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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 (e.g. Hazardous waste will not be disposed into the Municipal landfill).

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 4th and 5th 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).

Hydrogeology

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.

Surface hydrology

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

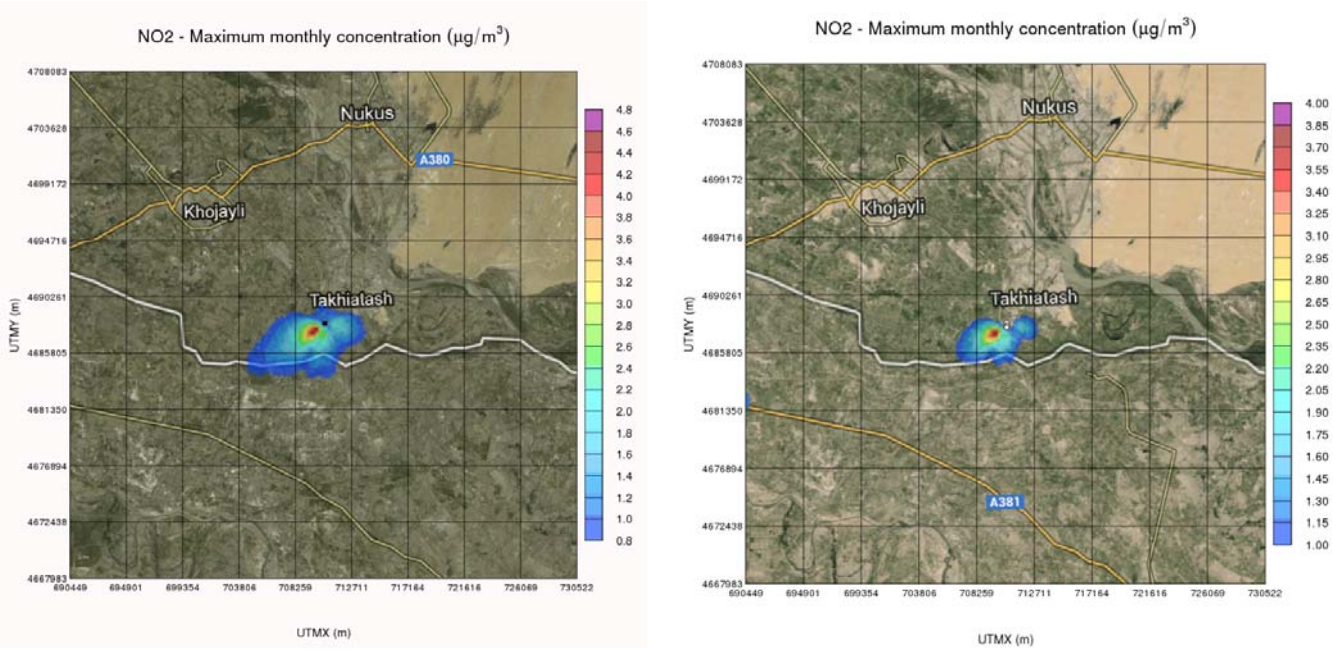
IMPACT ASSESSMENT SUMMARY - CONSTRUCTION/DECOMMISSIONING PHASES				
IMPACT	**SIGN**	**NORMALIZED INCIDENCE (BETWEEN 0 AND 1)**	**MAGNITUDE**	**FINAL IMPACT VALUE**
Potential discrete and local increase in particulate matter suspended in air.	-	INSIGNIFICANT		
Potential degradation of air quality due 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.

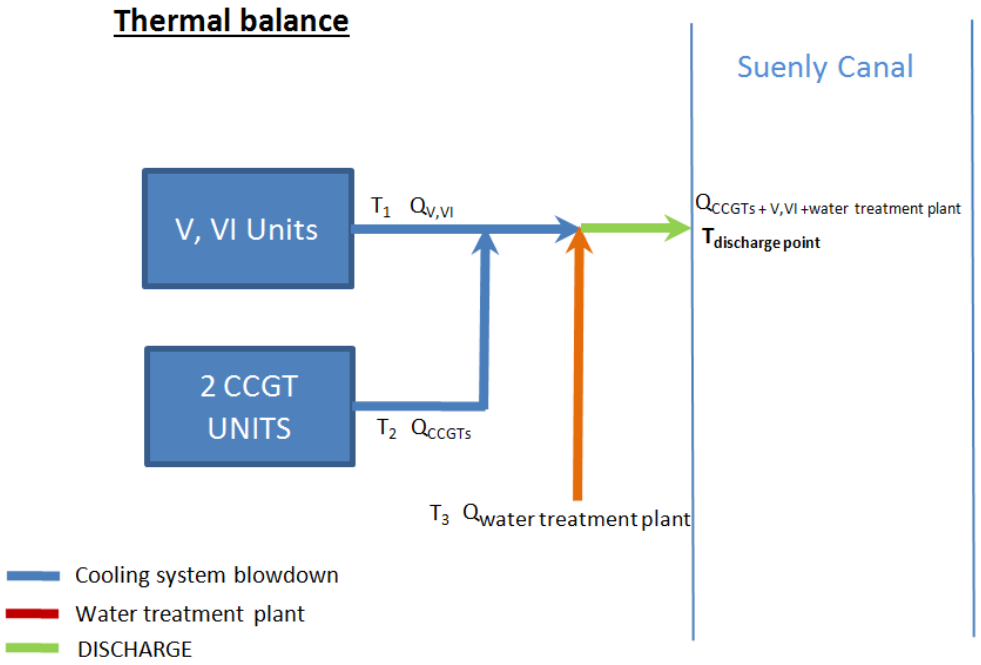


Figure 5. Thermal balance of water discharge to Suenly canal

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:

