.49 = 38.16	63.6%	2.48%
National standards for air pollutants				
Monthly maximum value				
Station	Monthly mean limit value	PLANNED INMISSION: Air quality (2011/2012 monthly mean maximum) + modeling (2012 monthly mean maximum)	current % of air quality standard	% current TPP contribution to the air quality standard
# 5	50.00	29.36 + 0.15 = 29.51	59.0%	0.3%
# 7		29.07 + 0.18 = 29.25	58.5%	0.36%
National standards for air pollutants and WORLD BANK GROUP IFC GUIDELINES 2007				
Annual maximum value				
Station	Annual mean limit value	PLANNED INMISSION: Air quality (2011/2012 annual mean maximum) + modeling (2012 annual mean maximum)	current % of air quality standard	% current TPP contribution to the air quality standard
# 5	40.00	24.25 + 0.06 = 24.31	60.8%	0.15%
# 7		24.28 + 0.09 = 24.37	60.9%	0.225%

Table 31. Air quality reference limit values for NO (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 INMISSION: Air quality (2011/2012 daily mean maximum) + modeling (2012 daily mean maximum)	current % of air quality standard	% current TPP contribution to the air quality standard
# 5	250.00	80.00 + 0.17 = 80.17	32.1%	0.17%
National standards for air pollutants				
Monthly maximum value				
Station	Monthly mean limit value	PLANNED INMISSION: Air quality (2011/2012 monthly mean maximum) + modeling (2012 monthly mean maximum)	current % of air quality standard	% current TPP contribution to the air quality standard
# 5	120.00	16.54 + 0.02 = 16.56	13.8%	0.02%
National standards for air pollutants				
Annual maximum value				
Station	Annual mean limit value	PLANNED INMISSION: Air quality (2011/2012 annual mean maximum) + modeling (2012 annual mean maximum)	current % of air quality standard	% current TPP contribution to the air quality standard
# 5	60.00	12.84 + 0.01 = 12.85	21.4%	0.016%

Table 32. Air quality reference limit values for CO (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 INMISSION: Air quality (2011/2012 daily mean maximum) + modeling (2012 daily mean maximum)	current % of air quality standard	% current TPP contribution to the air quality standard
# 7	4000.00	3333.33 + 0.08 = 3333.41	83.3%	0.002%
National standards for air pollutants				
Monthly maximum value				
Station	Monthly mean limit value	PLANNED INMISSION: Air quality (2011/2012 monthly mean maximum) + modeling (2012 monthly mean maximum)	current % of air quality standard	% current TPP contribution to the air quality standard
# 7	3500.00	2506.67 + 0.01 = 2506.68	71.6%	0.0003%

B) Scenario 2: Future situation (V, VI and the two new future CCGT 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.

Table 33. Air quality reference limit values for NO_2 (National standards for air pollutants) for scenario 2

NO_2 (μgm^{-3})				
WORLD BANK GROUP IFC GUIDELINES 2007				
Hourly maximum value				
Station	Hourly mean limit value	PLANNED INMISSION: Air quality (2011/2012 hourly mean maximum) + modeling (2012 hourly mean maximum)	Future % of air quality standard	% future TPP contribution to the air quality standard
# 5	200.00	50.00 + 18.23 = 68.23	34.1%	9.11%
# 7		50.00 + 12.31 = 62.31	31.2%	6.15%
National standards for air pollutants				
Daily maximum value				
Station	Daily mean limit value	PLANNED INMISSION: Air quality (2011/2012 daily mean maximum) + modeling (2012 daily mean maximum)	Future % of air quality standard	% future TPP contribution to the air quality standard
# 5	60.00	36.67 + 0.93 = 37.60	62.7%	1.55%
# 7		36.67 + 1.29 = 37.96	63.3%	2.15%
National standards for air pollutants				
Monthly maximum value				
Station	Monthly mean limit value	PLANNED INMISSION: Air quality (2011/2012 monthly mean maximum) + modeling (2012 monthly mean maximum)	Future % of air quality standard	% future TPP contribution to the air quality standard
# 5	50.00	29.36 + 0.12 = 29.48	59.0%	0.24%
# 7		29.07 + 0.15 = 29.22	58.4%	0.3%
National standards for air pollutants and WORLD BANK GROUP IFC GUIDELINES 2007				
Annual maximum value				
Station	Annual mean limit value	PLANNED INMISSION: Air quality (2011/2012 annual mean maximum) + modeling (2012 annual mean maximum)	Future % of air quality standard	% future TPP contribution to the air quality standard
# 5	40.00	24.25 + 0.05 = 24.30	60.8%	0.125%
# 7		24.28 + 0.08 = 24.36	60.9%	0.2%

Table 34. Air quality reference limit values for NO_2 (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 INMISSION: Air quality (2011/2012 daily mean maximum) + modeling (2012 daily mean maximum)	Future % of air quality standard	% future TPP contribution to the air quality standard
# 5	250.00	80.00 + 0.38 = 80.38	32.2%	0.15%
National standards for air pollutants				
Monthly maximum value				
Station	Monthly mean limit value	PLANNED INMISSION: Air quality (2011/2012 monthly mean maximum) + modeling (2012 monthly mean maximum)	Future % of air quality standard	% future TPP contribution to the air quality standard
# 5	120.00	16.54 + 0.05 = 16.59	13.8%	0.04%
National standards for air pollutants				
Annual maximum value				
Station	Annual mean limit value	PLANNED INMISSION: Air quality (2011/2012 annual mean maximum) + modeling (2012 annual mean maximum)	Future % of air quality standard	% future TPP contribution to the air quality standard
# 5	60.00	12.84 + 0.02 = 12.86	21.4%	0.03%

Table 35. Air quality reference limit values for NO_2 (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 INMISSION: Air quality (2011/2012 daily mean maximum) + modeling (2012 daily mean maximum)	Future % of air quality standard	% future TPP contribution to the air quality standard
# 7	4000.00	3333.33 + 0.22 = 3333.55	83.3%	0.006%
National standards for air pollutants				
Monthly maximum value				
Station	Monthly mean limit value	PLANNED INMISSION: Air quality (2011/2012 monthly mean maximum) + modeling (2012 monthly mean maximum)	Future % of air quality standard	% future TPP contribution to the air quality standard
# 7	3500.00	2506.67 + 0.03 = 2506.70	71.6%	0.0009%

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 on a domain of 40x40 km^2.

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 two new future CCGT units)) on levels of CO, NO and NO_2. SO_2 and particulate matter are practically not emitted by the combustion of natural gas. Scenario 2 (future) is currently overestimated as existing units V and VI are planned to operate only as back-up units during maintenance operations of the CCGTs, therefore, the real situation would be represented by the operation of the two CCGTs only. The reason to include units V and VI is to assess the potential future worst case, as the current demand is expected to increase in the future (for 2020 the demand estimated is of 620 MW at maximum load, far below the maximal potential future load of 930 MW anyway).

For the scenario 2 the aim of the study was also to determine the optimum stacks height for the two new CCGT units. Stacks height for the two new CCGT units have been calculated based on the international practice recommended by the industry (GIIP), according to the document "Réf. US EPA: 40 CFR, partie 51.100 (ii)" resulting in 112.5.

In the time between the entrance into commercial operation of the CCGT1 and the CCGT2, the simultaneous operation of the CCGT1 and the blocks IV, V and VI is possible, however this scenario is not considered because:

- This situation will last only for three months,
- The maximum current demand (about 470 MW) is much lower than the available full capacity of the referred units (780 MW), and
- The emission level expected in this scenario (CCGT1 + blocks IV, V and VI) is covered by the considered scenario of CCGT1 + CCGT2 + blocks V and VI at full load (930 MW).

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

- Continuous operation with a 100%. Real operation is not going to be continuous as can be observed in the following table:

	Current indices		**Future indices**		
	III and IV	**V and VI**	**V and VI**	**CCGT 1**	**CCGT 2**
Installed capacity (MW)	310	420	420	254	254
TOTAL CAPACITY (MW)	730		930		
Operating hours (h)	3083	5525	1014	6912	6912

Continuous operation during the simulated year is considered in order to analyze all the possible hourly meteorological combinations to obtain hourly maximum results. Nevertheless, averaged daily, monthly and annually results will be higher than the real ones obtained with less operation hours.

- 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 NO_2 emission value for simulation. This is a very stringent hypothesis as NO_x emitted is basically composed both of NO_2 and NO. On top of that, an 84% of NO_x has been considered to be emitted as NO but, as we are considering all the NO_2 as NO_x, NO is overestimated also. In this way, it can be guaranteed than the considered emission values to simulate are the highest possible. For CO, a very conservative bibliographic data has been considered.

The simulation provides results in the area of study (40x40 km) and in specific receptors: air quality stations and sensitive areas. Air quality stations measurements are added to the results of the simulation In order to analyze if the air quality limits are being fulfilled. Air quality baseline data of years 2011 and 2012 from two air quality stations within the area of study have been analyzed and measurements show fulfillment of all the standards for all the pollutants.

Sensitive receptors are analyzed in order to assess the contribution of the TPP to specific locations of Takhiatash city: Secondary School (1590 m from the TPP), kindergarten (1890 m from the TPP), city hospital (2125 m from the TPP) and College (2340 m from the TPP).

Conclusions regarding the modeling inmission results are:

- For scenario 1 (current situation):
  - Maximum values: It has been observed annual maximum values of 2.02 μgm^{-3} NO_2 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 NO_2 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 NO_2 has been 61.64 μgm^{-3} (World Bank limit 200 μgm^{-3}). In any case, results are away from the legal standard. Contribution of the TPP to the legal standard ranges between 30.82% for hourly NO_2 to 0.008% for monthly CO.
  - Values at the sensitive areas: For NO_2 annual values range is 0.31-0.35 ug/m3; monthly values range is 0.65-0.73 ug/m3; daily values range is 4.35-5.57 ug/m3; hourly values range is 26.11-30.41. For NO annual values range is 0.05-0.06 ug/m3; monthly values range is 0.11-0.12 ug/m3; daily values range is 0.71-0.91 ug/m3. For CO monthly value is 0.04 ug/m3; daily values range is 0.25-0.33 ug/m3. In this sensitive areas, contribution of the TPP to the legal standard ranges between 15.66% for hourly NO_2 to 0.001% for monthly CO.

- For scenario 2 (future situation) it has obtained similar values, all far below the legal standards.
  - Maximum values: 1.63 µgm-3 NO_2 and 0.78 µgm-3 NO has been obtained for annual maximum values. For monthly results 3.79 µgm-3 has been observed as a maximum value of NO_2, 1.83 µgm-3 for NO and 0.79 µgm-3 of CO. In the case of NO_2 has been observed

9.83 µgm-3 for daily maximum values, 4.81 µgm-3 NO and 2.11 µgm-3 CO. Finally, 55.91 µgm-3 of NO_2 has been obtained for hourly values. Contribution of the TPP to the legal standard ranges between 27.59% for hourly NO2 to 0.022% for monthly CO.

- Values at the sensitive areas: For NO_2 annual values range is 0.26-0.30 ug/m3; monthly values range is 0.54-0.6 ug/m3; daily values range is 3.47-4.31 ug/m3; hourly values range is 24.14-28.56. For NO annual values range is 0.11-0.12 ug/m3; monthly values range is 0.18-0.22 ug/m3; daily values range is 1.61-2.07 ug/m3. For CO monthly values range is 0.09-0.11 ug/m3; daily values range is 0.7-0.9 ug/m3. In this sensitive areas, contribution of the TPP to the legal standard ranges between 14.29% for hourly NO_2 to 0.003% for monthly CO.

Comparing contribution to air quality baseline between the current and future stages, it can be concluded that NO2 inmissions will be decreased around 16%. ([1])

Examination of the simulation maps leads to the conclusion that maximum hourly concentration maps, for scenario 1 and for each pollutant, shows spots located at the ESE and between 2,300 m to 5,500 m for NO_2, NO and CO from the plant. In the NNW direction appears other spots with not so high concentration values. On the other hand, for scenario 2 the spots affected are more variable, being situated along the E to S: between 1,100 m to 5,000.

Maximum daily concentration maps show for each scenario and pollutant that the spots affected by them are those located along the S and not farther than 2,000 m from the plant.

For maximum monthly and annual concentration maps the spots affected by the maximum concentration values are those located at the SW and respectively not farther than 2,000 m.

Due to the close distance to the Turkmen side, the dispersion plume of the TPP operation affects this area 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.

Conclusions regarding fulfillment of air quality legal standards are:

- It should be taking into account that results are being overestimated because of:
    - 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.
    - 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 existing unit's contribution. 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. In this regard, air quality measured in the stations cannot be compared with the simulation results as; the first one considers contribution of

[1] Regarding NO and CO, we have to consider that the emission values included in the model for the two new CCGT units have been very overestimated and comparison with the existing situation (where emission values are fit to operation) would bring into not realistic conclusions.

several sources (among them the TPP) and the second one considers just the contribution of the TPP.

- Even considering the above remarks, the results show that in neither case inmissions from the scenarios exceed air quality limits established in National Standards for Air Pollutants and the World Bank Group IFC guidelines 2007 (based on the WHO standards). Percentage of contribution of the TPP to the air quality legal standards at the air quality stations comparing current and future scenarios show a slight improvement for NO_2 and a slight deteriorate in the NO and CO (1). In this regard, contribution of the operation of the TPP is high for NO_2 short periods (hourly results) and not very significant for annual, monthly and daily averages. Nevertheless, for NO the contribution is almost no perceptible and for CO is insignificant.

As a conclusion, with the two 112.5 m stacks considering the worst case scenario (potential maximum and continuous power generation currently not being demanded, maximum emission and air quality baseline overestimated) **the results added to the air quality baseline are far below the air quality legal standards.** In those receptors in where there is not air quality baseline (maximum ground level points and sensitive receptors) results show low values also. Comparing the current with the future scenario, the contribution to the NO_2 air quality due to the operation of the TPP is reduced about 16%. Nevertheless, as air quality stations are in the area of influence but not in the area of maximum ground level concentrations of the simulation, it is highly advisable to install in this area the fix air quality station included in the project at the earliest convenience (pre-construction phase) in order to gather as much air quality data possible prior to the construction of the stacks and to check if air quality standards are still being fulfilled.

Appendix 1: Modellization maps

Scenario 1

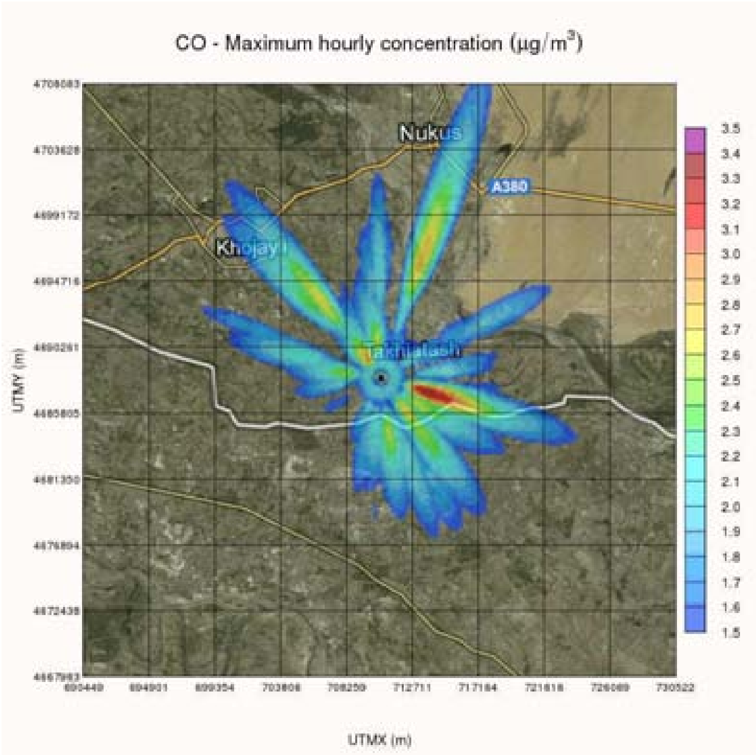


Illustration AI-1. CO maximum hourly concentration for scenario 1.

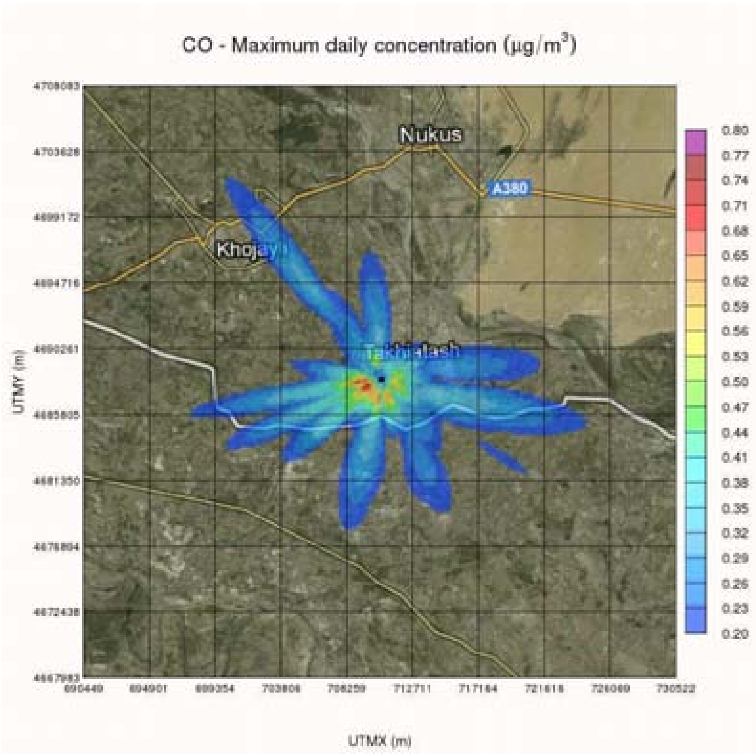


Illustration AI-2. CO maximum daily concentration for scenario 1.

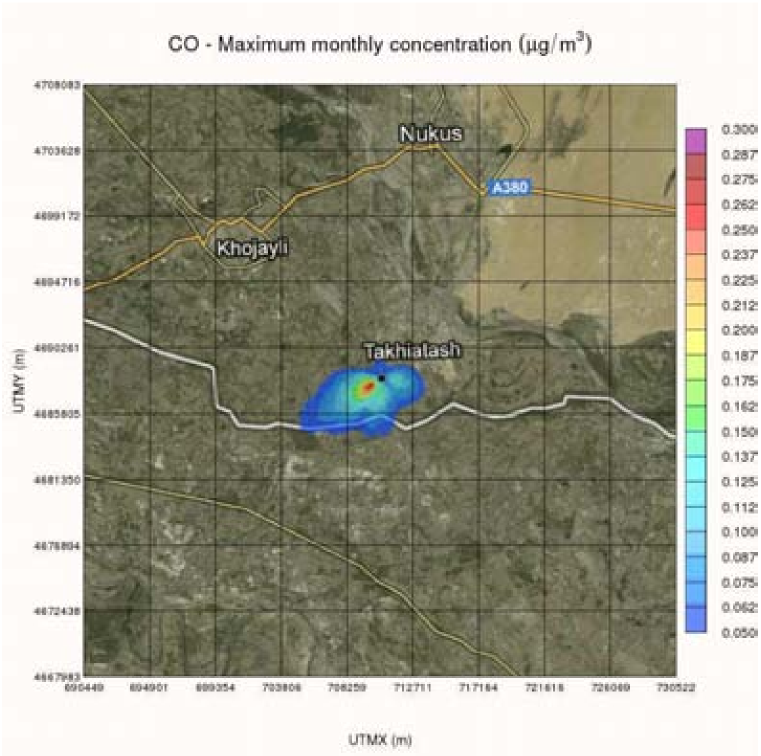


Illustration AI-3. CO maximum monthly concentration for scenario 1.

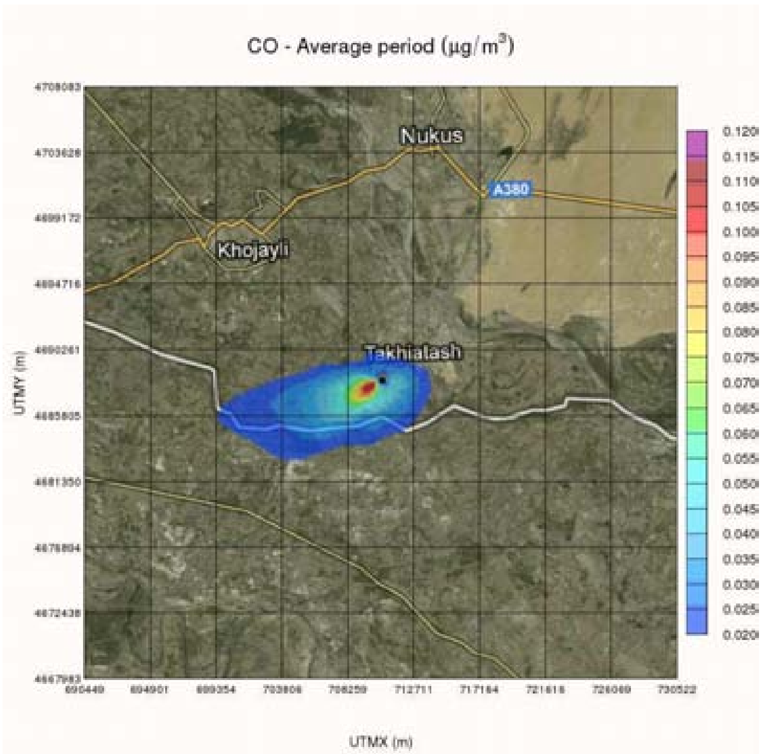


Illustration AI-4. CO average period concentration for scenario 1.

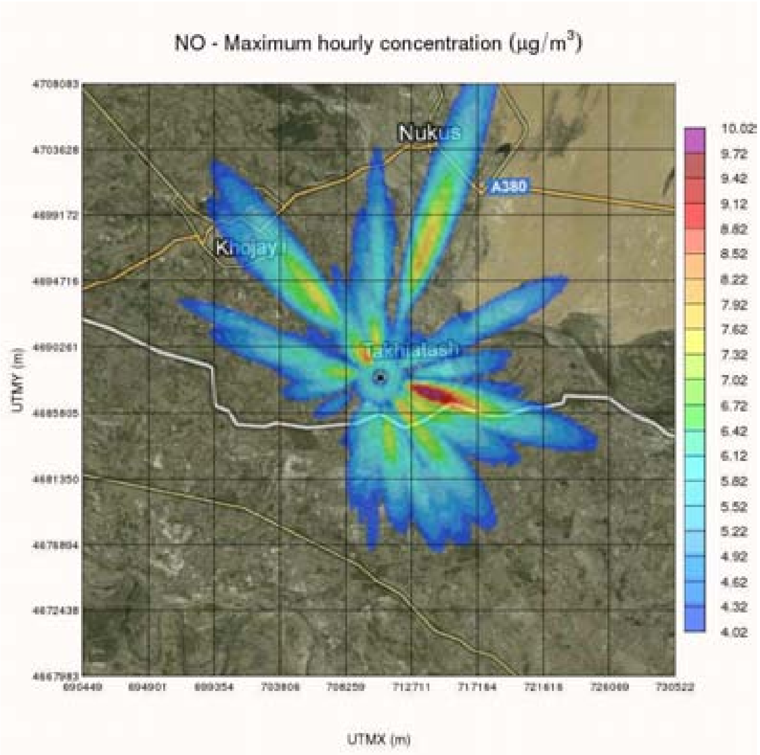


Illustration AI-5. NO maximum hourly concentration for scenario 1.

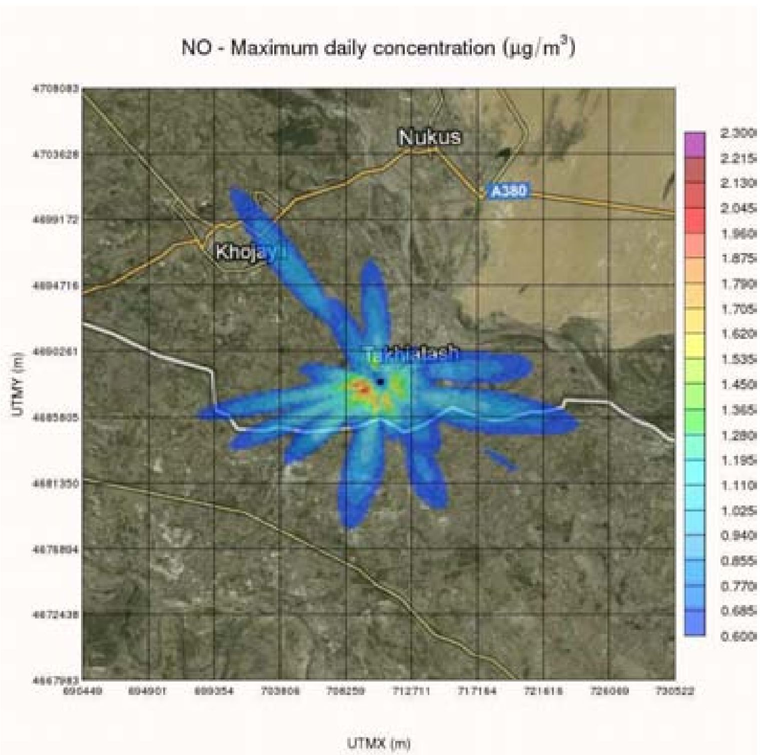


Illustration AI-6. NO maximum daily concentration for scenario 1.

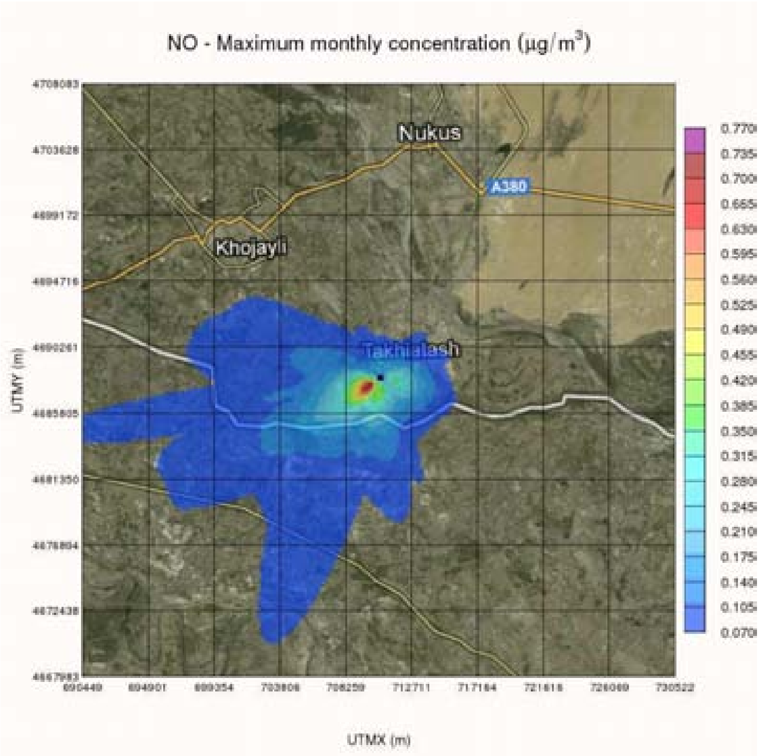


Illustration AI-7. NO maximum monthly concentration for scenario 1.

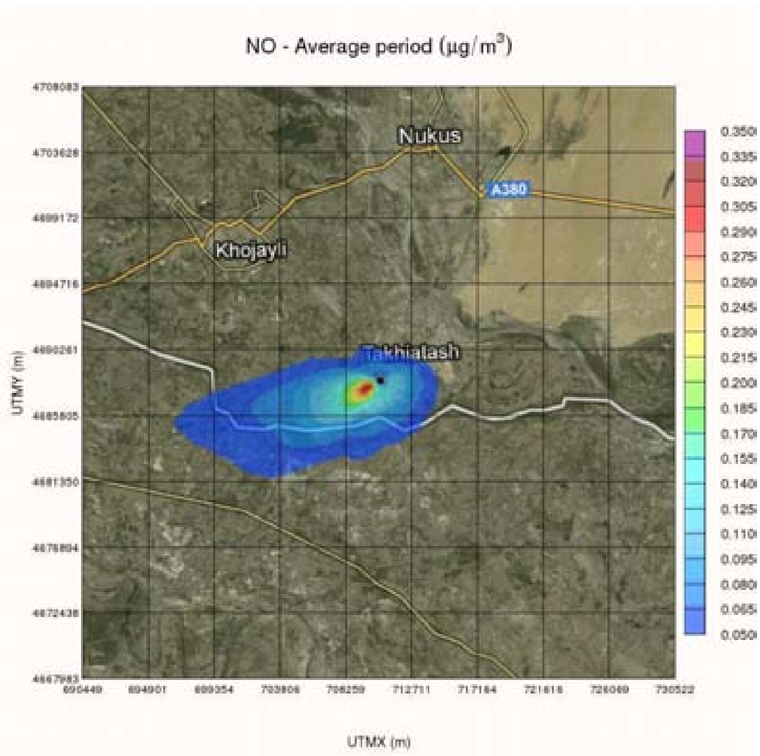


Illustration AI-8. NO average period concentration for scenario 1.

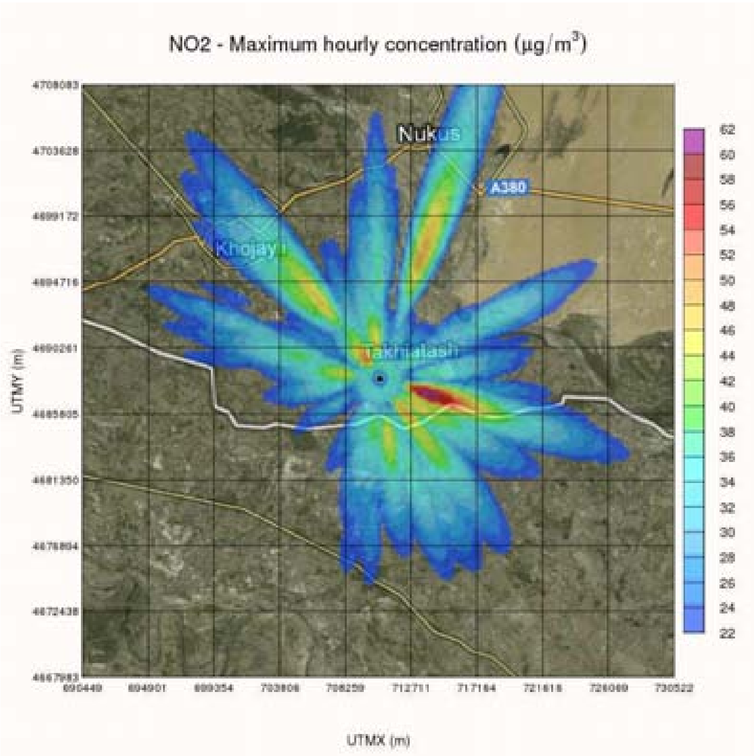


Illustration AI-9. NO_2 maximum hourly concentration for scenario 1.

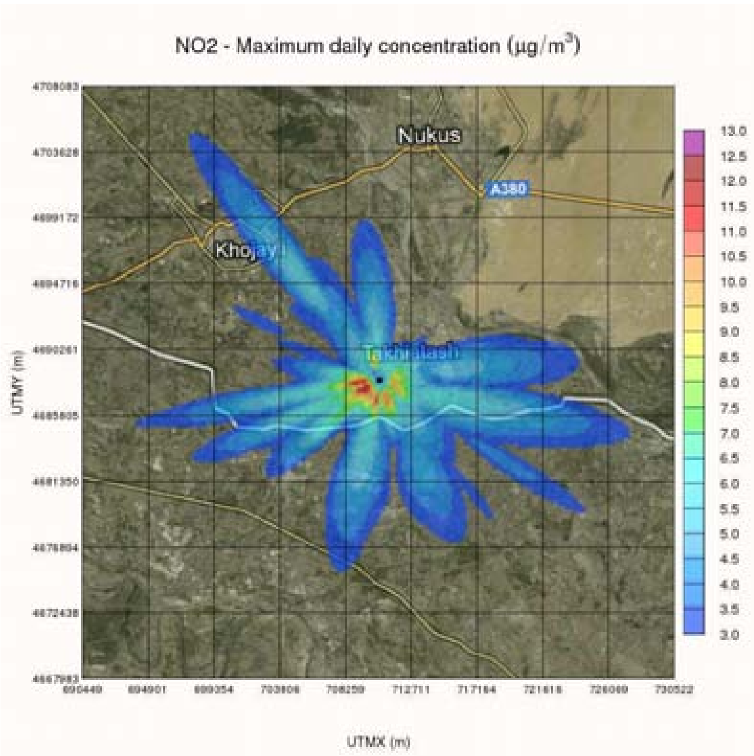


Illustration AI-10. NO_2 maximum daily concentration for scenario 1.

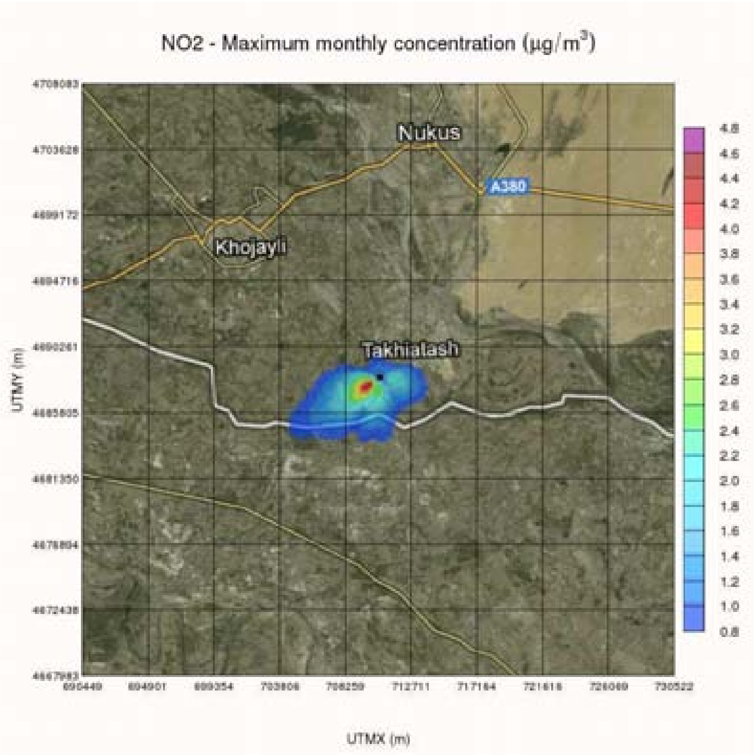


Illustration AI-11. NO_2 maximum monthly concentration for scenario 1.

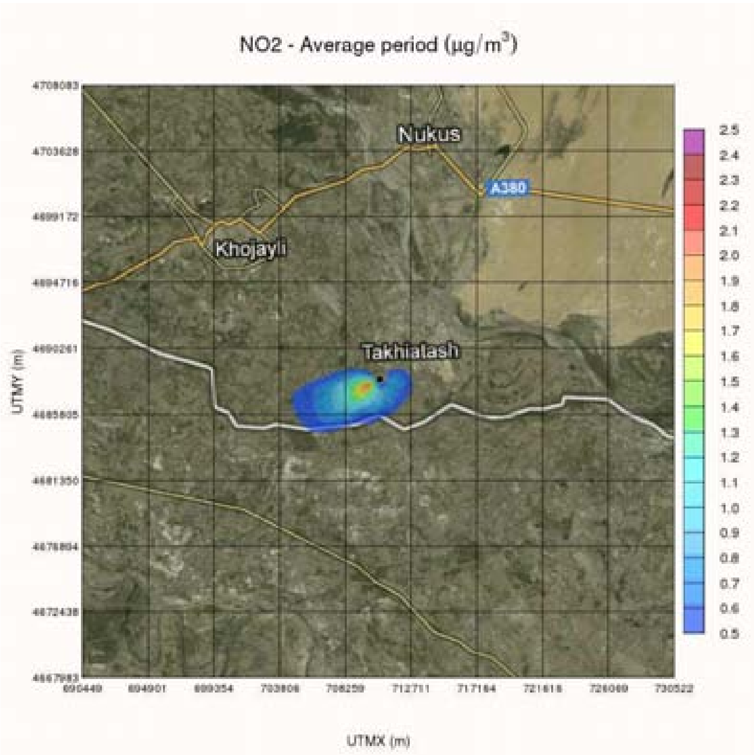


Illustration AI-12. NO_2 average period concentration for scenario 1.

Scenario 2

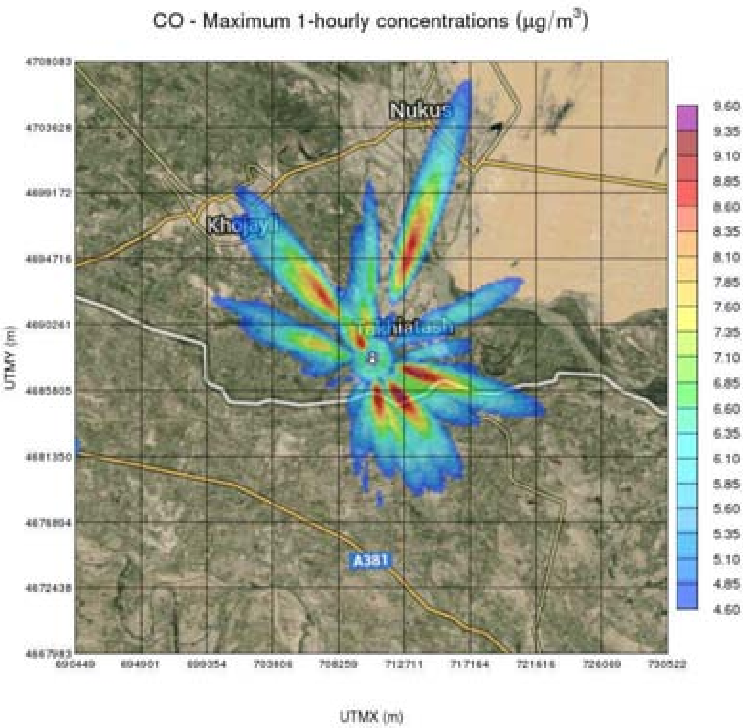


Illustration AI-13. CO maximum hourly concentration for scenario 2.

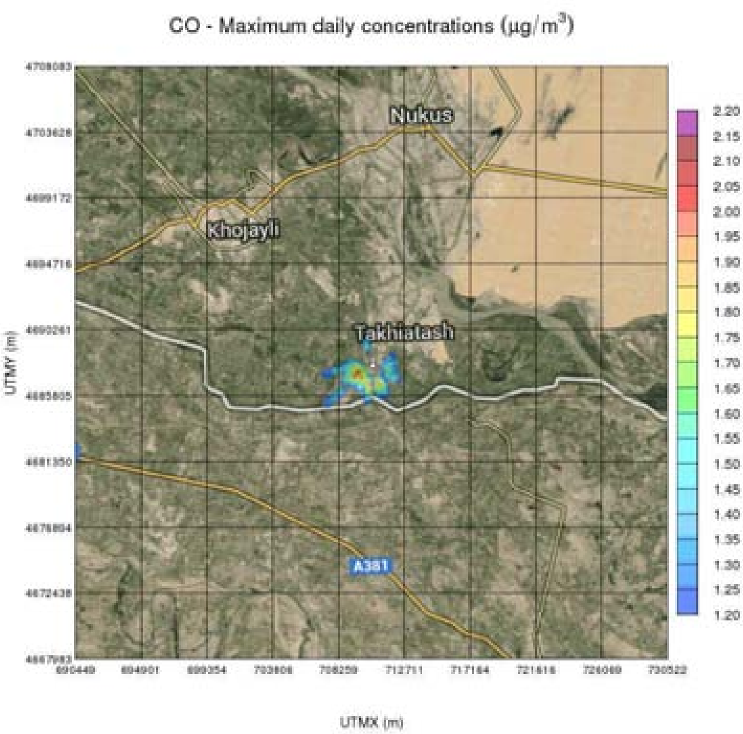


Illustration AI-14. CO maximum daily concentration for scenario 2.

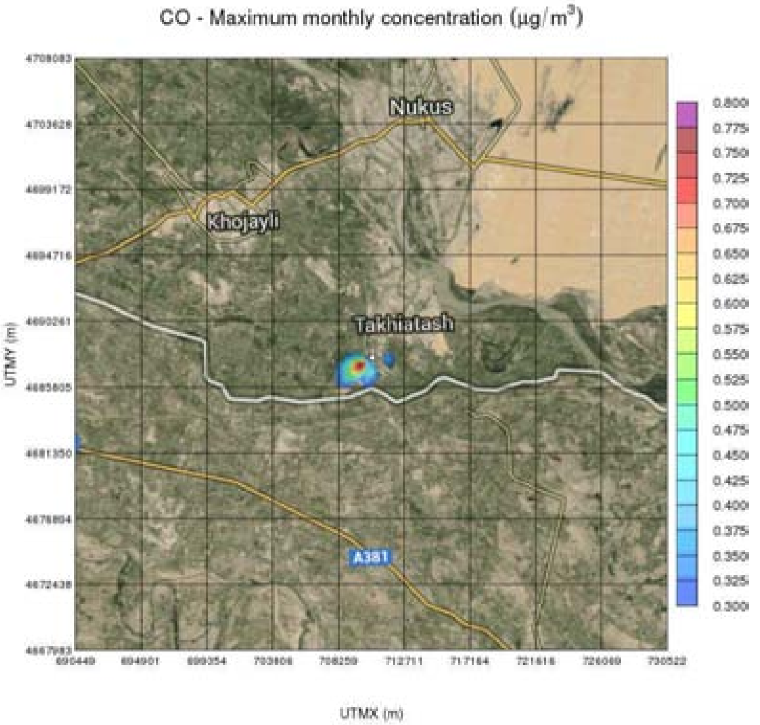


Illustration AI-15. CO maximum monthly concentration for scenario 2.

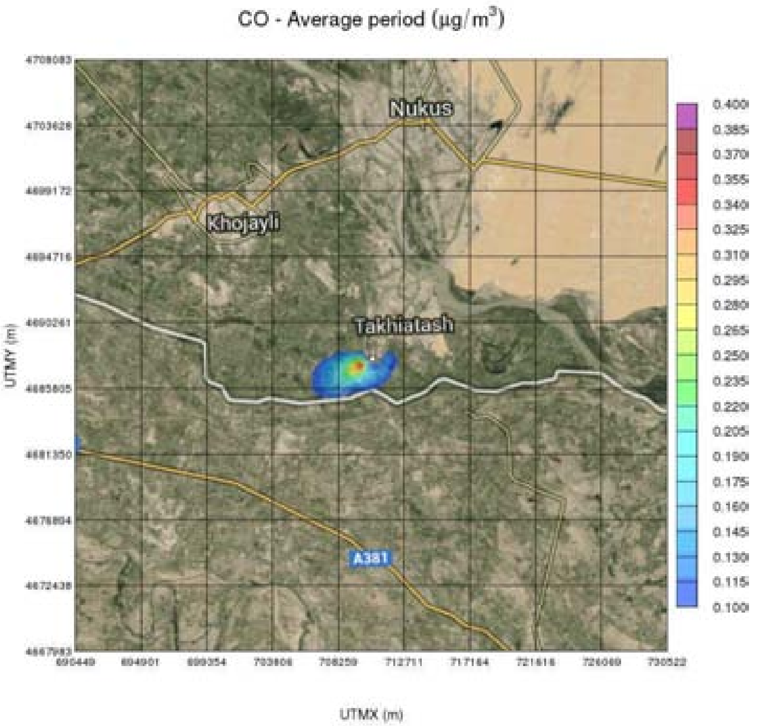


Illustration AI-16. CO average period concentration for scenario 2.

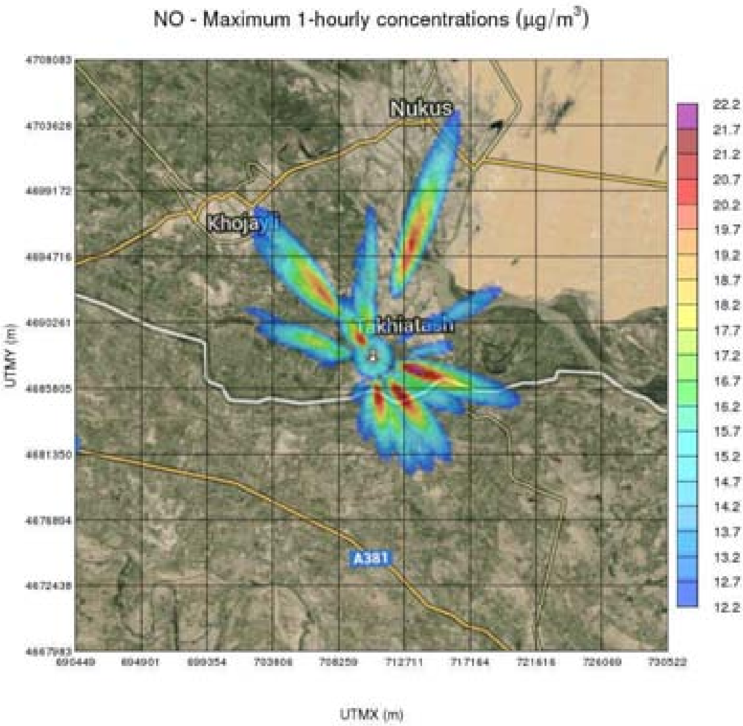


Illustration AI-17. NO maximum hourly concentration for scenario 2.

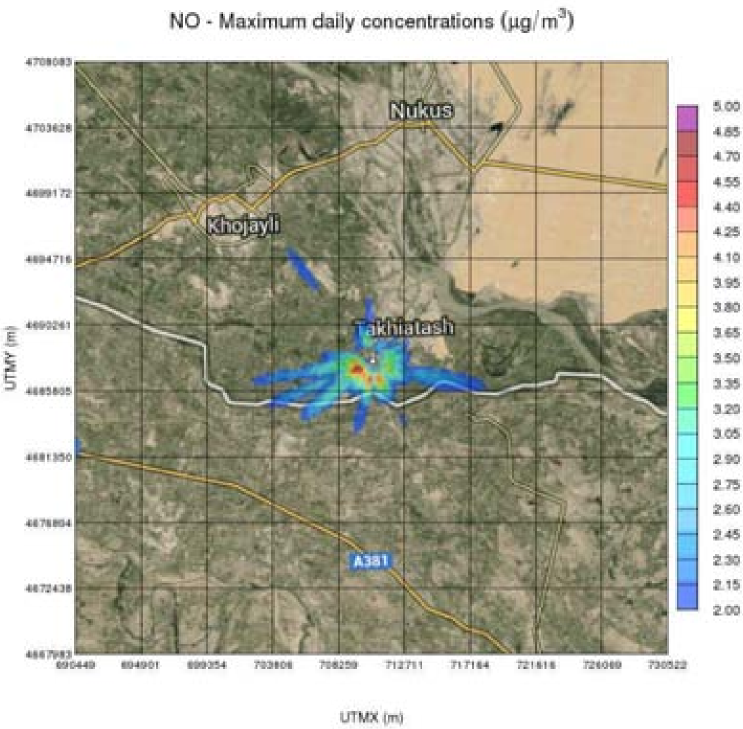


Illustration AI-18. NO maximum daily concentration for scenario 2.

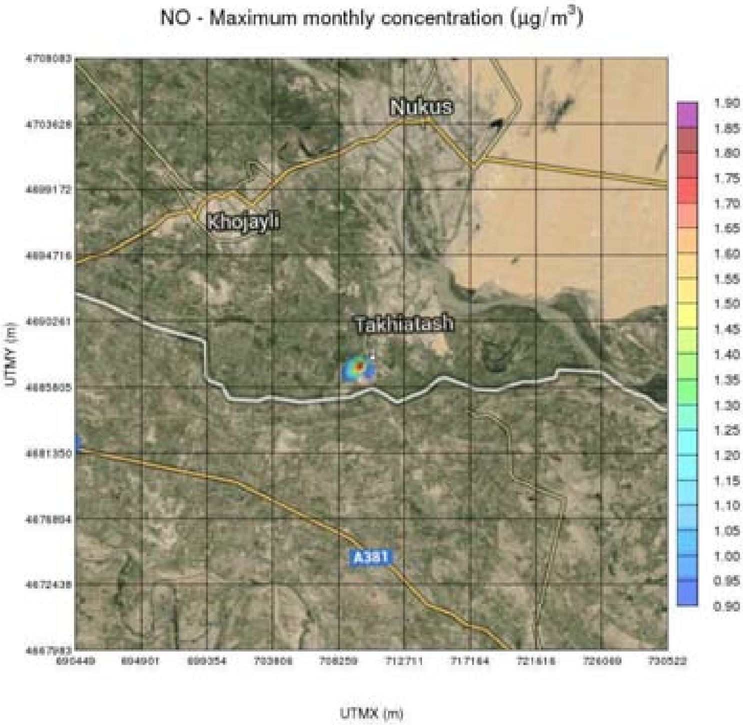


Illustration AI-19. NO maximum monthly concentration for scenario 2.

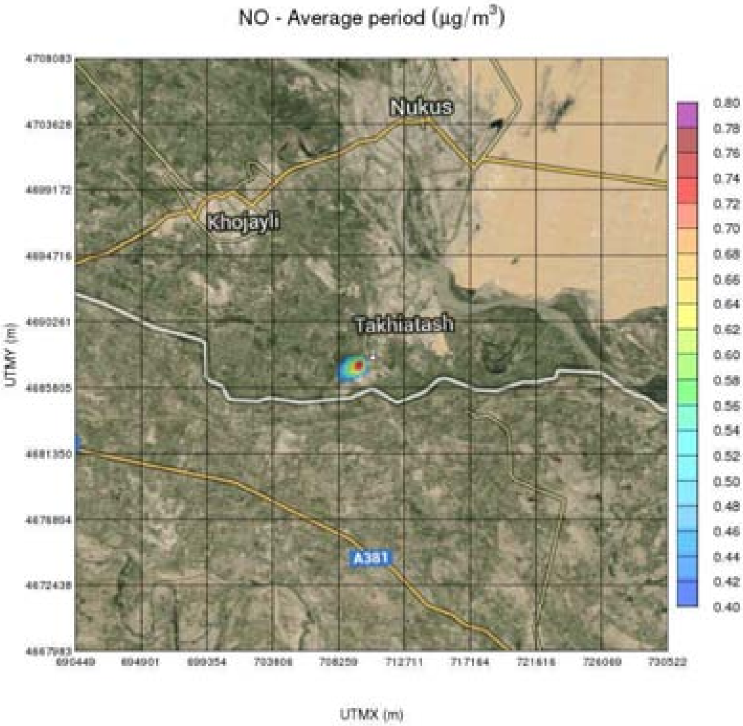


Illustration AI-20. NO average period concentration for scenario 2.

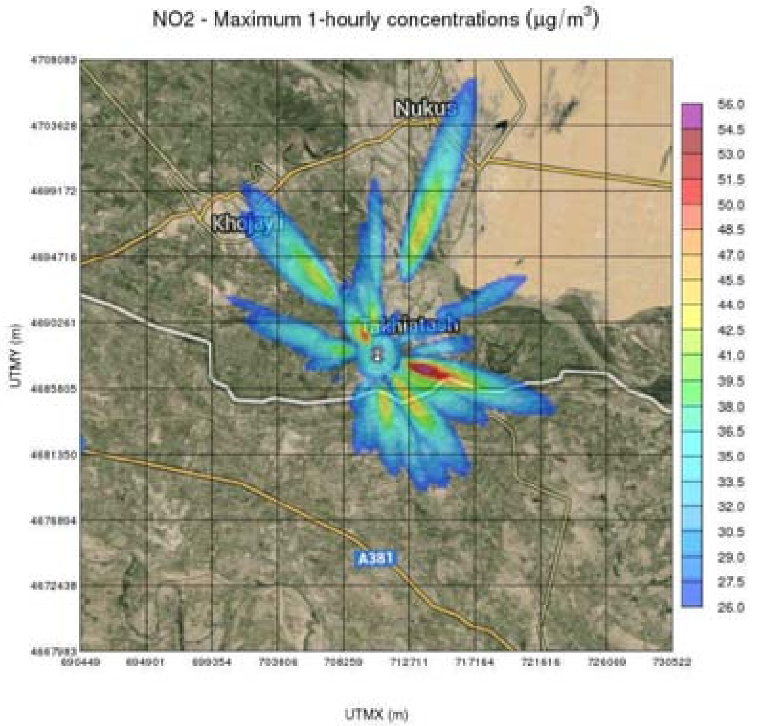


Illustration AI-21. NO_2 maximum hourly concentration for scenario 2.

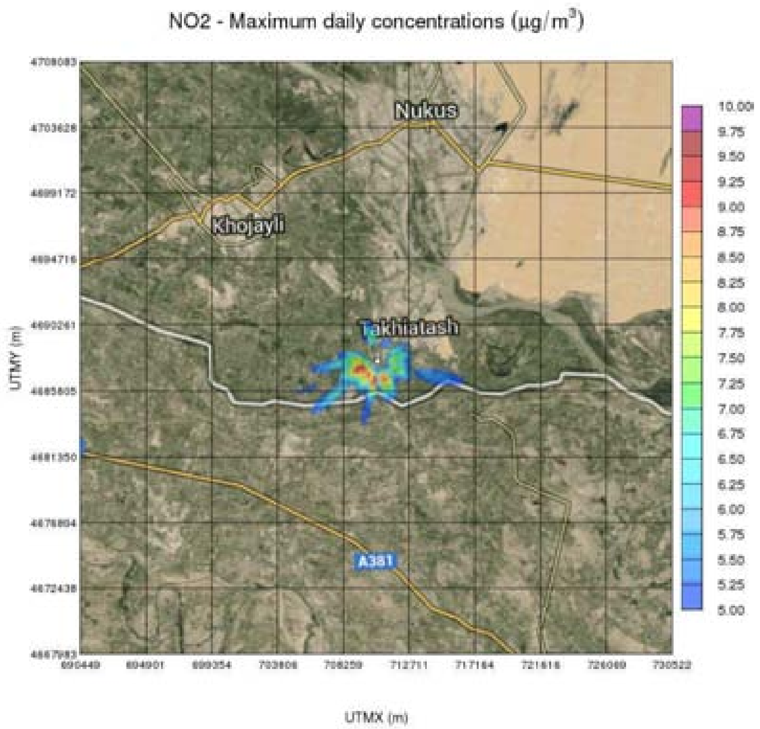


Illustration AI-22. NO_2 maximum daily concentration for scenario 2.

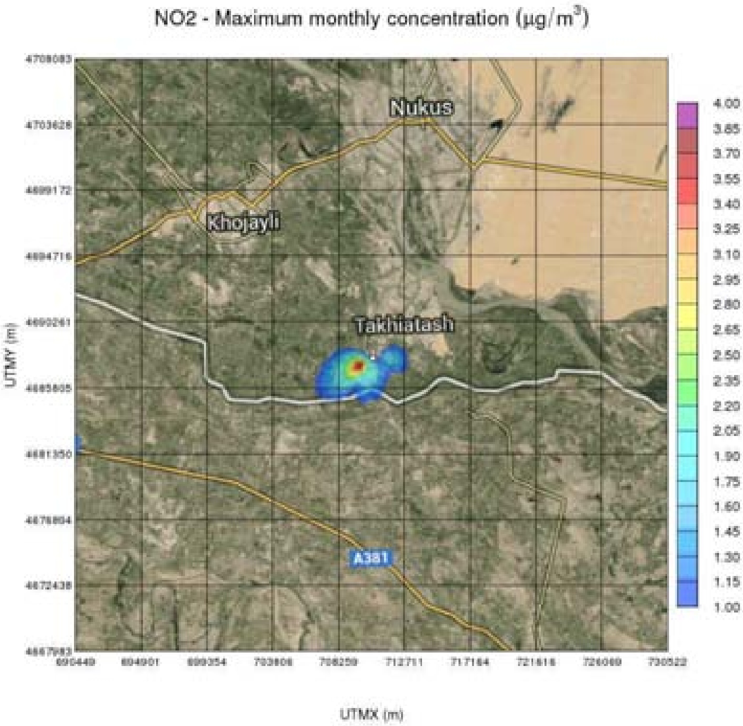


Illustration AI-23. NO_2 maximum monthly concentration for scenario 2.

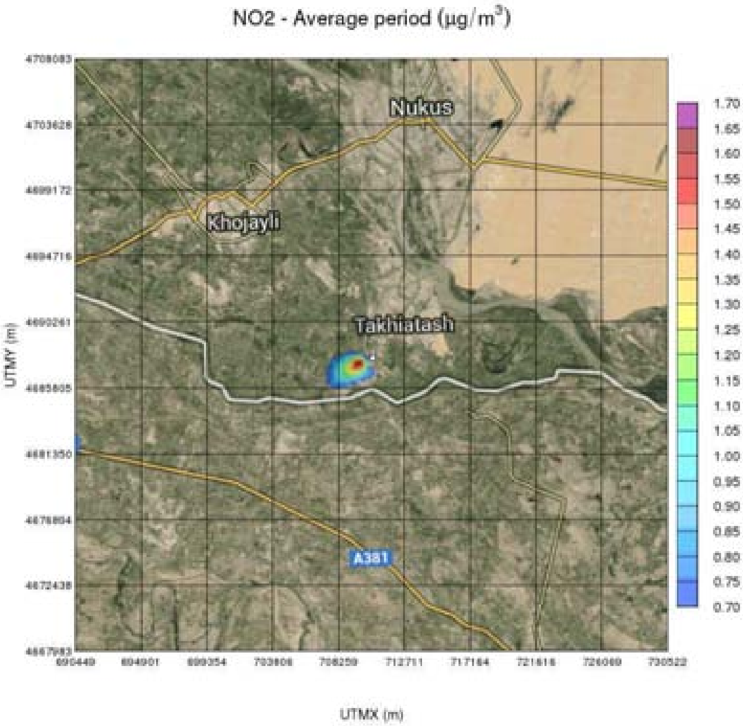


Illustration AI-24. NO_2 average period concentration for scenario 2.

Appendix 2: Concentration values

Scenario 1

Table AII-1. The 50 maximum 1-hr concentration of CO.

CO maximum 1-hr concentration					
	Concentration	**UTMX**	**UTMY**	**Distance from source**	**Date and time**
	ug/m3	**m**	**m**	**m**	**yyyy-mm-dd hh:mm**
1	3.37	713988	4687136	3544	2012-02-12 12:00
2	3.36	713788	4687136	3353	2012-02-12 12:00
3	3.35	713588	4687336	3105	2012-02-12 12:00
4	3.34	714188	4687136	3736	2012-02-12 12:00
5	3.33	713388	4687336	2912	2012-02-12 12:00
6	3.32	713588	4687136	3162	2012-02-12 12:00
7	3.31	713788	4687336	3298	2012-02-12 12:00
8	3.30	714188	4686936	3795	2012-02-12 12:00
9	3.30	714388	4686936	3985	2012-02-12 12:00
10	3.28	714388	4687136	3929	2012-02-12 12:00
11	3.28	713188	4687336	2720	2012-02-12 12:00
12	3.27	714588	4686936	4176	2012-02-12 12:00
13	3.26	713988	4686936	3606	2012-02-12 12:00
14	3.25	713988	4687336	3493	2012-02-12 12:00
15	3.23	714788	4686936	4368	2012-02-12 12:00
16	3.22	713388	4687136	2973	2012-02-12 12:00
17	3.21	714588	4687136	4123	2012-02-12 12:00
18	3.18	713788	4686936	3418	2012-02-12 12:00
19	3.18	714788	4686736	4427	2012-02-12 12:00
20	3.17	714588	4686736	4238	2012-02-12 12:00
21	3.17	714988	4686936	4561	2012-02-12 12:00
22	3.17	714188	4687336	3688	2012-02-12 12:00
23	3.16	714988	4686736	4617	2012-02-12 12:00
24	3.15	713188	4687536	2668	2012-02-12 12:00
25	3.15	712988	4687336	2530	2012-02-12 12:00
26	3.14	714388	4686736	4050	2012-02-12 12:00
27	3.13	713388	4687536	2864	2012-02-12 12:00
28	3.13	714788	4687136	4317	2012-02-12 12:00
29	3.13	715188	4686736	4808	2012-02-12 12:00
30	3.12	712988	4687536	2474	2012-02-12 12:00
31	3.09	715188	4686936	4754	2012-02-12 12:00
32	3.08	714388	4687336	3883	2012-02-12 12:00

33	3.08	713588	4687536	3059	2012-02-12 12:00
34	3.07	714188	4686736	3863	2012-02-12 12:00
35	3.07	715388	4686736	5000	2012-02-12 12:00
36	3.06	713188	4687136	2786	2012-02-12 12:00
37	3.04	713588	4686936	3231	2012-02-12 12:00
38	3.04	714988	4687136	4512	2012-02-12 12:00
39	3.03	715188	4686536	4870	2012-02-12 12:00
40	3.02	714988	4686536	4682	2012-02-12 12:00
41	3.02	712788	4687536	2280	2012-02-12 12:00
42	3.02	715388	4686536	5060	2012-02-12 12:00
43	3.01	715388	4686936	4948	2012-02-12 12:00
44	3.01	713788	4687536	3256	2012-02-12 12:00
45	3.00	715588	4686736	5192	2012-02-12 12:00
46	2.99	714788	4686536	4494	2012-02-12 12:00
47	2.98	714588	4687336	4079	2012-02-12 12:00
48	2.98	715588	4686536	5250	2012-02-12 12:00
49	2.96	713988	4686736	3677	2012-02-12 12:00
50	2.94	715788	4686536	5441	2012-02-12 12:00

Table AII-2. The 50 maximum 24-hr concentration of CO.

CO maximum 24-hr concentration					
	Concentration	**UTMX**	**UTMY**	**Distance from source**	**Date and time**
	ug/m3	**m**	**m**	**m**	**yyyy-mm-dd hh:mm**
1	0.72	709388	4687536	1342	2012-07-04 24:00
2	0.71	709788	4687736	894	2012-07-04 24:00
3	0.70	709588	4687536	1166	2012-07-04 24:00
4	0.70	709588	4687736	1077	2012-07-04 24:00
5	0.69	708988	4687936	1612	2012-04-17 24:00
6	0.67	709788	4687736	894	2012-07-05 24:00
7	0.67	709188	4687936	1414	2012-04-17 24:00
8	0.66	709588	4687536	1166	2012-05-20 24:00
9	0.66	710388	4686936	1217	2012-07-23 24:00
10	0.66	709588	4688136	1000	2012-07-10 24:00
11	0.66	709188	4687936	1414	2012-07-10 24:00
12	0.66	709788	4687536	1000	2012-08-12 24:00
13	0.66	708788	4687936	1811	2012-04-17 24:00
14	0.66	709388	4688136	1200	2012-07-10 24:00

15	0.65	708988	4687936	1612	2012-07-10 24:00
16	0.65	709588	4687536	1166	2012-07-05 24:00
17	0.65	709588	4687736	1077	2012-07-05 24:00
18	0.64	710388	4687136	1020	2012-07-23 24:00
19	0.64	709788	4687736	894	2012-05-20 24:00
20	0.64	709188	4687336	1612	2012-07-04 24:00
21	0.64	710388	4686736	1414	2012-07-23 24:00
22	0.64	709188	4687536	1523	2012-07-04 24:00
23	0.64	709388	4687536	1342	2012-05-07 24:00
24	0.64	709388	4687936	1217	2012-07-10 24:00
25	0.63	709788	4687536	1000	2012-07-06 24:00
26	0.63	709588	4687936	1020	2012-05-21 24:00
27	0.63	709588	4687336	1281	2012-08-12 24:00
28	0.63	709388	4687536	1342	2012-07-05 24:00
29	0.63	709188	4688136	1400	2012-07-10 24:00
30	0.62	709588	4687536	1166	2012-05-07 24:00
31	0.62	709988	4687136	1166	2012-05-11 24:00
32	0.62	710988	4687336	894	2012-06-04 24:00
33	0.62	709788	4687536	1000	2012-08-16 24:00
34	0.62	709388	4687936	1217	2012-05-21 24:00
35	0.62	709188	4687336	1612	2012-05-07 24:00
36	0.62	708588	4687936	2010	2012-04-17 24:00
37	0.62	711188	4686936	1342	2012-06-04 24:00
38	0.61	710988	4687136	1077	2012-06-04 24:00
39	0.61	709788	4687536	1000	2012-05-19 24:00
40	0.61	709788	4687336	1131	2012-08-12 24:00
41	0.61	708788	4687936	1811	2012-07-10 24:00
42	0.60	709388	4687536	1342	2012-07-03 24:00
43	0.60	709788	4688136	800	2012-07-10 24:00
44	0.60	709788	4687736	894	2012-08-30 24:00
45	0.60	709588	4687536	1166	2012-07-03 24:00
46	0.60	709788	4687736	894	2012-06-08 24:00
47	0.60	709388	4687336	1442	2012-05-20 24:00
48	0.60	711188	4687136	1166	2012-06-04 24:00
49	0.60	709388	4687936	1217	2012-04-17 24:00
50	0.60	709788	4687536	1000	2012-05-20 24:00

Table AII-3. The 50 maximum Month concentration of CO.

CO maximum month concentration					
	Concentration	**UTMX**	**UTMY**	**Distance from source**	**Date and time**
	ug/m3	**m**	**m**	**m**	**yyyy-mm-dd hh:mm**
1	0.27	709788	4687536	1000	2012-08-31 24:00
2	0.26	709988	4687736	721	2012-08-31 24:00
3	0.26	709588	4687536	1166	2012-08-31 24:00
4	0.26	709788	4687736	894	2012-08-31 24:00
5	0.25	709588	4687336	1281	2012-08-31 24:00
6	0.24	709988	4687536	849	2012-08-31 24:00
7	0.24	709788	4687336	1131	2012-08-31 24:00
8	0.23	709388	4687336	1442	2012-08-31 24:00
9	0.23	709788	4687736	894	2012-07-31 24:00
10	0.23	709788	4687736	894	2012-05-31 24:00
11	0.23	709588	4687536	1166	2012-05-31 24:00
12	0.22	709788	4687536	1000	2012-05-31 24:00
13	0.22	709588	4687736	1077	2012-07-31 24:00
14	0.22	709388	4687536	1342	2012-08-31 24:00
15	0.22	709588	4687736	1077	2012-08-31 24:00
16	0.22	709988	4687736	721	2012-05-31 24:00
17	0.21	709588	4687536	1166	2012-07-31 24:00
18	0.21	709388	4687136	1562	2012-08-31 24:00
19	0.21	709588	4687336	1281	2012-05-31 24:00
20	0.21	709588	4687136	1414	2012-08-31 24:00
21	0.21	709588	4687736	1077	2012-05-31 24:00
22	0.21	709788	4687936	825	2012-07-31 24:00
23	0.21	709388	4687536	1342	2012-07-31 24:00
24	0.21	709388	4687536	1342	2012-05-31 24:00
25	0.21	709388	4687336	1442	2012-05-31 24:00
26	0.20	709388	4687736	1265	2012-07-31 24:00
27	0.20	709188	4687336	1612	2012-08-31 24:00
28	0.20	709188	4687136	1720	2012-08-31 24:00
29	0.20	709788	4687536	1000	2012-07-31 24:00
30	0.20	709988	4687736	721	2012-07-31 24:00
31	0.20	709988	4687536	849	2012-05-31 24:00
32	0.20	709588	4687936	1020	2012-07-31 24:00
33	0.20	709788	4687336	1131	2012-05-31 24:00
34	0.20	709788	4687736	894	2012-06-30 24:00

35	0.19	709988	4687936	632	2012-07-31 24:00
36	0.19	709988	4687936	632	2012-08-31 24:00
37	0.19	709788	4687736	894	2012-09-30 24:00
38	0.19	709188	4687536	1523	2012-07-31 24:00
39	0.19	709988	4687736	721	2012-06-30 24:00
40	0.19	710188	4687736	566	2012-08-31 24:00
41	0.19	709188	4687336	1612	2012-05-31 24:00
42	0.19	709988	4687336	1000	2012-08-31 24:00
43	0.19	709988	4687736	721	2012-09-30 24:00
44	0.19	709788	4687136	1281	2012-08-31 24:00
45	0.19	709988	4687936	632	2012-09-30 24:00
46	0.19	709788	4687536	1000	2012-06-30 24:00
47	0.19	709988	4687936	632	2012-05-31 24:00
48	0.19	709788	4687936	825	2012-05-31 24:00
49	0.19	709388	4687136	1562	2012-05-31 24:00
50	0.18	709388	4687336	1442	2012-07-31 24:00

Table AII-4. The 10 maximum period concentration of CO.

CO summary of maximum period concentration				
	Concentration	**UTMX**	**UTMY**	**Distance from source**
	ug/m3	**m**	**m**	**m**
1	0.12	709788	4687736	894
2	0.11	709588	4687536	1166
3	0.11	709788	4687536	1000
4	0.11	709588	4687736	1077
5	0.11	709988	4687736	721
6	0.11	709388	4687536	1342
7	0.10	709788	4687936	825
8	0.10	709588	4687336	1281
9	0.10	709388	4687336	1442
10	0.10	709988	4687936	632

Table AII-5. The 50 maximum 1-hr concentration of NO.

NO maximum 1-hr concentration					
	Concentration	**UTMX**	**UTMY**	**Distance from source**	**Date and time**
	ug/m3	**m**	**m**	**m**	**yyyy-mm-dd hh:mm**
1	10.02	713988	4687136	3544	2012-02-12 12:00
2	10.00	713788	4687136	3353	2012-02-12 12:00
3	9.92	713588	4687336	3105	2012-02-12 12:00
4	9.91	714188	4687136	3736	2012-02-12 12:00
5	9.87	713588	4687136	3162	2012-02-12 12:00
6	9.86	713388	4687336	2912	2012-02-12 12:00
7	9.81	714188	4686936	3795	2012-02-12 12:00
8	9.81	713788	4687336	3298	2012-02-12 12:00
9	9.80	714388	4686936	3985	2012-02-12 12:00
10	9.74	714388	4687136	3929	2012-02-12 12:00
11	9.73	714588	4686936	4176	2012-02-12 12:00
12	9.71	713188	4687336	2720	2012-02-12 12:00
13	9.70	713988	4686936	3606	2012-02-12 12:00
14	9.64	713988	4687336	3493	2012-02-12 12:00
15	9.60	714788	4686936	4368	2012-02-12 12:00
16	9.58	713388	4687136	2973	2012-02-12 12:00
17	9.53	714588	4687136	4123	2012-02-12 12:00
18	9.48	713788	4686936	3418	2012-02-12 12:00
19	9.46	714788	4686736	4427	2012-02-12 12:00
20	9.44	714588	4686736	4238	2012-02-12 12:00
21	9.41	714988	4686936	4561	2012-02-12 12:00
22	9.41	714988	4686736	4617	2012-02-12 12:00
23	9.39	714188	4687336	3688	2012-02-12 12:00
24	9.36	714388	4686736	4050	2012-02-12 12:00
25	9.33	712988	4687336	2530	2012-02-12 12:00
26	9.30	713188	4687536	2668	2012-02-12 12:00
27	9.29	715188	4686736	4808	2012-02-12 12:00
28	9.28	714788	4687136	4317	2012-02-12 12:00
29	9.25	713388	4687536	2864	2012-02-12 12:00
30	9.20	712988	4687536	2474	2012-02-12 12:00
31	9.18	715188	4686936	4754	2012-02-12 12:00
32	9.15	714188	4686736	3863	2012-02-12 12:00
33	9.13	714388	4687336	3883	2012-02-12 12:00
34	9.11	713188	4687136	2786	2012-02-12 12:00

35	9.10	715388	4686736	5000	2012-02-12 12:00
36	9.10	713588	4687536	3059	2012-02-12 12:00
37	9.07	713588	4686936	3231	2012-02-12 12:00
38	9.02	715188	4686536	4870	2012-02-12 12:00
39	9.01	714988	4687136	4512	2012-02-12 12:00
40	9.00	714988	4686536	4682	2012-02-12 12:00
41	8.96	715388	4686536	5060	2012-02-12 12:00
42	8.93	715388	4686936	4948	2012-02-12 12:00
43	8.92	714788	4686536	4494	2012-02-12 12:00
44	8.90	715588	4686736	5192	2012-02-12 12:00
45	8.89	712788	4687536	2280	2012-02-12 12:00
46	8.89	713788	4687536	3256	2012-02-12 12:00
47	8.85	715588	4686536	5250	2012-02-12 12:00
48	8.84	714588	4687336	4079	2012-02-12 12:00
49	8.83	713988	4686736	3677	2012-02-12 12:00
50	8.75	714588	4686536	4308	2012-02-12 12:00

Table AII-6. The 50 maximum 24-hr concentration of NO.

NO maximum 24-hr concentration					
	Concentration	**UTMX**	**UTMY**	**Distance from source**	**Date and time**
	ug/m3	**m**	**m**	**m**	**yyyy-mm-dd hh:mm**
1	2.04	709388	4687536	1342	2012-07-04 24:00
2	1.98	709588	4687536	1166	2012-07-04 24:00
3	1.93	709788	4687736	894	2012-07-04 24:00
4	1.92	709588	4687736	1077	2012-07-04 24:00
5	1.90	708988	4687936	1612	2012-04-17 24:00
6	1.86	709588	4687536	1166	2012-05-20 24:00
7	1.85	709788	4687736	894	2012-07-05 24:00
8	1.85	709188	4687336	1612	2012-07-04 24:00
9	1.84	710388	4686936	1217	2012-07-23 24:00
10	1.84	709188	4687936	1414	2012-07-10 24:00
11	1.84	709188	4687936	1414	2012-04-17 24:00
12	1.84	709588	4687536	1166	2012-07-05 24:00
13	1.82	709388	4688136	1200	2012-07-10 24:00
14	1.82	709788	4687536	1000	2012-08-12 24:00
15	1.82	708788	4687936	1811	2012-04-17 24:00
16	1.82	708988	4687936	1612	2012-07-10 24:00

17	1.82	709188	4687536	1523	2012-07-04 24:00
18	1.81	709588	4688136	1000	2012-07-10 24:00
19	1.80	710388	4686736	1414	2012-07-23 24:00
20	1.80	709588	4687736	1077	2012-07-05 24:00
21	1.80	709388	4687536	1342	2012-07-05 24:00
22	1.79	709588	4687336	1281	2012-08-12 24:00
23	1.79	709388	4687536	1342	2012-05-07 24:00
24	1.78	709788	4687536	1000	2012-07-06 24:00
25	1.77	709388	4687936	1217	2012-07-10 24:00
26	1.76	709988	4687136	1166	2012-05-11 24:00
27	1.76	710388	4687136	1020	2012-07-23 24:00
28	1.76	709188	4687336	1612	2012-05-07 24:00
29	1.75	709188	4688136	1400	2012-07-10 24:00
30	1.75	709588	4687936	1020	2012-05-21 24:00
31	1.75	709588	4687536	1166	2012-05-07 24:00
32	1.74	709788	4687736	894	2012-05-20 24:00
33	1.74	711188	4686936	1342	2012-06-04 24:00
34	1.73	708988	4687336	1789	2012-07-04 24:00
35	1.73	709788	4687536	1000	2012-08-16 24:00
36	1.73	709388	4687936	1217	2012-05-21 24:00
37	1.73	709388	4687336	1442	2012-07-04 24:00
38	1.72	709388	4687336	1442	2012-05-20 24:00
39	1.71	709788	4687336	1131	2012-08-12 24:00
40	1.71	708588	4687936	2010	2012-04-17 24:00
41	1.70	709388	4687536	1342	2012-07-03 24:00
42	1.70	708788	4687936	1811	2012-07-10 24:00
43	1.70	709588	4687336	1281	2012-07-06 24:00
44	1.69	710988	4687136	1077	2012-06-04 24:00
45	1.69	709588	4687536	1166	2012-07-03 24:00
46	1.69	709788	4687536	1000	2012-05-19 24:00
47	1.68	710388	4686536	1612	2012-07-23 24:00
48	1.68	709788	4687736	894	2012-06-29 24:00
49	1.68	710988	4687336	894	2012-06-04 24:00
50	1.68	709788	4687736	894	2012-06-08 24:00

Table AII-7. The 50 maximum Month concentration of NO.

NO maximum month concentration					
	Concentration	**UTMX**	**UTMY**	**Distance from source**	**Date and time**
	ug/m3	**m**	**m**	**m**	**yyyy-mm-dd hh:mm**
1	0.77	709788	4687536	1000	2012-08-31 24:00
2	0.73	709588	4687536	1166	2012-08-31 24:00
3	0.72	709988	4687736	721	2012-08-31 24:00
4	0.71	709588	4687336	1281	2012-08-31 24:00
5	0.71	709788	4687736	894	2012-08-31 24:00
6	0.68	709788	4687336	1131	2012-08-31 24:00
7	0.68	709988	4687536	849	2012-08-31 24:00
8	0.67	709388	4687336	1442	2012-08-31 24:00
9	0.64	709588	4687536	1166	2012-05-31 24:00
10	0.63	709788	4687736	894	2012-07-31 24:00
11	0.63	709588	4687736	1077	2012-07-31 24:00
12	0.63	709788	4687536	1000	2012-05-31 24:00
13	0.62	709788	4687736	894	2012-05-31 24:00
14	0.62	709388	4687536	1342	2012-08-31 24:00
15	0.62	709388	4687136	1562	2012-08-31 24:00
16	0.61	709588	4687536	1166	2012-07-31 24:00
17	0.60	709588	4687136	1414	2012-08-31 24:00
18	0.60	709588	4687736	1077	2012-08-31 24:00
19	0.60	709588	4687336	1281	2012-05-31 24:00
20	0.59	709388	4687536	1342	2012-07-31 24:00
21	0.59	709388	4687336	1442	2012-05-31 24:00
22	0.59	709388	4687536	1342	2012-05-31 24:00
23	0.58	709588	4687736	1077	2012-05-31 24:00
24	0.58	709988	4687736	721	2012-05-31 24:00
25	0.58	709188	4687336	1612	2012-08-31 24:00
26	0.58	709188	4687136	1720	2012-08-31 24:00
27	0.58	709388	4687736	1265	2012-07-31 24:00
28	0.57	709788	4687936	825	2012-07-31 24:00
29	0.56	709788	4687536	1000	2012-07-31 24:00
30	0.55	709788	4687336	1131	2012-05-31 24:00
31	0.55	709188	4687536	1523	2012-07-31 24:00
32	0.55	709188	4687336	1612	2012-05-31 24:00
33	0.55	709788	4687736	894	2012-06-30 24:00
34	0.55	709988	4687736	721	2012-07-31 24:00

35	0.54	709588	4687936	1020	2012-07-31 24:00
36	0.54	709988	4687536	849	2012-05-31 24:00
37	0.54	709788	4687736	894	2012-09-30 24:00
38	0.54	709988	4687336	1000	2012-08-31 24:00
39	0.54	709788	4687136	1281	2012-08-31 24:00
40	0.53	709988	4687736	721	2012-06-30 24:00
41	0.53	709388	4687336	1442	2012-07-31 24:00
42	0.53	709388	4687136	1562	2012-05-31 24:00
43	0.53	709188	4686936	1844	2012-08-31 24:00
44	0.53	709788	4687536	1000	2012-06-30 24:00
45	0.53	709388	4686936	1697	2012-08-31 24:00
46	0.52	709188	4687136	1720	2012-05-31 24:00
47	0.52	709988	4687936	632	2012-07-31 24:00
48	0.52	709988	4687736	721	2012-09-30 24:00
49	0.52	709188	4687336	1612	2012-07-31 24:00
50	0.52	709188	4687536	1523	2012-05-31 24:00

Table AII-8. The 10 maximum period concentration of NO.

NO summary of maximum period concentration				
	Concentration	**UTMX**	**UTMY**	**Distance from source**
	ug/m3	**m**	**m**	**m**
1	0.33	709788	4687736	894
2	0.32	709588	4687536	1166
3	0.32	709788	4687536	1000
4	0.31	709588	4687736	1077
5	0.30	709988	4687736	721
6	0.30	709388	4687536	1342
7	0.30	709588	4687336	1281
8	0.29	709388	4687336	1442
9	0.28	709788	4687936	825
10	0.28	709388	4687736	1265

Table AII-9. The 50 maximum 1-hr concentration of NO_2.

NO_2 maximum 1-hr concentration					
	Concentration	**UTMX**	**UTMY**	**Distance from source**	**Date and time**
	ug/m3	**m**	**m**	**m**	**yyyy-mm-dd hh:mm**
1	61.64	713988	4687136	3544	2012-02-12 12:00
2	61.52	713788	4687136	3353	2012-02-12 12:00
3	61.02	713588	4687336	3105	2012-02-12 12:00
4	60.98	714188	4687136	3736	2012-02-12 12:00
5	60.73	713588	4687136	3162	2012-02-12 12:00
6	60.68	713388	4687336	2912	2012-02-12 12:00
7	60.40	714188	4686936	3795	2012-02-12 12:00
8	60.38	713788	4687336	3298	2012-02-12 12:00
9	60.34	714388	4686936	3985	2012-02-12 12:00
10	59.96	714388	4687136	3929	2012-02-12 12:00
11	59.88	714588	4686936	4176	2012-02-12 12:00
12	59.74	713188	4687336	2720	2012-02-12 12:00
13	59.67	713988	4686936	3606	2012-02-12 12:00
14	59.32	713988	4687336	3493	2012-02-12 12:00
15	59.10	714788	4686936	4368	2012-02-12 12:00
16	58.93	713388	4687136	2973	2012-02-12 12:00
17	58.64	714588	4687136	4123	2012-02-12 12:00
18	58.34	713788	4686936	3418	2012-02-12 12:00
19	58.24	714788	4686736	4427	2012-02-12 12:00
20	58.10	714588	4686736	4238	2012-02-12 12:00
21	57.93	714988	4686936	4561	2012-02-12 12:00
22	57.88	714988	4686736	4617	2012-02-12 12:00
23	57.79	714188	4687336	3688	2012-02-12 12:00
24	57.59	714388	4686736	4050	2012-02-12 12:00
25	57.42	712988	4687336	2530	2012-02-12 12:00
26	57.24	713188	4687536	2668	2012-02-12 12:00
27	57.15	715188	4686736	4808	2012-02-12 12:00
28	57.12	714788	4687136	4317	2012-02-12 12:00
29	56.90	713388	4687536	2864	2012-02-12 12:00
30	56.61	712988	4687536	2474	2012-02-12 12:00
31	56.49	715188	4686936	4754	2012-02-12 12:00
32	56.33	714188	4686736	3863	2012-02-12 12:00
33	56.21	714388	4687336	3883	2012-02-12 12:00
34	56.04	713188	4687136	2786	2012-02-12 12:00

35	56.03	715388	4686736	5000	2012-02-12 12:00
36	56.01	713588	4687536	3059	2012-02-12 12:00
37	55.82	713588	4686936	3231	2012-02-12 12:00
38	55.49	715188	4686536	4870	2012-02-12 12:00
39	55.43	714988	4687136	4512	2012-02-12 12:00
40	55.39	714988	4686536	4682	2012-02-12 12:00
41	55.15	715388	4686536	5060	2012-02-12 12:00
42	54.93	715388	4686936	4948	2012-02-12 12:00
43	54.88	714788	4686536	4494	2012-02-12 12:00
44	54.76	715588	4686736	5192	2012-02-12 12:00
45	54.72	712788	4687536	2280	2012-02-12 12:00
46	54.70	713788	4687536	3256	2012-02-12 12:00
47	54.45	715588	4686536	5250	2012-02-12 12:00
48	54.38	714588	4687336	4079	2012-02-12 12:00
49	54.37	713988	4686736	3677	

Table AII-10. The 50 maximum 24-hr concentration of NO_2.

NO_2 maximum 24-hr concentration					
	Concentration	**UTMX**	**UTMY**	**Distance from source**	**Date and time**
	ug/m3	**m**	**m**	**m**	**yyyy-mm-dd hh:mm**
1	12.54	709388	4687536	1342	2012-07-04 24:00
2	12.16	709588	4687536	1166	2012-07-04 24:00
3	11.85	709788	4687736	894	2012-07-04 24:00
4	11.79	709588	4687736	1077	2012-07-04 24:00
5	11.68	708988	4687936	1612	2012-04-17 24:00
6	11.43	709588	4687536	1166	2012-05-20 24:00
7	11.39	709788	4687736	894	2012-07-05 24:00
8	11.37	709188	4687336	1612	2012-07-04 24:00
9	11.35	710388	4686936	1217	2012-07-23 24:00
10	11.35	709188	4687936	1414	2012-07-10 24:00
11	11.34	709188	4687936	1414	2012-04-17 24:00
12	11.32	709588	4687536	1166	2012-07-05 24:00
13	11.22	709388	4688136	1200	2012-07-10 24:00
14	11.20	709788	4687536	1000	2012-08-12 24:00
15	11.19	708788	4687936	1811	2012-04-17 24:00
16	11.18	708988	4687936	1612	2012-07-10 24:00
17	11.17	709188	4687536	1523	2012-07-04 24:00

18	11.12	709588	4688136	1000	2012-07-10 24:00
19	11.09	710388	4686736	1414	2012-07-23 24:00
20	11.09	709588	4687736	1077	2012-07-05 24:00
21	11.06	709388	4687536	1342	2012-07-05 24:00
22	11.02	709588	4687336	1281	2012-08-12 24:00
23	11.01	709388	4687536	1342	2012-05-07 24:00
24	10.93	709788	4687536	1000	2012-07-06 24:00
25	10.90	709388	4687936	1217	2012-07-10 24:00
26	10.84	709988	4687136	1166	2012-05-11 24:00
27	10.82	710388	4687136	1020	2012-07-23 24:00
28	10.82	709188	4687336	1612	2012-05-07 24:00
29	10.78	709188	4688136	1400	2012-07-10 24:00
30	10.75	709588	4687936	1020	2012-05-21 24:00
31	10.75	709588	4687536	1166	2012-05-07 24:00
32	10.70	709788	4687736	894	2012-05-20 24:00
33	10.68	711188	4686936	1342	2012-06-04 24:00
34	10.66	708988	4687336	1789	2012-07-04 24:00
35	10.64	709788	4687536	1000	2012-08-16 24:00
36	10.62	709388	4687936	1217	2012-05-21 24:00
37	10.62	709388	4687336	1442	2012-07-04 24:00
38	10.57	709388	4687336	1442	2012-05-20 24:00
39	10.55	709788	4687336	1131	2012-08-12 24:00
40	10.52	708588	4687936	2010	2012-04-17 24:00
41	10.49	709388	4687536	1342	2012-07-03 24:00
42	10.46	708788	4687936	1811	2012-07-10 24:00
43	10.45	709588	4687336	1281	2012-07-06 24:00
44	10.43	710988	4687136	1077	2012-06-04 24:00
45	10.43	709588	4687536	1166	2012-07-03 24:00
46	10.40	709788	4687536	1000	2012-05-19 24:00
47	10.35	710388	4686536	1612	2012-07-23 24:00
48	10.33	709788	4687736	894	2012-06-29 24:00
49	10.33	710988	4687336	894	2012-06-04 24:00
50	10.33	709788	4687736	894	2012-06-08 24:00

Table AII-11. The 50 maximum Month concentration of NO_2.

NO_2 maximum month concentration					
	Concentration	**UTMX**	**UTMY**	**Distance from source**	**Date and time**

	ug/m3	m	m	m	yyyy-mm-dd hh:mm
1	4.71	709788	4687536	1000	2012-08-31 24:00
2	4.49	709588	4687536	1166	2012-08-31 24:00
3	4.41	709988	4687736	721	2012-08-31 24:00
4	4.38	709588	4687336	1281	2012-08-31 24:00
5	4.37	709788	4687736	894	2012-08-31 24:00
6	4.16	709788	4687336	1131	2012-08-31 24:00
7	4.16	709988	4687536	849	2012-08-31 24:00
8	4.09	709388	4687336	1442	2012-08-31 24:00
9	3.92	709588	4687536	1166	2012-05-31 24:00
10	3.89	709788	4687736	894	2012-07-31 24:00
11	3.87	709588	4687736	1077	2012-07-31 24:00
12	3.86	709788	4687536	1000	2012-05-31 24:00
13	3.84	709788	4687736	894	2012-05-31 24:00
14	3.83	709388	4687536	1342	2012-08-31 24:00
15	3.79	709388	4687136	1562	2012-08-31 24:00
16	3.74	709588	4687536	1166	2012-07-31 24:00
17	3.72	709588	4687136	1414	2012-08-31 24:00
18	3.70	709588	4687736	1077	2012-08-31 24:00
19	3.69	709588	4687336	1281	2012-05-31 24:00
20	3.65	709388	4687536	1342	2012-07-31 24:00
21	3.62	709388	4687336	1442	2012-05-31 24:00
22	3.61	709388	4687536	1342	2012-05-31 24:00
23	3.60	709588	4687736	1077	2012-05-31 24:00
24	3.60	709988	4687736	721	2012-05-31 24:00
25	3.58	709188	4687336	1612	2012-08-31 24:00
26	3.58	709188	4687136	1720	2012-08-31 24:00
27	3.56	709388	4687736	1265	2012-07-31 24:00
28	3.50	709788	4687936	825	2012-07-31 24:00
29	3.47	709788	4687536	1000	2012-07-31 24:00
30	3.41	709788	4687336	1131	2012-05-31 24:00
31	3.40	709188	4687536	1523	2012-07-31 24:00
32	3.38	709188	4687336	1612	2012-05-31 24:00
33	3.37	709788	4687736	894	2012-06-30 24:00
34	3.37	709988	4687736	721	2012-07-31 24:00
35	3.35	709588	4687936	1020	2012-07-31 24:00
36	3.35	709988	4687536	849	2012-05-31 24:00
37	3.33	709788	4687736	894	2012-09-30 24:00
38	3.30	709988	4687336	1000	2012-08-31 24:00

39	3.29	709788	4687136	1281	2012-08-31 24:00
40	3.28	709988	4687736	721	2012-06-30 24:00
41	3.28	709388	4687336	1442	2012-07-31 24:00
42	3.27	709388	4687136	1562	2012-05-31 24:00
43	3.25	709188	4686936	1844	2012-08-31 24:00
44	3.24	709788	4687536	1000	2012-06-30 24:00
45	3.24	709388	4686936	1697	2012-08-31 24:00
46	3.23	709188	4687136	1720	2012-05-31 24:00
47	3.22	709988	4687936	632	2012-07-31 24:00
48	3.22	709988	4687736	721	2012-09-30 24:00
49	3.21	709188	4687336	1612	2012-07-31 24:00
50	3.20	709188	4687536	1523	2012-05-31 24:00

Table AII-12. The 10 maximum period concentration of NO_2.

NO_2 summary of maximum period concentration				
	Concentration	**UTMX**	**UTMY**	**Distance from source**
	ug/m3	**m**	**m**	**m**
1	2.02	709788	4687736	894
2	1.99	709588	4687536	1166
3	1.95	709788	4687536	1000
4	1.92	709588	4687736	1077
5	1.88	709988	4687736	721
6	1.86	709388	4687536	1342
7	1.82	709588	4687336	1281
8	1.80	709388	4687336	1442
9	1.74	709788	4687936	825
10	1.74	709388	4687736	1265

Scenario 2

Table AII-13. The 50 maximum 1-hr concentration of CO.

CO maximum 1-hr concentration					
	Concentration	**UTMX**	**UTMY**	**Distance from source**	**Date and time**
	ug/m3	**m**	**m**	**m**	**yyyy-mm-dd hh:mm**
1	9.54	712388	4685536	3162	2012-01-13 10:00
2	9.48	712388	4685336	3329	2012-01-13 10:00
3	9.48	712188	4685736	2884	2012-01-13 10:00
4	9.44	712588	4685336	3441	2012-01-13 10:00
5	9.41	712188	4685536	3053	2012-01-13 10:00
6	9.39	712588	4685136	3606	2012-01-13 10:00
7	9.38	713588	4686936	3231	2012-02-12 12:00
8	9.37	713188	4687136	2786	2012-02-12 12:00
9	9.35	713788	4686936	3418	2012-02-12 12:00
10	9.35	713388	4686936	3046	2012-02-12 12:00
11	9.35	710988	4685336	2828	2012-02-12 08:00
12	9.34	713388	4687136	2973	2012-02-12 12:00
13	9.31	712388	4685736	3000	2012-01-13 10:00
14	9.30	710988	4685136	3027	2012-02-12 08:00
15	9.28	710988	4685536	2631	2012-02-12 08:00
16	9.25	712788	4685136	3720	2012-01-13 10:00
17	9.23	712988	4687136	2600	2012-02-12 12:00
18	9.22	712788	4684936	3883	2012-01-13 10:00
19	9.22	713988	4686936	3606	2012-02-12 12:00
20	9.21	712588	4685536	3280	2012-01-13 10:00
21	9.21	712188	4685936	2720	2012-01-13 10:00
22	9.20	711988	4685936	2608	2012-01-13 10:00
23	9.19	710788	4685536	2608	2012-02-12 08:00
24	9.17	713588	4687136	3162	2012-02-12 12:00
25	9.15	712388	4685136	3499	2012-01-13 10:00
26	9.14	712588	4684936	3774	2012-01-13 10:00
27	9.14	713988	4686736	3677	2012-02-12 12:00
28	9.13	711988	4685736	2778	2012-01-13 10:00
29	9.13	710988	4684936	3225	2012-02-12 08:00
30	9.12	710788	4685336	2807	2012-02-12 08:00
31	9.11	709788	4688936	1131	2012-03-02 06:00
32	9.11	714188	4686736	3863	2012-02-12 12:00

33	9.11	713188	4686936	2864	2012-02-12 12:00
34	9.11	710788	4685736	2408	2012-02-12 08:00
35	9.10	710988	4685736	2433	2012-02-12 08:00
36	9.06	713788	4686736	3493	2012-02-12 12:00
37	9.06	712188	4685336	3225	2012-01-13 10:00
38	9.05	712788	4685336	3561	2012-01-13 10:00
39	9.04	714188	4686936	3795	2012-02-12 12:00
40	9.02	714388	4686736	4050	2012-02-12 12:00
41	8.98	712988	4684936	4000	2012-01-13 10:00
42	8.98	712788	4684736	4050	2012-01-13 10:00
43	8.98	712988	4684736	4162	2012-01-13 10:00
44	8.96	710788	4685136	3007	2012-02-12 08:00
45	8.96	713788	4687136	3353	2012-02-12 12:00
46	8.93	710788	4685936	2209	2012-02-12 08:00
47	8.92	710988	4684736	3423	2012-02-12 08:00
48	8.91	709788	4689136	1281	2012-03-02 06:00
49	8.89	712788	4687136	2417	2012-02-12 12:00
50	8.89	713588	4686736	3311	2012-02-12 12:00

Table AII-14. The 50 maximum 24-hr concentration of CO.

CO maximum 24-hr concentration					
	Concentration	**UTMX**	**UTMY**	**Distance from source**	**Date and time**
	ug/m3	**m**	**m**	**m**	**yyyy-mm-dd hh:mm**
1	2.11	709588	4687336	1281	2012-07-04 24:00
2	2.01	709388	4687136	1562	2012-07-04 24:00
3	1.96	709788	4687136	1281	2012-08-12 24:00
4	1.94	709588	4687336	1281	2012-07-05 24:00
5	1.94	709188	4687136	1720	2012-07-04 24:00
6	1.94	710388	4686536	1612	2012-07-23 24:00
7	1.93	709388	4687336	1442	2012-07-04 24:00
8	1.93	710388	4686736	1414	2012-07-23 24:00
9	1.89	709788	4687336	1131	2012-05-20 24:00
10	1.89	709988	4686936	1342	2012-05-11 24:00
11	1.88	709588	4687136	1414	2012-05-20 24:00
12	1.86	709788	4687336	1131	2012-07-04 24:00
13	1.84	710388	4686336	1811	2012-07-23 24:00
14	1.83	709788	4687336	1131	2012-07-05 24:00

15	1.83	710788	4686736	1414	2012-07-26 24:00
16	1.83	710988	4686936	1265	2012-06-04 24:00
17	1.82	710988	4686736	1456	2012-06-04 24:00
18	1.82	709988	4686736	1523	2012-05-11 24:00
19	1.82	709588	4686936	1562	2012-08-12 24:00
20	1.81	709788	4687136	1281	2012-05-19 24:00
21	1.81	709388	4687136	1562	2012-05-20 24:00
22	1.80	711188	4686536	1709	2012-06-04 24:00
23	1.80	709588	4687136	1414	2012-08-12 24:00
24	1.80	711188	4686736	1523	2012-06-04 24:00
25	1.79	709388	4687736	1265	2012-07-10 24:00
26	1.79	709788	4687136	1281	2012-08-16 24:00
27	1.79	709388	4687536	1342	2012-05-21 24:00
28	1.78	709588	4687336	1281	2012-05-20 24:00
29	1.78	709788	4687336	1131	2012-07-06 24:00
30	1.77	709588	4687136	1414	2012-07-06 24:00
31	1.77	709588	4687136	1414	2012-07-04 24:00
32	1.77	710788	4686536	1612	2012-07-26 24:00
33	1.77	709788	4687136	1281	2012-07-06 24:00
34	1.77	709388	4687136	1562	2012-07-05 24:00
35	1.76	709388	4687136	1562	2012-05-07 24:00
36	1.76	710188	4686336	1844	2012-07-23 24:00
37	1.75	709388	4687336	1442	2012-07-05 24:00
38	1.75	709588	4687736	1077	2012-07-10 24:00
39	1.74	709588	4687336	1281	2012-05-07 24:00
40	1.74	709588	4687336	1281	2012-08-30 24:00
41	1.73	709788	4687336	1131	2012-08-17 24:00
42	1.73	710988	4686536	1649	2012-07-26 24:00
43	1.72	710988	4686336	1844	2012-07-26 24:00
44	1.72	709588	4687336	1281	2012-07-03 24:00
45	1.72	709588	4687336	1281	2012-06-08 24:00
46	1.72	710188	4686136	2040	2012-07-23 24:00
47	1.72	709188	4687536	1523	2012-05-21 24:00
48	1.72	709788	4686736	1612	2012-05-11 24:00
49	1.72	709388	4687136	1562	2012-07-03 24:00
50	1.72	709788	4687336	1131	2012-08-16 24:00

Table AII-15. The 50 maximum Month concentration of CO.

CO maximum month concentration					
	Concentration	**UTMX**	**UTMY**	**Distance from source**	**Date and time**
	ug/m3	**m**	**m**	**m**	**yyyy-mm-dd hh:mm**
1	0.79	709788	4687336	1131	2012-08-31 24:00
2	0.78	709788	4687136	1281	2012-08-31 24:00
3	0.76	709588	4687136	1414	2012-08-31 24:00
4	0.72	709988	4687336	1000	2012-08-31 24:00
5	0.71	709588	4687336	1281	2012-08-31 24:00
6	0.69	709588	4686936	1562	2012-08-31 24:00
7	0.68	709388	4687136	1562	2012-08-31 24:00
8	0.67	709388	4686936	1697	2012-08-31 24:00
9	0.66	709788	4687336	1131	2012-05-31 24:00
10	0.66	709588	4687336	1281	2012-07-31 24:00
11	0.66	709988	4687136	1166	2012-08-31 24:00
12	0.65	709788	4686936	1442	2012-08-31 24:00
13	0.64	709788	4687336	1131	2012-07-31 24:00
14	0.64	709588	4687136	1414	2012-05-31 24:00
15	0.64	709588	4687336	1281	2012-05-31 24:00
16	0.63	709788	4687136	1281	2012-05-31 24:00
17	0.62	709388	4687336	1442	2012-07-31 24:00
18	0.61	709588	4687536	1166	2012-07-31 24:00
19	0.61	709388	4687136	1562	2012-05-31 24:00
20	0.61	709788	4687536	1000	2012-07-31 24:00
21	0.60	709188	4686936	1844	2012-08-31 24:00
22	0.59	709388	4686736	1844	2012-08-31 24:00
23	0.59	709588	4687136	1414	2012-07-31 24:00
24	0.59	709388	4687136	1562	2012-07-31 24:00
25	0.58	709388	4687336	1442	2012-08-31 24:00
26	0.58	709788	4687336	1131	2012-06-30 24:00
27	0.58	709988	4687536	849	2012-08-31 24:00
28	0.58	709788	4687536	1000	2012-08-31 24:00
29	0.57	709588	4686936	1562	2012-05-31 24:00
30	0.57	709388	4686936	1697	2012-05-31 24:00
31	0.57	709388	4687336	1442	2012-05-31 24:00
32	0.57	709588	4686736	1720	2012-08-31 24:00
33	0.57	709188	4687136	1720	2012-08-31 24:00
34	0.57	709188	4686736	1980	2012-08-31 24:00

35	0.57	709988	4687336	1000	2012-05-31 24:00
36	0.56	709788	4687336	1131	2012-09-30 24:00
37	0.56	709388	4687536	1342	2012-07-31 24:00
38	0.55	709188	4687336	1612	2012-07-31 24:00
39	0.55	709188	4687136	1720	2012-07-31 24:00
40	0.55	709788	4687536	1000	2012-05-31 24:00
41	0.54	709788	4687136	1281	2012-07-31 24:00
42	0.54	709188	4687136	1720	2012-05-31 24:00
43	0.54	709588	4687336	1281	2012-06-30 24:00
44	0.54	709188	4686936	1844	2012-05-31 24:00
45	0.54	709788	4687536	1000	2012-09-30 24:00
46	0.54	709988	4687536	849	2012-09-30 24:00
47	0.54	709988	4687336	1000	2012-06-30 24:00
48	0.54	709588	4687336	1281	2012-09-30 24:00
49	0.54	709588	4687536	1166	2012-05-31 24:00
50	0.53	709988	4687336	1000	2012-09-30 24:00

Table AII-15. The 10 maximum period concentration of CO.

CO summary of maximum period concentration				
	Concentration	**UTMX**	**UTMY**	**Distance from source**
	ug/m3	**m**	**m**	**m**
1	0.34	709788	4687336	1131
2	0.33	709588	4687336	1281
3	0.32	709588	4687136	1414
4	0.31	709788	4687136	1281
5	0.31	709388	4687136	1562
6	0.31	709388	4687336	1442
7	0.30	709788	4687536	1000
8	0.30	709588	4687536	1166
9	0.30	709988	4687336	1000
10	0.28	709388	4686936	1697

Table AII-16. The 50 maximum 1-hr concentration of NO.

NO maximum 1-hr concentration					
	Concentration	**UTMX**	**UTMY**	**Distance from source**	**Date and time**
	ug/m3	**m**	**m**	**m**	**yyyy-mm-dd hh:mm**
1	22.16	713788	4686936	3418	2012-02-12 12:00
2	22.15	713388	4687136	2973	2012-02-12 12:00
3	22.15	713188	4687136	2786	2012-02-12 12:00
4	22.15	713588	4686936	3231	2012-02-12 12:00
5	21.99	713388	4686936	3046	2012-02-12 12:00
6	21.89	713988	4686936	3606	2012-02-12 12:00
7	21.85	713588	4687136	3162	2012-02-12 12:00
8	21.81	712388	4685536	3162	2012-01-13 10:00
9	21.73	712988	4687136	2600	2012-02-12 12:00
10	21.69	712588	4685336	3441	2012-01-13 10:00
11	21.69	712388	4685336	3329	2012-01-13 10:00
12	21.61	712588	4685136	3606	2012-01-13 10:00
13	21.56	714188	4686736	3863	2012-02-12 12:00
14	21.56	713988	4686736	3677	2012-02-12 12:00
15	21.53	712188	4685736	2884	2012-01-13 10:00
16	21.51	710988	4685336	2828	2012-02-12 08:00
17	21.51	714188	4686936	3795	2012-02-12 12:00
18	21.47	710988	4685136	3027	2012-02-12 08:00
19	21.41	712188	4685536	3053	2012-01-13 10:00
20	21.38	713788	4687136	3353	2012-02-12 12:00
21	21.37	714388	4686736	4050	2012-02-12 12:00
22	21.36	712788	4685136	3720	2012-01-13 10:00
23	21.34	713188	4686936	2864	2012-02-12 12:00
24	21.32	713788	4686736	3493	2012-02-12 12:00
25	21.30	710988	4685536	2631	2012-02-12 08:00
26	21.29	712788	4684936	3883	2012-01-13 10:00
27	21.26	712388	4685736	3000	2012-01-13 10:00
28	21.18	709788	4688936	1131	2012-03-02 06:00
29	21.16	712588	4685536	3280	2012-01-13 10:00
30	21.12	710988	4684936	3225	2012-02-12 08:00
31	21.05	710788	4685536	2608	2012-02-12 08:00
32	21.04	712588	4684936	3774	2012-01-13 10:00
33	21.03	714588	4686736	4238	2012-02-12 12:00
34	20.98	712388	4685136	3499	2012-01-13 10:00

35	20.97	710788	4685336	2807	2012-02-12 08:00
36	20.96	714388	4686936	3985	2012-02-12 12:00
37	20.91	709788	4689136	1281	2012-03-02 06:00
38	20.88	712188	4685936	2720	2012-01-13 10:00
39	20.87	712788	4685336	3561	2012-01-13 10:00
40	20.83	713588	4686736	3311	2012-02-12 12:00
41	20.82	713988	4687136	3544	2012-02-12 12:00
42	20.82	712988	4687336	2530	2012-02-12 12:00
43	20.82	712988	4684936	4000	2012-01-13 10:00
44	20.81	712988	4684736	4162	2012-01-13 10:00
45	20.81	712788	4687136	2417	2012-02-12 12:00
46	20.80	710988	4685736	2433	2012-02-12 08:00
47	20.78	710788	4685736	2408	2012-02-12 08:00
48	20.76	711988	4685936	2608	2012-01-13 10:00
49	20.76	712788	4684736	4050	2012-01-13 10:00
50	20.71	713188	4687336	2720	2012-02-12 12:00

Table AII-17. The 50 maximum 24-hr concentration of NO.

NO maximum 24-hr concentration					
	Concentration	**UTMX**	**UTMY**	**Distance from source**	**Date and time**
	ug/m3	**m**	**m**	**m**	**yyyy-mm-dd hh:mm**
1	4.81	709588	4687336	1281	2012-07-04 24:00
2	4.56	709388	4687136	1562	2012-07-04 24:00
3	4.48	710388	4686536	1612	2012-07-23 24:00
4	4.48	709388	4687336	1442	2012-07-04 24:00
5	4.47	709188	4687136	1720	2012-07-04 24:00
6	4.47	709788	4687136	1281	2012-08-12 24:00
7	4.45	710388	4686736	1414	2012-07-23 24:00
8	4.44	709588	4687336	1281	2012-07-05 24:00
9	4.37	709988	4686936	1342	2012-05-11 24:00
10	4.28	709788	4687336	1131	2012-05-20 24:00
11	4.26	709588	4687136	1414	2012-05-20 24:00
12	4.24	710388	4686336	1811	2012-07-23 24:00
13	4.20	710788	4686736	1414	2012-07-26 24:00
14	4.20	709988	4686736	1523	2012-05-11 24:00
15	4.19	710988	4686936	1265	2012-06-04 24:00
16	4.17	709588	4687136	1414	2012-08-12 24:00

17	4.17	710988	4686736	1456	2012-06-04 24:00
18	4.17	709388	4687136	1562	2012-05-20 24:00
19	4.16	711188	4686736	1523	2012-06-04 24:00
20	4.16	711188	4686536	1709	2012-06-04 24:00
21	4.16	709588	4686936	1562	2012-08-12 24:00
22	4.15	709788	4687336	1131	2012-07-04 24:00
23	4.12	709788	4687136	1281	2012-05-19 24:00
24	4.12	709788	4687336	1131	2012-07-05 24:00
25	4.12	709588	4687336	1281	2012-05-20 24:00
26	4.08	709788	4687336	1131	2012-07-06 24:00
27	4.07	709588	4687136	1414	2012-07-06 24:00
28	4.07	709388	4687336	1442	2012-07-05 24:00
29	4.07	710188	4686336	1844	2012-07-23 24:00
30	4.06	709388	4687736	1265	2012-07-10 24:00
31	4.06	710788	4686536	1612	2012-07-26 24:00
32	4.06	709788	4687136	1281	2012-08-16 24:00
33	4.04	709388	4687536	1342	2012-05-21 24:00
34	4.03	709388	4687136	1562	2012-07-05 24:00
35	4.01	709388	4687136	1562	2012-05-07 24:00
36	4.00	710988	4686536	1649	2012-07-26 24:00
37	3.99	709788	4687136	1281	2012-07-06 24:00
38	3.99	710988	4686336	1844	2012-07-26 24:00
39	3.99	710188	4686136	2040	2012-07-23 24:00
40	3.99	709588	4687336	1281	2012-05-07 24:00
41	3.98	709788	4686736	1612	2012-05-11 24:00
42	3.97	710188	4686536	1649	2012-07-23 24:00
43	3.97	709588	4687336	1281	2012-08-30 24:00
44	3.96	709588	4687136	1414	2012-07-04 24:00
45	3.96	709788	4687336	1131	2012-08-16 24:00
46	3.96	709588	4687336	1281	2012-07-03 24:00
47	3.95	708988	4687136	1887	2012-07-04 24:00
48	3.94	709588	4687136	1414	2012-08-16 24:00
49	3.94	709788	4687336	1131	2012-08-17 24:00
50	3.93	709588	4687336	1281	2012-06-08 24:00

Table AII-18. The 50 maximum Month concentration of NO.

NO maximum month concentration					
	Concentration	UTMX	UTMY	Distance from source	Date and time
	ug/m3	m	m	m	yyyy-mm-dd hh:mm
1	1.83	709788	4687336	1131	2012-08-31 24:00
2	1.77	709788	4687136	1281	2012-08-31 24:00
3	1.76	709588	4687136	1414	2012-08-31 24:00
4	1.65	709588	4687336	1281	2012-08-31 24:00
5	1.65	709988	4687336	1000	2012-08-31 24:00
6	1.58	709588	4686936	1562	2012-08-31 24:00
7	1.57	709388	4687136	1562	2012-08-31 24:00
8	1.54	709388	4686936	1697	2012-08-31 24:00
9	1.52	709788	4687336	1131	2012-05-31 24:00
10	1.52	709588	4687336	1281	2012-07-31 24:00
11	1.49	709988	4687136	1166	2012-08-31 24:00
12	1.48	709588	4687336	1281	2012-05-31 24:00
13	1.48	709588	4687136	1414	2012-05-31 24:00
14	1.47	709788	4687336	1131	2012-07-31 24:00
15	1.47	709788	4686936	1442	2012-08-31 24:00
16	1.43	709788	4687136	1281	2012-05-31 24:00
17	1.42	709388	4687336	1442	2012-07-31 24:00
18	1.42	709588	4687536	1166	2012-07-31 24:00
19	1.40	709388	4687136	1562	2012-05-31 24:00
20	1.40	709788	4687536	1000	2012-07-31 24:00
21	1.40	709188	4686936	1844	2012-08-31 24:00
22	1.37	709388	4687336	1442	2012-08-31 24:00
23	1.36	709788	4687536	1000	2012-08-31 24:00
24	1.36	709388	4686736	1844	2012-08-31 24:00
25	1.35	709388	4687136	1562	2012-07-31 24:00
26	1.35	709588	4687136	1414	2012-07-31 24:00
27	1.34	709988	4687536	849	2012-08-31 24:00
28	1.34	709788	4687336	1131	2012-06-30 24:00
29	1.34	709388	4687336	1442	2012-05-31 24:00
30	1.33	709188	4687136	1720	2012-08-31 24:00
31	1.32	709388	4686936	1697	2012-05-31 24:00
32	1.32	709588	4686936	1562	2012-05-31 24:00
33	1.31	709188	4686736	1980	2012-08-31 24:00
34	1.31	709388	4687536	1342	2012-07-31 24:00

35	1.30	709588	4686736	1720	2012-08-31 24:00
36	1.29	709788	4687336	1131	2012-09-30 24:00
37	1.29	709988	4687336	1000	2012-05-31 24:00
38	1.29	709188	4687336	1612	2012-07-31 24:00
39	1.28	709788	4687536	1000	2012-05-31 24:00
40	1.28	709188	4687136	1720	2012-07-31 24:00
41	1.26	709188	4687136	1720	2012-05-31 24:00
42	1.26	709588	4687536	1166	2012-05-31 24:00
43	1.25	709588	4687336	1281	2012-06-30 24:00
44	1.25	709188	4686936	1844	2012-05-31 24:00
45	1.25	709788	4687536	1000	2012-09-30 24:00
46	1.24	709788	4687136	1281	2012-07-31 24:00
47	1.24	709588	4687336	1281	2012-09-30 24:00
48	1.24	709988	4687536	849	2012-09-30 24:00
49	1.23	709988	4687336	1000	2012-06-30 24:00
50	1.21	709988	4687336	1000	2012-09-30 24:00

Table AII-19. The 10 maximum period concentration of NO.

NO summary of maximum period concentration				
	Concentration	**UTMX**	**UTMY**	**Distance from source**
	ug/m3	**m**	**m**	**m**
1	0.78	709788	4687336	1131
2	0.77	709588	4687336	1281
3	0.74	709588	4687136	1414
4	0.71	709388	4687136	1562
5	0.71	709788	4687136	1281
6	0.71	709388	4687336	1442
7	0.70	709788	4687536	1000
8	0.69	709588	4687536	1166
9	0.67	709988	4687336	1000
10	0.66	709188	4687136	1720

Table AII-20. The 50 maximum 1-hr concentration of NO_2.

NO_2 maximum 1-hr concentration					
	Concentration	**UTMX**	**UTMY**	**Distance from source**	**Date and time**
	ug/m3	**m**	**m**	**m**	**yyyy-mm-dd hh:mm**
1	55.91	713588	4687136	3162	2012-02-12 12:00
2	55.62	713388	4687136	2973	2012-02-12 12:00
3	55.53	713788	4687136	3353	2012-02-12 12:00
4	55.25	713988	4686936	3606	2012-02-12 12:00
5	55.13	713788	4686936	3418	2012-02-12 12:00
6	54.94	714188	4686936	3795	2012-02-12 12:00
7	54.71	713988	4687136	3544	2012-02-12 12:00
8	54.43	713188	4687136	2786	2012-02-12 12:00
9	54.19	713188	4687336	2720	2012-02-12 12:00
10	54.08	713588	4686936	3231	2012-02-12 12:00
11	54.00	714388	4686936	3985	2012-02-12 12:00
12	53.95	713388	4687336	2912	2012-02-12 12:00
13	53.43	712988	4687336	2530	2012-02-12 12:00
14	53.40	714188	4687136	3736	2012-02-12 12:00
15	53.28	714388	4686736	4050	2012-02-12 12:00
16	53.27	713588	4687336	3105	2012-02-12 12:00
17	53.16	714188	4686736	3863	2012-02-12 12:00
18	52.87	714588	4686736	4238	2012-02-12 12:00
19	52.79	714588	4686936	4176	2012-02-12 12:00
20	52.46	713388	4686936	3046	2012-02-12 12:00
21	52.41	713988	4686736	3677	2012-02-12 12:00
22	52.24	714788	4686736	4427	2012-02-12 12:00
23	52.02	712988	4687136	2600	2012-02-12 12:00
24	51.96	713788	4687336	3298	2012-02-12 12:00
25	51.83	714388	4687136	3929	2012-02-12 12:00
26	51.49	714788	4686936	4368	2012-02-12 12:00
27	51.32	714988	4686736	4617	2012-02-12 12:00
28	51.16	712788	4687336	2341	2012-02-12 12:00
29	50.92	713788	4686736	3493	2012-02-12 12:00
30	50.65	714788	4686536	4494	2012-02-12 12:00
31	50.50	714588	4686536	4308	2012-02-12 12:00
32	50.45	714988	4686536	4682	2012-02-12 12:00
33	50.44	713988	4687336	3493	2012-02-12 12:00
34	50.17	715188	4686736	4808	2012-02-12 12:00

35	50.07	714588	4687136	4123	2012-02-12 12:00
36	50.02	715188	4686536	4870	2012-02-12 12:00
37	49.95	714988	4686936	4561	2012-02-12 12:00
38	49.86	714388	4686536	4123	2012-02-12 12:00
39	49.55	713188	4686936	2864	2012-02-12 12:00
40	49.30	709788	4689136	1281	2012-03-02 06:00
41	49.26	715388	4686536	5060	2012-02-12 12:00
42	49.02	709588	4689336	1562	2012-03-02 06:00
43	48.84	715388	4686736	5000	2012-02-12 12:00
44	48.83	709788	4689336	1442	2012-03-02 06:00
45	48.73	714188	4686536	3940	2012-02-12 12:00
46	48.72	713588	4686736	3311	2012-02-12 12:00
47	48.66	714188	4687336	3688	2012-02-12 12:00
48	48.59	712988	4687536	2474	2012-02-12 12:00
49	48.38	713188	4687536	2668	2012-02-12 12:00
50	48.32	715188	4686936	4754	2012-02-12 12:00

Table AII-21. The 50 maximum 24-hr concentration of NO_2.

NO_2 maximum 24-hr concentration					
	Concentration	**UTMX**	**UTMY**	**Distance from source**	**Date and time**
	ug/m3	**m**	**m**	**m**	**yyyy-mm-dd hh:mm**
1	9.83	709388	4687336	1442	2012-07-04 24:00
2	9.44	710388	4686736	1414	2012-07-23 24:00
3	9.42	710388	4686536	1612	2012-07-23 24:00
4	9.35	709188	4687336	1612	2012-07-04 24:00
5	9.30	709988	4686936	1342	2012-05-11 24:00
6	9.19	709188	4687136	1720	2012-07-04 24:00
7	9.13	709588	4687336	1281	2012-07-04 24:00
8	8.96	709588	4687136	1414	2012-08-12 24:00
9	8.94	711188	4686736	1523	2012-06-04 24:00
10	8.94	710388	4686336	1811	2012-07-23 24:00
11	8.94	708988	4687136	1887	2012-07-04 24:00
12	8.91	709388	4687336	1442	2012-07-05 24:00
13	8.83	710188	4686336	1844	2012-07-23 24:00
14	8.82	709588	4687336	1281	2012-05-20 24:00
15	8.74	709588	4687336	1281	2012-07-05 24:00
16	8.71	711188	4686536	1709	2012-06-04 24:00

17	8.70	709988	4686736	1523	2012-05-11 24:00
18	8.70	710188	4686536	1649	2012-07-23 24:00
19	8.66	709788	4686736	1612	2012-05-11 24:00
20	8.65	710988	4686536	1649	2012-07-26 24:00
21	8.64	709588	4687536	1166	2012-07-04 24:00
22	8.62	710188	4686136	2040	2012-07-23 24:00
23	8.59	709588	4687536	1166	2012-07-05 24:00
24	8.58	709788	4687336	1131	2012-08-12 24:00
25	8.58	709388	4687136	1562	2012-05-20 24:00
26	8.55	710788	4686736	1414	2012-07-26 24:00
27	8.54	710988	4686336	1844	2012-07-26 24:00
28	8.51	709788	4687136	1281	2012-08-12 24:00
29	8.50	710988	4686936	1265	2012-06-04 24:00
30	8.44	710388	4686936	1217	2012-07-23 24:00
31	8.42	709388	4687136	1562	2012-07-04 24:00
32	8.41	709388	4687336	1442	2012-05-07 24:00
33	8.41	709788	4687336	1131	2012-07-06 24:00
34	8.41	709588	4687336	1281	2012-07-06 24:00
35	8.39	709388	4687336	1442	2012-07-03 24:00
36	8.37	709588	4687136	1414	2012-07-06 24:00
37	8.36	709388	4686936	1697	2012-08-12 24:00
38	8.34	709788	4687336	1131	2012-08-16 24:00
39	8.33	709388	4687336	1442	2012-05-20 24:00
40	8.33	709988	4687136	1166	2012-05-11 24:00
41	8.29	710388	4686136	2010	2012-07-23 24:00
42	8.29	709188	4687136	1720	2012-05-20 24:00
43	8.28	709188	4687336	1612	2012-07-05 24:00
44	8.27	709788	4686936	1442	2012-05-11 24:00
45	8.26	710788	4686536	1612	2012-07-26 24:00
46	8.26	709588	4687136	1414	2012-08-16 24:00
47	8.25	710988	4686736	1456	2012-06-04 24:00
48	8.24	709588	4687136	1414	2012-05-19 24:00
49	8.22	709188	4687136	1720	2012-05-07 24:00
50	8.21	709388	4687536	1342	2012-07-04 24:00

Table AII-22. The 50 maximum Month concentration of NO_2.

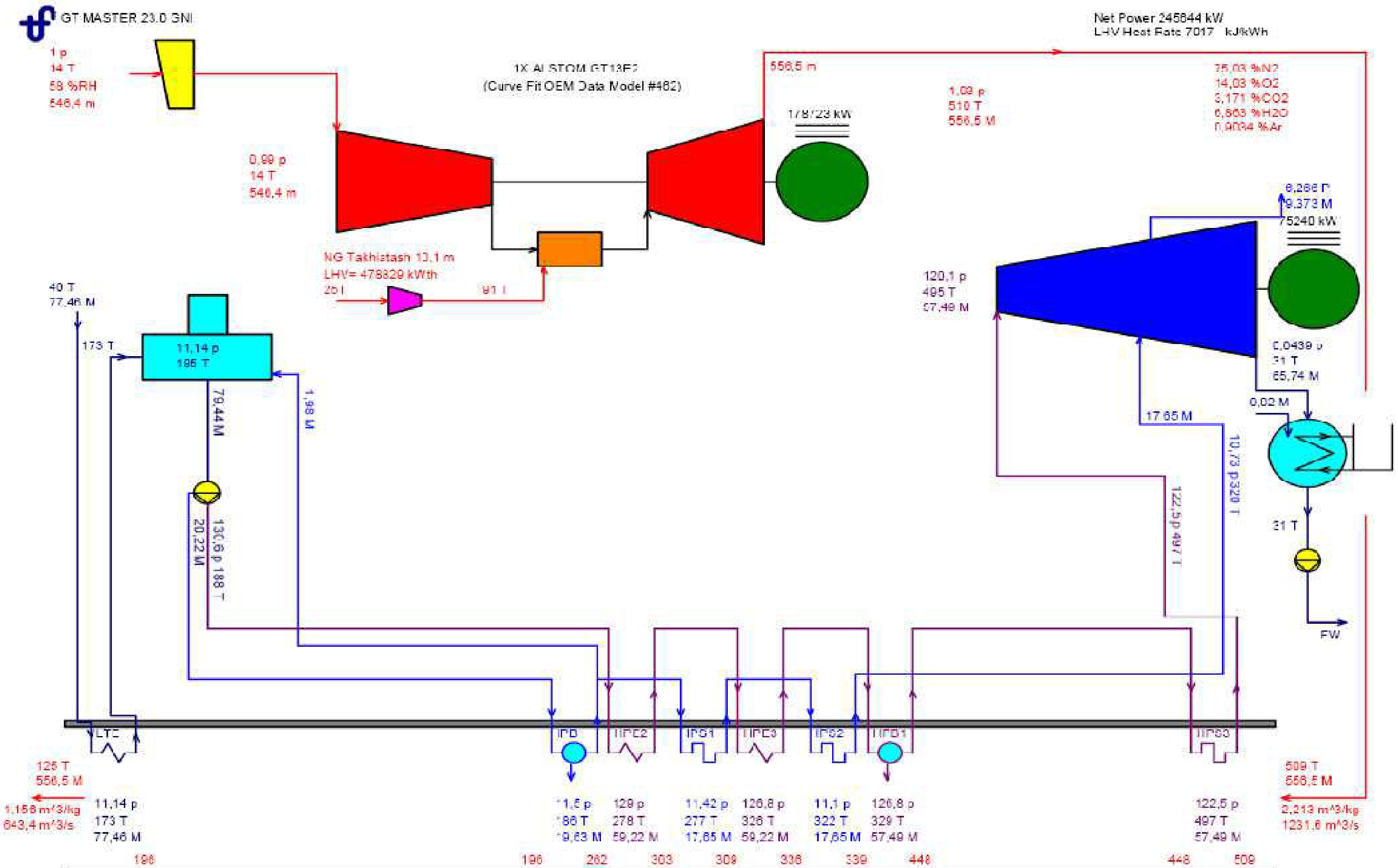
NO_2 maximum month concentration					
	Concentration	**UTMX**	**UTMY**	**Distance from source**	**Date and time**
	ug/m3	**m**	**m**	**m**	**yyyy-mm-dd hh:mm**
1	3.79	709788	4687336	1131	2012-08-31 24:00
2	3.72	709588	4687336	1281	2012-08-31 24:00
3	3.63	709588	4687136	1414	2012-08-31 24:00
4	3.47	709388	4687136	1562	2012-08-31 24:00
5	3.44	709788	4687136	1281	2012-08-31 24:00
6	3.31	709788	4687536	1000	2012-08-31 24:00
7	3.30	709388	4687336	1442	2012-08-31 24:00
8	3.22	709388	4686936	1697	2012-08-31 24:00
9	3.21	709588	4687336	1281	2012-05-31 24:00
10	3.16	709588	4687536	1166	2012-07-31 24:00
11	3.16	709988	4687336	1000	2012-08-31 24:00
12	3.15	709588	4686936	1562	2012-08-31 24:00
13	3.12	709588	4687536	1166	2012-08-31 24:00
14	3.11	709188	4687136	1720	2012-08-31 24:00
15	3.11	709588	4687336	1281	2012-07-31 24:00
16	3.10	709788	4687336	1131	2012-05-31 24:00
17	3.07	709188	4686936	1844	2012-08-31 24:00
18	3.07	709388	4687336	1442	2012-07-31 24:00
19	3.03	709588	4687136	1414	2012-05-31 24:00
20	3.03	709388	4687336	1442	2012-05-31 24:00
21	3.02	709388	4687536	1342	2012-07-31 24:00
22	3.02	709388	4687136	1562	2012-05-31 24:00
23	2.97	709788	4687536	1000	2012-07-31 24:00
24	2.97	709988	4687536	849	2012-08-31 24:00
25	2.94	709588	4687536	1166	2012-05-31 24:00
26	2.88	709188	4687336	1612	2012-07-31 24:00
27	2.88	709788	4687536	1000	2012-05-31 24:00
28	2.87	709788	4687336	1131	2012-07-31 24:00
29	2.83	709188	4687136	1720	2012-05-31 24:00
30	2.81	709788	4686936	1442	2012-08-31 24:00
31	2.81	709788	4687136	1281	2012-05-31 24:00
32	2.80	709188	4687336	1612	2012-08-31 24:00
33	2.79	709188	4686736	1980	2012-08-31 24:00
34	2.78	708988	4686936	2000	2012-08-31 24:00

35	2.77	709388	4686736	1844	2012-08-31 24:00
36	2.77	709588	4687736	1077	2012-07-31 24:00
37	2.77	709988	4687136	1166	2012-08-31 24:00
38	2.76	709188	4687536	1523	2012-07-31 24:00
39	2.76	709388	4687136	1562	2012-07-31 24:00
40	2.74	709388	4686936	1697	2012-05-31 24:00
41	2.74	709188	4687336	1612	2012-05-31 24:00
42	2.73	709788	4687336	1131	2012-06-30 24:00
43	2.72	709388	4687536	1342	2012-05-31 24:00
44	2.72	709188	4687136	1720	2012-07-31 24:00
45	2.70	709788	4687536	1000	2012-09-30 24:00
46	2.70	709588	4687336	1281	2012-06-30 24:00
47	2.69	709788	4687536	1000	2012-06-30 24:00
48	2.69	709188	4686936	1844	2012-05-31 24:00
49	2.67	708988	4687136	1887	2012-08-31 24:00
50	2.67	708988	4686736	2126	2012-08-31 24:00

Table AII-23. The 10 maximum period concentration of NO_2.

NO_2 summary of maximum period concentration				
	Concentration	**UTMX**	**UTMY**	**Distance from source**
	ug/m3	**m**	**m**	**m**
1	1.63	709588	4687336	1281
2	1.57	709788	4687336	1131
3	1.57	709588	4687536	1166
4	1.56	709388	4687336	1442
5	1.54	709788	4687536	1000
6	1.50	709388	4687136	1562
7	1.50	709588	4687136	1414
8	1.48	709388	4687536	1342
9	1.45	709188	4687336	1612
10	1.44	709188	4687136	1720

Appendix 3: Thermoflow results



p[bar], T[C], M[kg/s], Steam Properties: IFC-67

540 05-22-2013 10:50:24 file=D:\TAKIATASH\Modelos\Nuevo CC\Interim Report\Alstom\THTM\Altura chimenea 112.5 m\Diseño Media Anual GTM

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[2]											
	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 ^{o}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

[2] 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^{0}C 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		
γ - HCH		not detected	Complying	-
DDE	DDT and its metabolites Σ=0.5 mg/kg	0.005		
DDD		not detected	Complying	-
DDT		Trace		
№2 α - HCH	Σ=0.1 mg/kg	not detected		
γ - HCH		not detected	Complying	-
DDE	DDT and its metabolites Σ=0.5 mg/kg	not detected		
DDD		not detected	Complying	-
DDT		not detected		
№3 α - HCH	Σ=0.1 mg/kg	not detected		
γ - HCH		not detected	Complying	-
DDE	DDT and its metabolites Σ=0.5 mg/kg	not detected		
DDD		not detected	Complying	-
DDT		not detected		
№4 α - HCH	Σ=0.1 mg/kg	not detected		
γ - HCH		not detected	Complying	-
DDE	DDT and its metabolites Σ=0.5 mg/kg	not detected		
DDD		not detected	Complying	-
DDT		not detected		
№5 α - HCH	Σ=0.1 mg/kg	not detected		
γ - HCH		not detected	Complying	-
DDE	DDT and its metabolites Σ=0.5 mg/kg	not detected		
DDD		not detected	Complying	-
DDT		not detected		
№6 - HCH	Σ=0.1 mg/kg	not detected		
γ - HCH		not detected	Complying	-
DDE	DDT and its metabolites Σ=0.5 mg/kg	not detected		
DDD		not detected	Complying	-
DDT		not detected		
№7 α - HCH	Σ=0.1 mg/kg	not detected		
γ - HCH		not detected	Complying	-
DDE	DDT and its metabolites Σ=0.5 mg/kg	not detected		
DDD		not detected	Complying	-
DDT		not detected		
№8 α - HCH	Σ=0.1 mg/kg	not detected		
γ - HCH		not detected	Complying	-
DDE	DDT and its metabolites Σ=0.5 mg/kg	not detected		
DDD		not detected	Complying	-
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

Name of parameters (requirements)	Value of parameters (requirements)		Compliance with parameters (requirements)
	by Regulatory documentation	Actual	
Cd	-	0.616	-
Cu	3.0	15.584	Not complying
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

Name of parameters (requirements)		Value of parameters (requirements)		Compliance with parameters (requirements)
		by Regulatory documentation	Actual	
	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
	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	-

Name of parameters (requirements)	Value of parameters (requirements) by Regulatory documentation	Actual	Compliance of parameters with (requirements)
Sample No9 dry residue %	-	3.55	-
moisture %		21.1	
pH	-	6.15	-
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[3] 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:

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

[3] *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).

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
(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
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
	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

ORGANOCHLORINE PESTICIDES			
Sample Number	**Contaminant**	**Concentration (mg/kg)**	**Reference standard maximum value (mg/kg)**
	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
	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

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
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

METALS			
Sample Number	**Contaminant**	**Concentration (mg/kg)**	**Reference standard maximum value (mg/kg)**
	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
	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

METALS			
Sample Number	**Contaminant**	**Concentration (mg/kg)**	**Reference standard maximum value (mg/kg)**
	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
	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

METALS			
Sample Number	**Contaminant**	**Concentration (mg/kg)**	**Reference standard maximum value (mg/kg)**
	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
	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

METALS			
Sample Number	**Contaminant**	**Concentration (mg/kg)**	**Reference standard maximum value (mg/kg)**
	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. INFORMATION DISCLOSURE AND PUBLIC CONSULTATION. GRIEVANCE MECHANISM

Appendix 1: Information letters from the Takhiatash TPP of the three Public Consultations

"O'ZBEKENERGO"
DAVLAT-AKSIYADORLIK
KOMPANIYASI
"TAXIYATOSH ISSIQLIK ELEKTR
STANSIYASI"
OCHIQ AKSIYADORLIK JAMIYATI
"TAXIYATOSH IES" O.A.J.
«25» 04 2013 yil
№ 26-29-708

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
"TAXIYATOSH ISSIQLIK ELEKTR
STANSIYASI"
OCHIQ AKSIYADORLIK JAMIYATI
"TAXIYATOSH IES" O.A.J.

09. 04 20 13 yil
№ 26-29-575

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
"TAXIYATOSH 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**

"O'ZBEKENERGO"
DAVLAT-AKSIYADORLIK
KOMPANIYASI
"TAXIATOSH ISSIQLIK ELEKTR
STANSIYASI"
OCHIQ AKSIYADORLIK JAMIYATI
TAXIATOSH IES OAJ
04. 07. 2013 yil
№ 26-29-1199

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

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 двух парогазовых установок мощностью 230-250 МВт на Тахиаташской ТЭС» и привлечением инвестиционных средств Азиатского Банка Развития. В рамках подготовки экологического компонента проекта планируется проведение 3-го раунда общественных слушаний с привлечением всех заинтересованных сторон. На слушаниях будут представлены основные результаты проведенной экологической оценки воздейсвия проекта «Строительство двух парогазовых установок мощностью 230-250 МВт на Тахиаташской ТЭС» на окружающую среду. Проведение общественных слушаний запланировано на 8 июля 2013 в 11 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
"TAXIATOSH IES" OAJ
04. 07 20 13 y.
№ 26-29-1198

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 двух парогазовых установок мощностью 230-250 МВт на Тахиаташской ТЭС» и привлечением инвестиционных средств Азиатского Банка Развития.

В рамках подготовки экологического компонента проекта планируется проведение 3-го раунда общественных слушаний с привлечением всех заинтересованных сторон. На слушаниях будут представлены основные результаты проведенной экологической оценки воздейсвия проекта «Строительство двух парогазовых установок мощностью 230-250 МВт на Тахиаташской ТЭС» на окружающую среду. Проведение слушаний запланировано на 8 июля 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 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, 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.

деп пәтия етеди.

Қарақалпақстанның арқасында жасап хәм мийнет етип атырған шымбайлы қарақалпақ, өзбек, түркмен, қазақ, қырғыз, рус, кореец, грек миллетиндегилер өз-ара қуда-қудағай болып, бири-бирин бауырлап, дослық

зентим, деп тән алып, нан-дуз берген, оқытып-тәрбиялап камалатқа жеткерип, мийрим-шәпәәт берген пейили кен, кутлы мәкан өзбек хәм қарақалпақ халқының алдында басымызды ийип, тәжим етемиз!

Хәр қандай миллет, халықты Ўатан

ДАҒАЗА

Өзбекстан Республикасы Президентиниң 15.12.2010-жылдағы №ПП 1442 «2011-2015-жылларда Өзбекстан Республикасы санаатын раўажландырыў үстинлиги» қарарына муўапық «Өзбекэнерго» мәмлекетлик акционерлик компаниясы «Тақыятас ЖЭС ында 230-250 МВт қуўатлықтағы пуўгаз үскенелери қурылысы» инвестициялық жойбары хәм Азия Раўажланыў Банкиниң инвестицияларын тартыў әмелге асырылмақта. Экологиялық баҳалаў шегинде хәмме 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 хәмме қызығыўшы ағзалар қатнасыўына мирәт етиледи.

«Тақыятас ЖЭС» ААЖ басқармасы.

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


Еркин Қарақалпақстан

Елдиң бирлиги ҳәм абаданлығы ушын!

№51 (19357) 27-АПРЕЛЬ 2013-ЖЫЛ ШЕМБИ

ЕКИНШИ ЖЕР ЖҮЗИЛИК УРЫС ҚАТНАСЫЎШЫЛАРЫН ХОШАМЕТЛЕЎ ҲАҚҚЫНДА

ӨЗБЕКСТАН РЕСПУБЛИКАСЫ ПРЕЗИДЕНТИНИҢ ПӘРМАНЫ

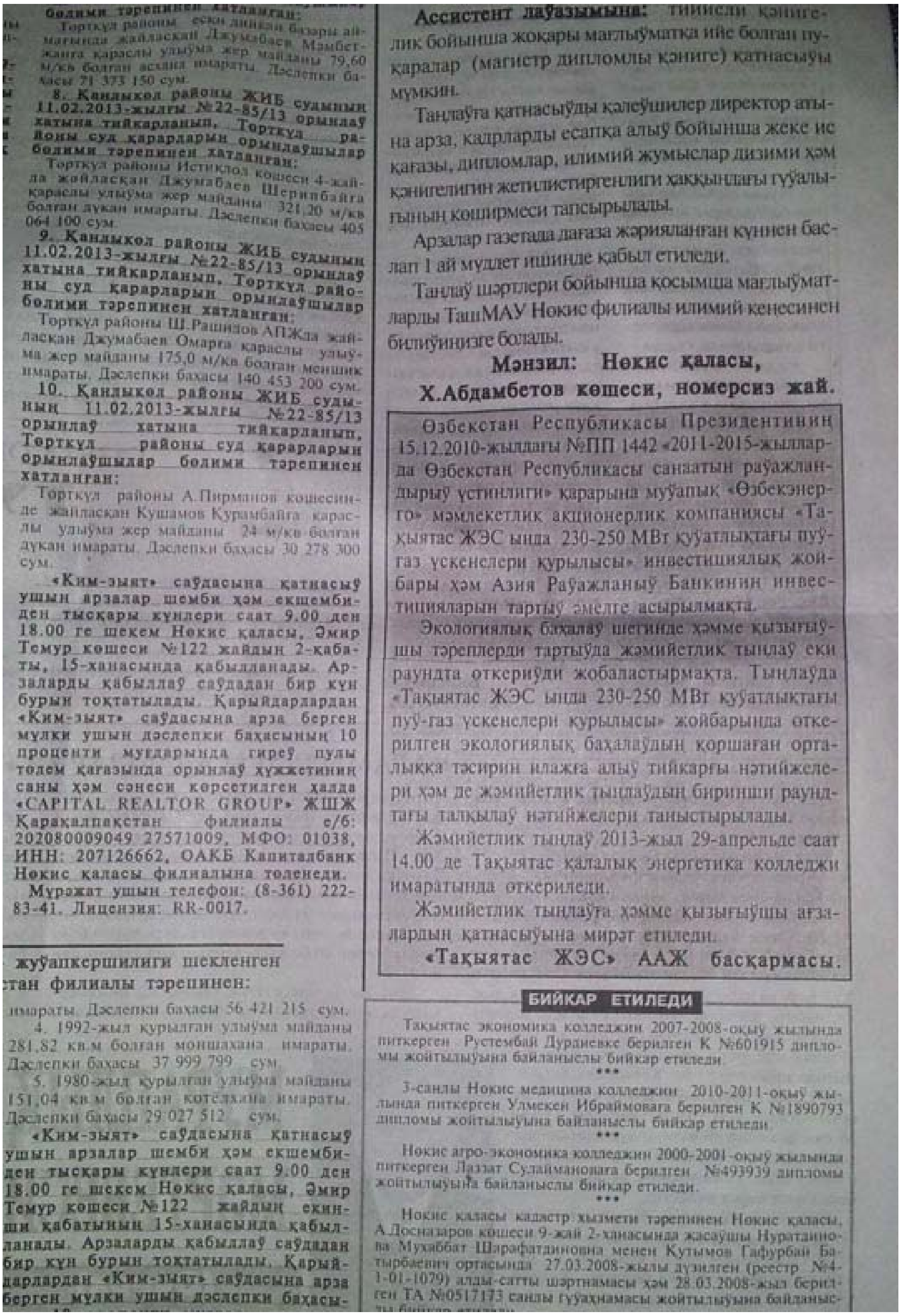
Өзбекстан Республикасы Президенти И.КАРИМОВ

«9-МАЙ — ЕСЛЕЎ ҲӘМ ҚӘДИРЛЕЎ КҮНИ» АЛДЫНАН

«ҲӘСИРЕТЛИ АНА»НЫҢ ҚОНЫСЫ ЖАҢАЛАНБАҚТА

САЛАМАТ ӘЎЛАД — МИЛЛЕТТИҢ КЕЛЕШЕГИ

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



бөлими тәрепинен хатланган:

Төрткүл районы ескн дийхан базары аймағында жайласқан Джумабаев Мәмбетжанға қарәслы улыўма жер майданы 79,60 м/кв болған асхана имараты. Дәслепки баҳасы 71 373 150 сум.

8. Қанлыкөл районы ЖИБ судының 11.02.2013-жылғы №22-85/13 орынлаў хатына тийкарланып, Төрткүл районы суд қарарларын орынлаўшылар бөлими тәрепинен хатланган:

Төрткүл районы Истиқлол көшеси 4-жайда жайласқан Джумабаев Шерипбайға қарәслы улыўма жер майданы 321,20 м/кв болған дүкан имараты. Дәслепки баҳасы 405 064 100 сум.

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

Төрткүл районы Ш.Рашидов АПЖда жайласқан Джумабаев Омарға қарәслы улыўма жер майданы 175,0 м/кв болған меншик 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 қарарларын орынлаўшылар бөлими тәрепинен хатланган:

Төрткүл районы А.Пирманов көшесинде жайласқан Кушамов Курамбайға қарәслы улыўма жер майданы 24 м/кв болған дүкан имараты. Дәслепки баҳасы 30 278 300 сум.

«Ким-зыят» саўдасына қатнасыў ушын арзалар шемби ҳәм екшембиден тысқары күнлери саат 9.00 ден 18.00 ге шекем Нөкис қаласы, Әмир Темур көшеси №122 жайдын 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 гиреў пулы төлем қағазында орынлаў ҳүжжетиниң саны ҳәм сәнеси көрсетилген халда «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 қурылган улыўма майданы 281,82 кв.м болған моншахана имараты. Дәслепки баҳасы 37 999 799 сум.

5. 1980-жыл қурылган улыўма майданы 151,04 кв.м болған котельхана имараты. Дәслепки баҳасы 29 027 512 сум.

«Ким-зыят» саўдасына қатнасыў 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 баҳасы-

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

Таңлаўға қатнасыўды қәлеўшилер директор атына арза, кадрларды есапқа алыў бойынша жеке ис 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 мағлыўматларды 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 үстинлиги» қарарына муўапық «Өзбекэнерго» мәмлекетлик акционерлик компаниясы «Тақыятас ЖЭС ында 230-250 МВт қуўатлықтағы пуў-газ үскенелери қурылысы» 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 қурылысы» жойбарында өткерилген экологиялық баҳалаўдың қоршаған орталыққа тәсирин илажға 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 қатнасыўына 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.

***

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

***

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

***

Нөкис қаласы кадастр хызмети тәрепинен Нөкис қаласы, А.Досназаров көшеси 9-жай 2-ханасында жасаўшы Нуратдинова Мухаббат Шарафатдиновна менен Кутымов Гафурбай Батырбаевич ортасында 27.03.2008-жылы дүзилген (реестр №4-1-01-1079) алды-сатты шәртнамасы ҳәм 28.03.2008-жыл берилген ТА №0517173 санлы гүўаҳнамасы жойтылыўына байланыслы бийкар етилади.

Announcement in Karakalpak language

ВЕСТИ КАРАКАЛПАКСТАНА

Пусть здравствует дружба народов!

Суббота, 27 апреля 2013 года №34 (17814)

Издается с июня 1919 г.

Газета Жокаргы Кенеса и Совета Министров Республики Каракалпакстан

Цена свободная

УЧАСТНИКАМ МЕЖДУНАРОДНОЙ НАУЧНО-ПРАКТИЧЕСКОЙ КОНФЕРЕНЦИИ «ЗДОРОВОЕ ПОКОЛЕНИЕ – БУДУЩЕЕ НАЦИИ», ПОСВЯЩЕННОЙ 20-ЛЕТИЮ ОБРАЗОВАНИЯ ФОНДА «СОГЛОМ АВЛОД УЧУН»

ПРИЕМ В РЕЗИДЕНЦИИ ОКСАРОЙ

Президент Республики Узбекистан Ислам Каримов 24 апреля в резиденции Оксарой принял помощника Государственного секретаря США по Южной и Центральной Азии Роберта Блейка.

УКАЗ

ПРЕЗИДЕНТА РЕСПУБЛИКИ УЗБЕКИСТАН

О поощрении участников Второй мировой войны

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

ОБЪЯВЛЕНИЕ

В соответствии с Постановлением Президента Республики Узбекистан № ПП-1442 от 15.12.2010 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.

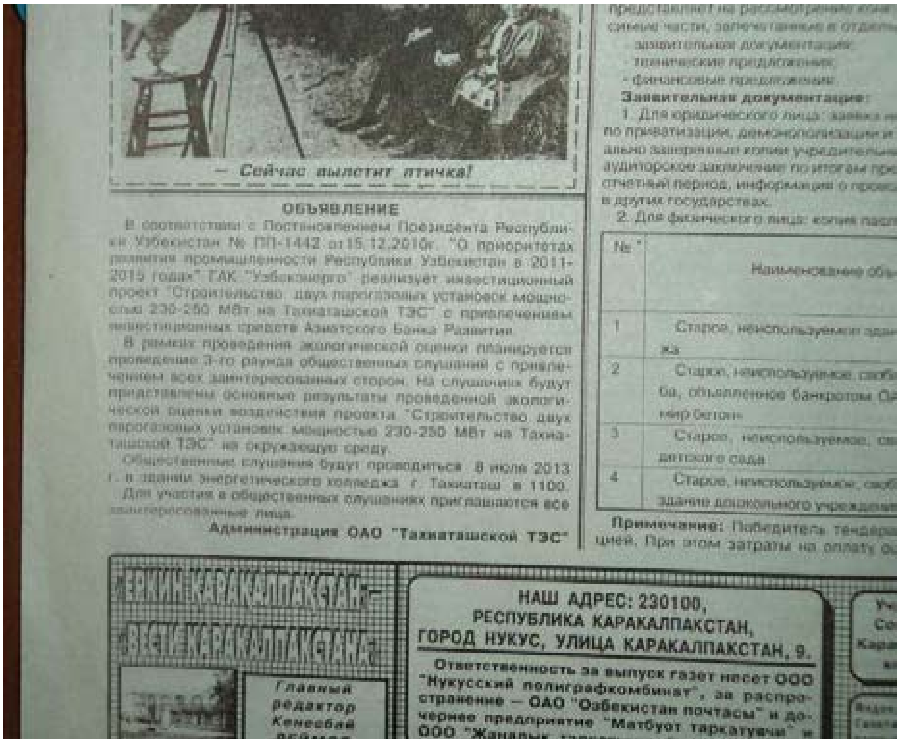
Для участия в общественных слушаниях приглашаются все заинтересованные лица.

АДМИНИСТРАЦИЯ ОАО "ТАХИАТАШСКОЙ ТЭС"

Announcement in Russian language

Announcement of the 3rd Public Consultation in Karakalpak language

Announcement of the 3rd Public Consultation in Russian language



– Сейчас вылетит птичка!

ОБЪЯВЛЕНИЕ

В соответствии с Постановлением Президента Республики Узбекистан № ПП-1442 от 15.12.2010г. "О приоритетах развития промышленности Республики Узбекистан в 2011-2015 годах" ГАК "Узбекэнерго" реализует инвестиционный проект "Строительство двух парогазовых установок мощностью 230-250 МВт на Тахиаташской ТЭС" с привлечением инвестиционных средств Азиатского Банка Развития.

В рамках проведения экологической оценки планируется проведение 3-го раунда общественных слушаний с привлечением всех заинтересованных сторон. На слушаниях будут представлены основные результаты проведенной экологической оценки воздействия проекта "Строительство двух парогазовых установок мощностью 230-250 МВт на Тахиаташской ТЭС" на окружающую среду.

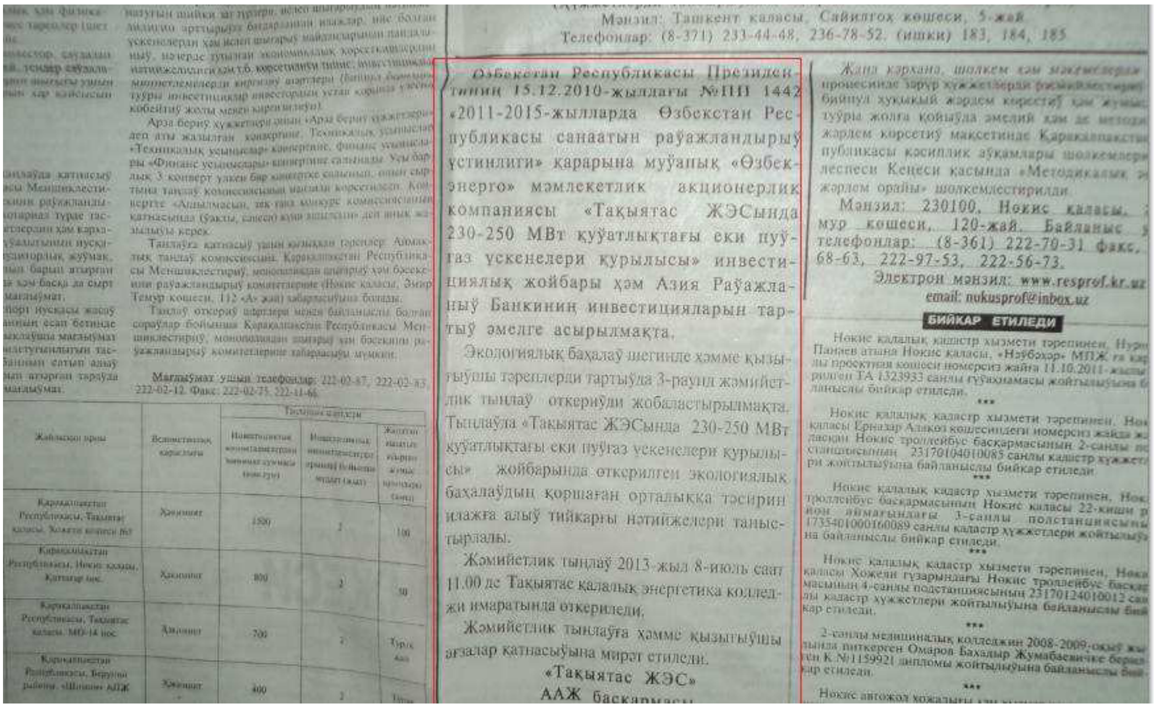
Общественные слушания будут проводиться 8 июля 2013 г. в здании энергетического колледжа г. Тахиаташ в 1100.

Для участия в общественных слушаниях приглашаются все заинтересованные лица.

Администрация ОАО "Тахиаташской ТЭС"

НАШ АДРЕС: 230100, РЕСПУБЛИКА КАРАКАЛПАКСТАН, ГОРОД НУКУС, УЛИЦА КАРАКАЛПАКСТАН, 9.

Announcement of the 3rd Public Consultation in Russian language



Мәнзил: Ташкент қаласы, Сайилгох көшеси, 5-жай
Телефонлар: (8-371) 233-44-48, 236-78-52, (ишки) 183, 184, 185

Өзбекстан Республикасы Президентиниң 15.12.2010-жылдағы №ПП 1442 «2011-2015-жылларда Өзбекстан Республикасы санаатын раўажландырыў устинлиги» қарарына муўапық «Өзбекэнерго» мәмлекетлик акционерлик компаниясы «Тақыятас ЖЭСында 230-250 МВт қуўатлықтағы еки пуўгаз үскенелери қурылысы» инвестициялық жойбары хәм Азия Раўажланыў Банкиниң инвестицияларын тартыў әмелге асырылмақта.

Экологиялық баҳалаў шегинде хәмме қызығыўшы тәреплерди тартыўда 3-раунд жәмийетлик тыңлаў өткериўди жобаластырылмақта. Тыңлаўда «Тақыятас ЖЭСында 230-250 МВт қуўатлықтағы еки пуўгаз үскенелери қурылысы» жойбарында өткерилген экологиялық баҳалаўдың қоршаған орталыққа тәсирин илажға алыў тийкарғы нәтийжелери таныстырылады.

Жәмийетлик тыңлаў 2013-жыл 8-июль саат 11.00 де Тақыятас қалалық энергетика колледжи имаратында өткериледи.

Жәмийетлик тыңлаўға хәмме қызығыўшы ағзалар қатнасыўына мирәт етиледи.

«Тақыятас ЖЭС»
ААЖ басқармасы

Announcement of the 3rd Public Consultation in Karakalpak 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	Экок.	[illegible]
2	Сапарова. Зульфия	Экок.	[illegible]
3	Бабаксанова. Г	М.п.ж. 4.	[illegible]
4	Атаксанова. С.	Табиат қорғау.	[illegible]
5	Якупов Ж	М.п.ж. 5.	[illegible]
6	Кутлымуратов. П	Тах-ш тес.	[illegible]
7	Матчанов У.	Тах-ш ТЭС	[illegible]
8	Жумамуратова М	Т-таш хак согалық	[illegible]
9	Тавекелова. А.	Махалла фонд	[illegible]
10	Данаев. А.	М.п.ж. №2.	[illegible]
11	Ширбаев. Д.	М.п.ж. №7.	[illegible]
12	Мадреймова. Г.	№6 М.п.ж. Масолахатчи	[illegible]
13	Мамбетадиева. Г.	№10 Хамкер.	[illegible]
14	Аузамбетова. К.	Хакимият.	[illegible]
15	Танжеков Азамат	«Камолот» ЖНХ	[illegible]
16	Жандуллаева. М.	№3. М.п.ж.	[illegible]
17	Турсымбаев. А.	№1. М.п.ж. [illegible]	[illegible]
18	Усманов. М.	№8 М.п.ж.	[illegible]
19	Шарымбетов. Ю.	МННО "Интеллект"	[illegible]
20	Арзиниязова Ф	КРРО Нишаного	[illegible]
21	Жапакова Г.	Ресурсный центр ННО[illegible]	[illegible]

№	Ф.И.О.	Должность	Подпись
22	Тагайниязов Ж.	Суу ақаба.	
23	Юнсапазаров А.	гл. Ақмангыт тауп реформ.	
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	Жакипова Г.	ЭКОК	
30	Даулетмуратова	ЕКОК.	
31	Хожсакова Б.	Мектеп №9 руководит.	
32	Бегжанов Р.	ЭКОК.	
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List of participants in the 1st round of Public Consultation of the Project "Takhiatash Power Plant Energy Efficiency Improvement Project" Takhiatash, 18 April 2013

№	Name	Position
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	Kalieeva Mexriban	Rahbar 12-maktab	[signature]
2	Matniyazov Maxset	TES master	[signature]
3	Лукманова Р	д/с № 9	[signature]
4	Бабажанова Г	д/с № 5	[signature]
5	Якубов Д.	Санэпидстанция	[signature]
6	Алимбетов	—//—	[signature]
7	Ниязов	—//—	[signature]
8	Бериев З.	Госкомприроды	[signature]
9	Серимбетова	поликл-ка	[signature]
10	Атамурадова	пол-ка 2	[signature]
11	Бекмуратова	—//—	[signature]
12	Фролова А	ПТО цех	[signature]
13	Матчанов. У	Нач-ик ТЭС	[signature]
14	Юлдашева Н	4-мактаб	[signature]
15	Ембаева Н	4-мактаб	[signature]
16	Урынбаева Г	1-пол-ка терапевт	[signature]
17	Утепов Т	Энергетика КЭК	[signature]
18	Жумамуратова	хакимият	[signature]
19	Аузимбетова	хакимият	[signature]
20	Жуманиязов К	энергетика	[signature]
21	Джсапабаев А	Энергетика КЭК	[signature]

№	Ф.И.О.	Должность	Подпись
22	Темиуратова М	Энергетика КХК	
23	Худайбергенова М	— " —	
24	Турсынбаев А	1-дом ком	
25	Хожанов Э	Энергетика КХК	
26	Утепенова Г	Қызыл Ярым Ай.	
27	Абдуллаев А	6-мактаб.	
28	Мадреймова Г	6-дом.ком	
29	Кутлымуратов. П	Тахиаташ ТЭС	
30	Досымбетов. М	Тахиаташ ТЭС	
31	Сабурбаева Г	Энергетика КХК	
32	Ганжиев А	„Камолот" ЖАХ	
33	Қутлымуратова Г	3-мактаб	
34	Сапарова З	— " —	
35	Сапарбаева Г	Тахиаташ ТЭС	
36	Маяниязова Г	— " —	
37	Халмуратова Г	— " —	
38	Худайбергенова Б	— " —	
39	Жанкабаева Ж	7-бақша	
40	Аташанов Р	Энергетика КХК.	
41	Қадиров М	— " —	
42	Худайбергенова Г	8-балалар бақшасы	
43	Сапашева Д	— " —	
44	Данаев А.	2-дом.ком.	
45	Нуримбетова Н.	Энергетика	
46	Даулетмуратов Г	— " —	
47	Шамедова Г	ГРЭС	
48	Сапарова З	Энергетика КХК	

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	Утенкешова С	— " —	
3	Ерназарова Ч	4-бала бақша	
4	Ешимбетова Н	10-бала бақша	
5	Мухалимова М	11-бала бақшасы	
6	Абдурасулов Ф	10-дом. ком	
7	Якупов Ш.	5-дом. ком.	
8	Юлдашева Н	2-мақтаб	
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List of participants in the 2nd round of Public Consultation on the Takhiatash Power Plant Efficiency Improvement Project

Takhiatash city, 29th April 2013

№	NAME	POSITION
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

"ТАХИАТОШ ИССИҚЛИК ЭЛЕКТР СТАНЦИЯСИНИНГ АТРОФ-МУҲИТГА ТАЪСИРНИ БАХОЛАШ" лойихаси бўйича ўтказилган жамоа эшитувида қатнашчилар рўйхати

№	ФИО	Лавозими/ должность	Имзо/подпись
1	Журтанов Муратбек	пенсионер МВД	[signature]
2	Базарбаева Айдайгул	ишсиз	[signature]
3	Халимаева Хатира	ишсиз	[signature]
4	Машарипова Мунават	ишсиз	[signature]
5	Худирова Нигора	ишсиз	[signature]
6	Сапарова Гулрух	ўқитувчи	[signature]
7	Курбамуратов Жулат	инженер ГРП	[signature]
8	Якубова Наргиза	ўқитувчи	[signature]
9	Юнусов Мурат	зам. директор	[signature]
10	Нуртанова Алёна	ТАЭС	[signature]
11	Юнусов Фархат	главный инженер	[signature]
12	Айимбетов Бахт	инженер	[signature]
13	Атажанова Санаргул	Госком природа	[signature]
14	Матжанов Оразбай	гл. инженер программист Канал	[signature]
15	Сапарова Жулдыз	Юго	[signature]
16	Хожамуратова Замира	ўқитувчи	[signature]
17	Бердиев И	Госком природа	[signature]
18	Артыкбаева Д	Сад №4	[signature]
19	Исманова Г.	НПО ЮК фирмы УАРЗ	[signature]
20	Агамова М.	К.К. отр. АПЗС	[signature]
21	Фролова А.Н	инженер ТЭС	[signature]
22	Халмуратова Г.	лаб-ка ХР ТЭС	[signature]
23	Антонова И	лабка ХР ТЭС	[signature]
24	Сапарбаева Т	лабка ХР ТЭС	[signature]
25	Вайсова Б	№10 НЧИБМ	[signature]

26	А. Тавкелова	"Махалла" фонд	
27	Санаров Жуманазар	ГТЭС	
28	Абдуллаева Саида	психолог Эн. кол	
29	Абдукаликов	№38 директор	
30	Мадаминов	№38 завхоз	
31	Жуманиязов	№24 мактаб	
32	Худайберганова Ш.	дет. полик.	
33	Исаева	дет. полик.	
34	Санарова Дилноза	депутат	
35	Тилекемова Саule	№13 сад	
36	Болдасова Лиза	№26 сад	
37	Сандуротова Маргиза	лаборант	
38	Макинова Гулнара	лаборант	
39	Мадаминова Шахноза	[illegible]	
40	Жуманиязова [illegible]	№1 колледж	
41	Матниязова Гулбахор	ГРЭС Х/цех	
42	Жумамуратова	хокимят	
43	Утегенова	хокимят	
44	Дарбаева	№5 сад	
45	Жолдыбекова Гулнара	город Нукус	
46	Бурдабаев Исмаил	№26 мактаб	
47	Ядгарова Феруза	№24 мактаб	
48	Умурратова Сулухан	Сад	
49	Нурумбетова	№26 мактаб	
50	Мухтарова	№26 мактаб	
51	Атажанова	№26 мактаб	
52	Дурдиева	№26 мактаб	

53	Жангабаева	№26 мактаб	
54	Алмашизода	№26 мактаб.	
55	Абдулаев	№28 мактаб	
56	Сапарова Зулфия	Ҷн КСК	
57	Бердамеев	ЧРЭС	
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List of participants in the 3rd round of Public Consultation on the Takhiatash Power Plant Efficiency Improvement Project

Takhiatash city, 8th July 2013

No.	Surname / Name	Position
1	Kurbanov Muratbek	Pensioner
2	Bazarbaeva Aydaygul	unemployed
3	Khalillaeva Khatira	unemployed
4	Masharipova Munojat	unemployed
5	Qidirova Nigora	unemployed
6	Saparova Gulrukh	Teacher
7	Qutlimuradov Pulat	TPP engineer
8	Yakubova Nargiza	teacher
9	Yusupov Murat	deputy director of school
10	Nurjanova Alyona	Takhiatash TPP
11	Yusupov Parakhat	Chief engineer TPP
12	Ayimbetov Bakht	engineer TPP
13	Atajanova Sapargul	Karakalpak nature protection Committee
14	Matjanov Urazbay	engineer TPP
15	Saparova Qundur	Environmental engineer TPP
16	Khojamuratova Zamira	teacher
17	Berdiev N.	Karakalpak nature protection Committee
18	Artikbaeva D.	kinder garden
19	Djapanova G.	NGO Karakalpak branch of reproductive health
20	Asanova Sh.	NGO Karakalpak Branch of kids and families of Uzbekistan
21	Frolova A.	engineer of env.laboratory of TPP
22	Khalmuratova G.	Laboratory assistant TPP
23	Antonova N.	Laboratory assistant TPP
24	Saparbaeva T.	Laboratory assistant TPP
25	Vaysova B.	Representative of makhalla
26	Pavekelova A.	"Makhalla" foundation
27	Saparov Djumanazar	TPP engineer
28	Abdullayeva Saida	Phycologist of Energy college
29	Abdukhalikov	School #38, director
30	Madaminov	School #38, administrative director
31	Djumaniyazov	teacher
32	Khudaybergenova Sh.	children polyclinic
33	Isayeva	children polyclinic

34	Saparova Dilnoza	teacher
35	Tilikeshova Saule	kinder garden #13
36	Qoldasova Liza	kinder garden #26
37	Eshmuratova Nargiza	Laboratory assistant TPP
38	Djakinova Gulnara	Laboratory assistant TPP
39	Madaminova Nargiza	Polyclinic # 1
40		Polyclinic # 1
41	Matniyazova Gulbakhor	TPP Water treatment department
42	Djumamratova	khokimiyat
43	Utegenova	khokimiyat
44	Darbaeva	kinder garden #5
45	Djolibekova Gulsara	housewife
46	Berdibaev Islam	school #26
47	Yadgarova Feruza	school #24
48	Utyamuratova Sulukhan	kinder garden #34
49	Nurimbetova	school # 26
50	Mukhtarova	school # 26
51	Atajanova	school # 26
52	Durdieva	school # 26
53	Djangabaeva	school # 26
54	Allaniyazova	school # 26
55	Abdullayev	school # 28
56	Saparova Zulfiya	Teacher energy college
57	Berdishev	TPP

Appendix 4. Presentation given during the Public Consultation

Takhiatash Power Plant Efficiency Improvement Project
ADB TA # 8142

Environmental Impact Assessment

"Uzbekenergo"

Consultant on technical assessment:

GAS NATURAL FENOSA ENGINEERING (GNFE) (Spain) u IKS (Uzbekistan)

Takhiatash, 8 July, 2013

Legal Requirements

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

NATIONAL FRAMEWORK	INTERNATIONAL FRAMEWORK
•**Uzbek Legislation** Law on Nature Protection of RUz (1992). Law on Environmental Expertise of RUz (2000) Other nature Protection laws; Sanitarian norms and rules, KMK, Appropriate guidelines and manua	**Asian Development Bank** ADB Safeguard Policy Statement (2009), taking into account: 007) ansboundary Movements of 1989), signed by Uzbekistan, etc

Key legislation norms and

- air quality
- water use
- waste management
- soil, undergound water
- biodiversity

THE MOST STRINGENT BETWEEN NATIONAL AND INTERNATIONAL STANDARDS

2

Legislation base

Environmental Clearance from State Nature Protection Committee was received for construction of 1st CCGT in November 2012. The new supplementary EA are preparing for construction of 2nd CCGT.

In accordance with Law of RUz "On Environmental Expertise" a "Statement on environmental consequences" will be developed and endorsed by State Nature Committee before CCGTs commissioning

Expected benefits

Project implementation will allow:

- Decrease operation cost;
- Increase efficiency and reliability of energy supply for consumers;
- Improve quality of environment on surround impacted territory.

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 strong with a number of industrial development projects envisaged for the region exceeding currently available capacity
- Takhiatash TPP produce hot water to provide citizens of Takhiatash city and for its own needs

Existing situation

Water is taken *from*:
- Canal Suenly
- «Vodocanal» city Takhiatash

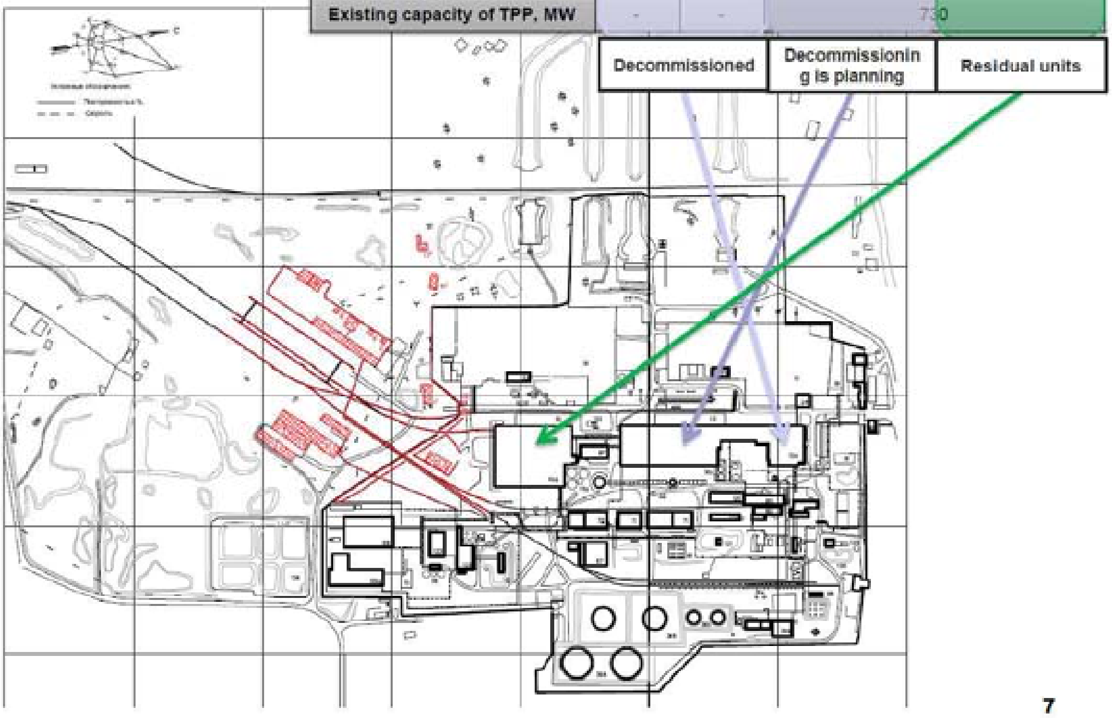
Water is discharged *into* the canal Suenly and Takhiatash WTTP

Open cooling system is used TPP

В качестве топлива используется газ ***Бухарского месторождения***

Existing usnits

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



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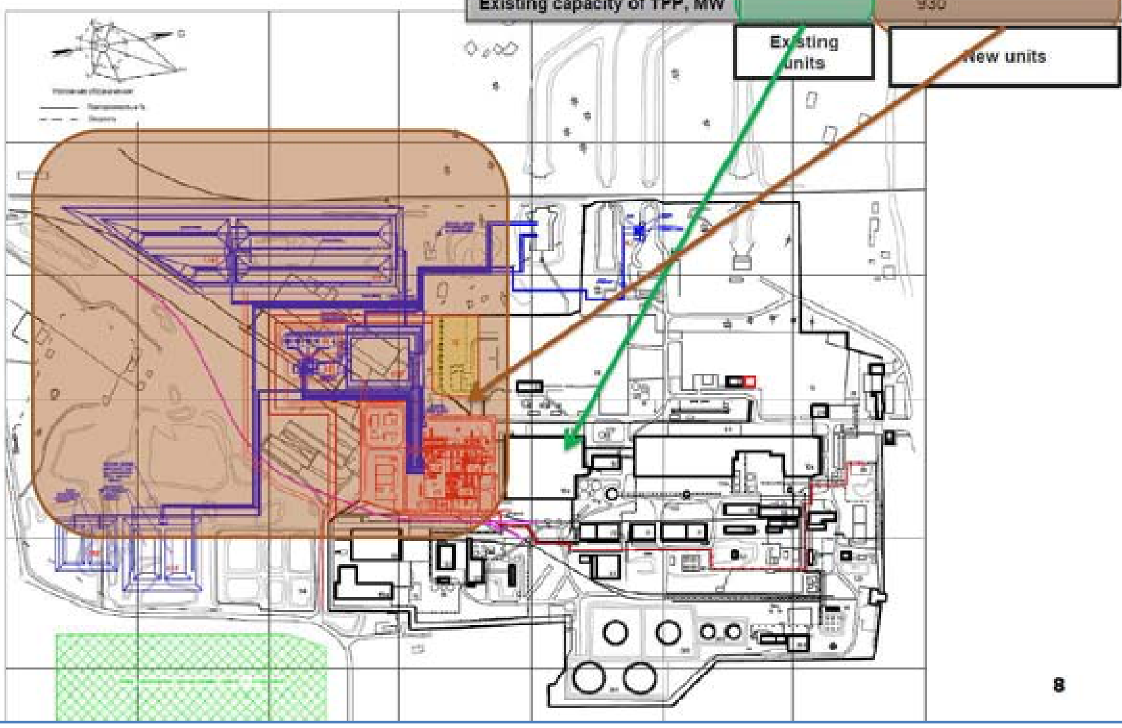
New TPP site for CCGTs

Unit	V	VI	CCGTU-1	CCGTU-2
Commissioning year	1987	1990	2016	2016
Installed capacity of the line, MW	210	210	253.9	253.9
Existing capacity of TPP, MW	930			



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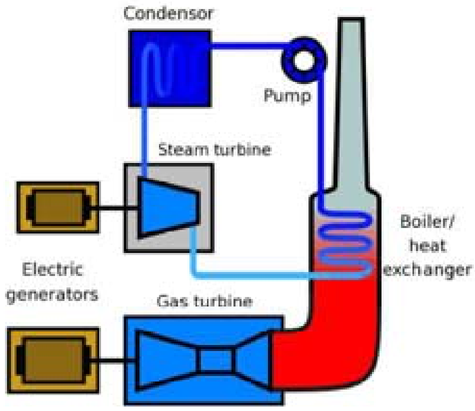
What is going to be done?

Nowadays energy and heat production is based on conventional steam technology.

Planning:

- To construct two CCGT with capacity **253.9 MW** each, consisted from steam turbine, steam generator of heat regeneration and one steam turbine;
- **Decommissioning units III и IV**, with general installed capacity **310 MW**.

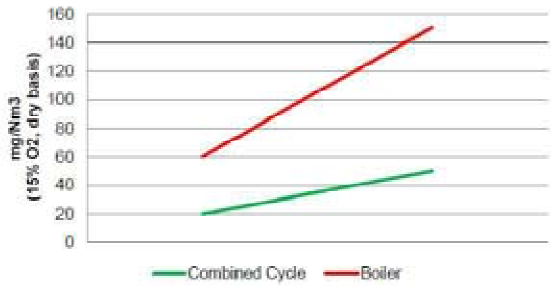
Increasing of energy efiicince will from **20-30%** up to **50-60%** (from **2700** GWt/year till **3937** GWt/year)



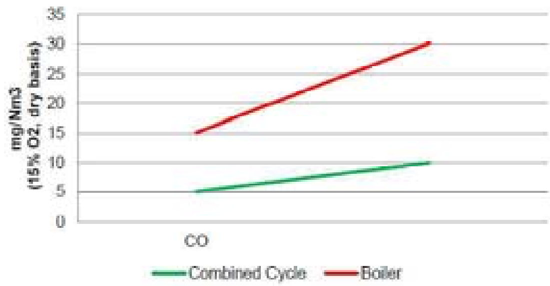
ПГУ

- The new technology is the best technology among existing technologies which based on oil fuel (necessary to provide basic energy which does not depend on solar and wind resources)

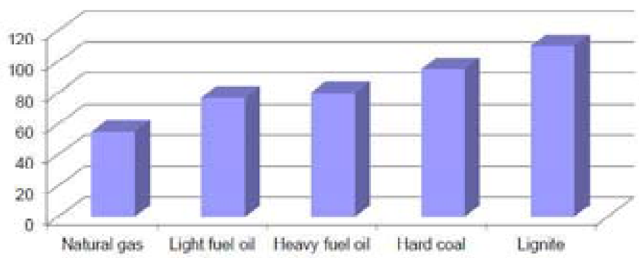
NOx emission



CO emissions



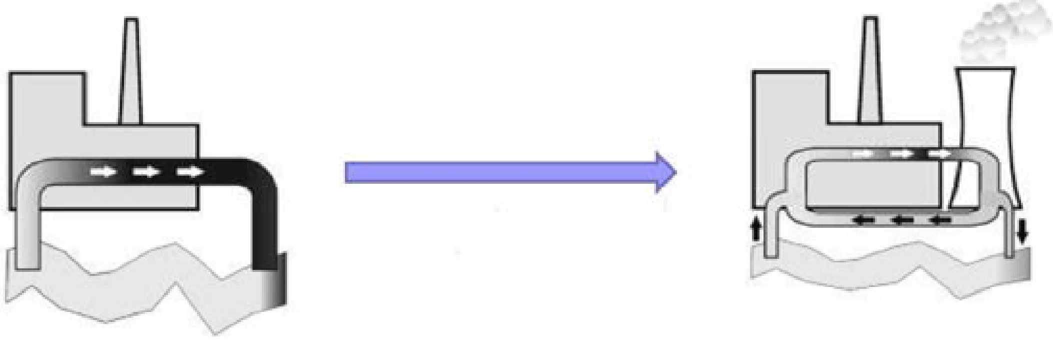
CO2 emission factor (t CO2/TJ)



Moving from open cycling cooling water use technology to close will allow

- Decreasing water intake and discharge from and in Suenly canal on 391 m³/hour
- Decreasing thermal discharges

Once-Through Cooling | Closed Circuit Cooling



Old units III and IV | New CCGT

Layout of new facilities

IMPACT ON ENVIRONMENT

- Construction stage
- Operation stage
- Decommissioning stage

IMPACT DURING CONSTRUCTION/DECOMISSIONING STAGE

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		

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NOISE IMPACT

Point	QUALITATY ASSESSMENT	
	DAY	NIGHT
P1	Not exceed	Not exceed
P2	Not exceed	Not exceed
P3	Not exceed	Not exceed
P4	Significant exceed	Two times exceed
P5	Not exceed	Not exceed
P6	Not exceed	Not exceed
P7	Significant exceed	Two times exceed
P8	выше на 50%	выше на 50%

- Special measurement have been conducted into 8 points close to TPP.
- Mitigation measures : heavy techniques activity carry out during the day time

Construction/decommissioning

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

- Adequate waste management
- Mitigation measures during the spoils

⇨ **Moderate**

➢ Increasing of traffic.

Traffic management plan will be submitted:

- ❖ Traffic control: to keep a disctance between vehicles.
- ❖ A route of heavy techniques will lie through less sensitive territory
- ❖ No transportation of heavy techniques during the night time.
- ❖ Proper registration of transport and heavy techniques, driving license.
- ❖ Control of speed and loading
- ❖ Measures on traffic regulation: place signs

⇩

MODERATE

Main existing roads which connect surrounding areas to Takhiatash TPP

17

WASTE MANAGEMENT

Materials	Total quantity (t)	Hazard (according to Basel Convention)
Asbestos cement plaster	278.4	Harzadous (Annex I: A2050; Y36)
Basalt extra-thin fibre	37	Non-harzadous
Wire netting	16.95	Non-harzadous
Fire resistant concrete	1080	Non-harzadous
Thermo-isolated concrete	762	Non-harzadous (except if containing asbestos)
Structural steel	1685	Non-hazardous
Structural concrete	65,434	Non-hazardous (except if containing asbestos)

OPETATION 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	—

Impact of CO_2 Emissions

UNITS	Installed Capacity (MW)	Power Generation (GWh/yr)	CO2 Emission (1000 tCO2e)
Existing Units	730	3276	2117
New Units	508	3511	1478
Decommissioning	310	956	741
Remaining	420	426	253
Net Change	198	661	-386
After Project	**928**	**3937**	**1731**

Environmental and social benefits of the Project

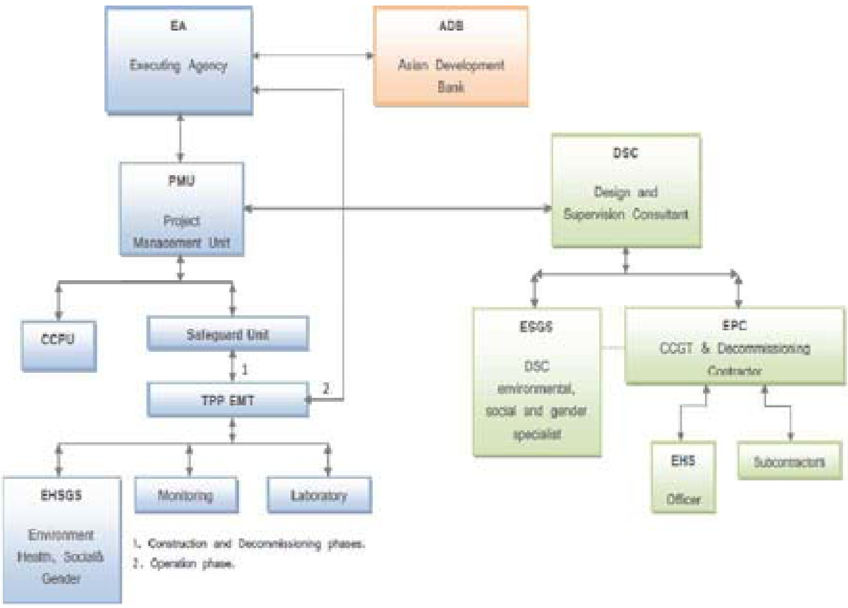
- Reduction of natural gas consumption on 300 million m^3/year
- 16% emission reduction of CO_2 (greenhouse gas) to the atmosphere, which will contribute to climate change mitigation
- 27% emission reduction of NOX to the atmosphere
- In accordance with the result obtained from the dispersion model of pollutants in the atmosphere using the EPA's "AERMOD" it can be stated that:
  - A 16% reduction of NO2 in ambient air quality is achieved
  - Current and future scenarios comply with air quality standards both at national and international level
- Decrease of accidental risk by means of using Automatic Control System;
- Increase in power supply will promote industrial development projects envisaged for the region; Consequently this will promote socio-economic development
- During the construction phase workforce demand will be highly increased

Environmental and social benefits of the Project

- The change from the open cooling system of units III and IV towards a closed circuit of the CCGT will lead to:
  - 86% reduction of water intake
  - Almost a 50% reduction of thermal effluent returned to the canal which will allow a better and faster dispersion. This fact would probably improve the environmental condition of the aquatic ecosystem.
  - Increase of 514 m^3/h of water consumption to replace evaporated water in the cooling towers. This is a negative impact but the magnitude is insignificant as it would represent 0.63% of Suenly canal flow rate.

Environmental Management Plan

Institutional arrangement



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.

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.

CURRENTLY REPORTING

- The Takhiatash TPP EMT annually submits two kinds of reports:
- Air emissions to the Goskompriroda of Karakalpakstan and Statistical Department of Karakalpakstan;
- Water use and effluents flues to:
  - Low Amudarya authority of irrigation system;
  - Goskompriroda
  - Takhiatash "Vodocanal

Planning reporting system

- In addition to existing reporting system, reports on the following parameters will be implemented:
  - Significant impact on environment.
  - Control on green gases emissions
  - Air quality control: air control and compliance with existing requirements
  - Water quality control: discharges
  - Ground water control
  - Wastes collecting and disposal
  - Noise level control
  - Control on work safety and health

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.

Results of 1 and 2 rounds of Public Consultation (18 and 29 April 2013)

- The following comments and suggestion from previous public consultation have been included in EIA:

The main questions:

- 1.- Will new installation impact on the water quality in canal Suenly?:

  A replacement of old equipment with new installation will not impact on water quality in Suenly canal. Any way, discharge of thermal water will decrease.
- 2.- Will construction of new CCGT impact on employment of graduating students of the energy college? :

  The relationship between TPP and college will not be changed after project commissioning.

Results of 1 and 2 rounds of Public Consultation (18 and 29 April 2013)

3.- What will be the workers who works on equipment which will be demolished?:

- A special training program is planning to be conducted to educate staff of TPP on working with new equipment

4. Is it planning to provide environmental monitoring report on the quarterly base?

The final version of the Environmental Assessment report includes requirements on providing environmental monitoring report on the annual base

Information disclosure

- EIA report will be available :

1.- Printed Russian version of the report will be available at the medical services of the TPP (200 meters outside of the TPP entrance)

2.- E-copy of the report in Russian language will be published on the "Uzbekenergo" official website

3.- E- copy of the report in English are published on the ADB website

Grievance mechanism

- The following activities will be used for the grievance mechanism :
  - The register set up via a physical logbook register which is available at the medical service of the Takhiatash TPP (200 meters outside the entrance of the TPP) throughout the life of the project
  - Public hearing.

- Grievances received and responses provided should be documented and reported back to the complainant. Response time will extend up to one month. The complainant can ask for reconsideration by a higher authority if not happy with the outcome

Organizational structure of the grievance redressing mechanism:

- 1st level: Takhiatash TPP
- Responsible person: Kutlimuradov Pulat, engineer of PIU:
  - Address: Republic of Karakalpakstan, Takhiatash, Takhiatash TPP, post office N° 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

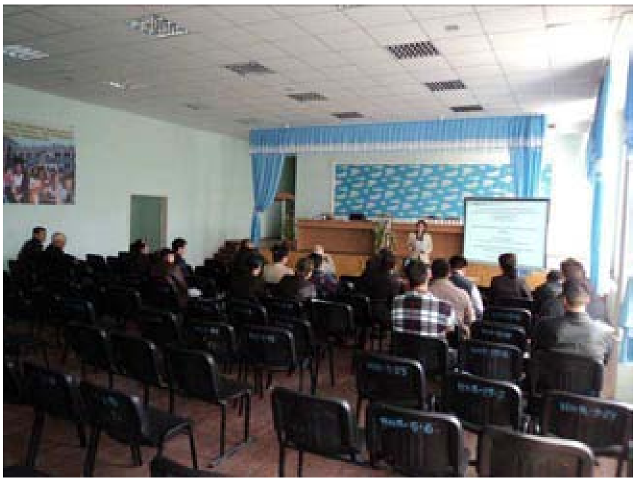
Contact details

- Karakalpakstan, Takhitash city, Takhiatash TPP, post department № 1 TPP, Kutlimuradov Pulat, engineer of PIU tel. +998982796871, www.piu_tps@mail.ru

- Tashkent city, Khorezm str. 69,PIU «Takhiatash TPP», Abdullaev Nurualla, manager of PIU
  tel. 83712363452, www.piu_tps@mail.ru

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 local makhalla

Student

Representative of the State Protection Committee of the Republic Karakalpakstan

Secondary school teacher

TPP worker and resident of community close to the TPP

3rd PUBLIC CONSULTATION:

Meeting with Takhiatash city khakim

Registration of participants

Welcome speech by Mr. Makhkamov U., representative of Takhiatash TPP

Speech by Mrs. Utami, ADB principle safeguard officer

Dr. Khalmirzaeva gives presentation

Director #38 asks question on irrigation water supply

Woman committee head asks question

Representative of makhalla #8 asks question

Engineer asks questions

Representative provide her comments on water supply issues

Appendix 6. Grievance Mechanism Register Logbook

# Register:	
Name:	**Surname:**
Organization:	**Address:**
Tel:	**Fax:**
Email:	
Comment / Complaint:	
Takhiatash person in charge:	
Date:	**Stamp:**

# Register:	
Name:	**Surname:**
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**	
Takhiatash person in charge:	
Date:	**Stamp:**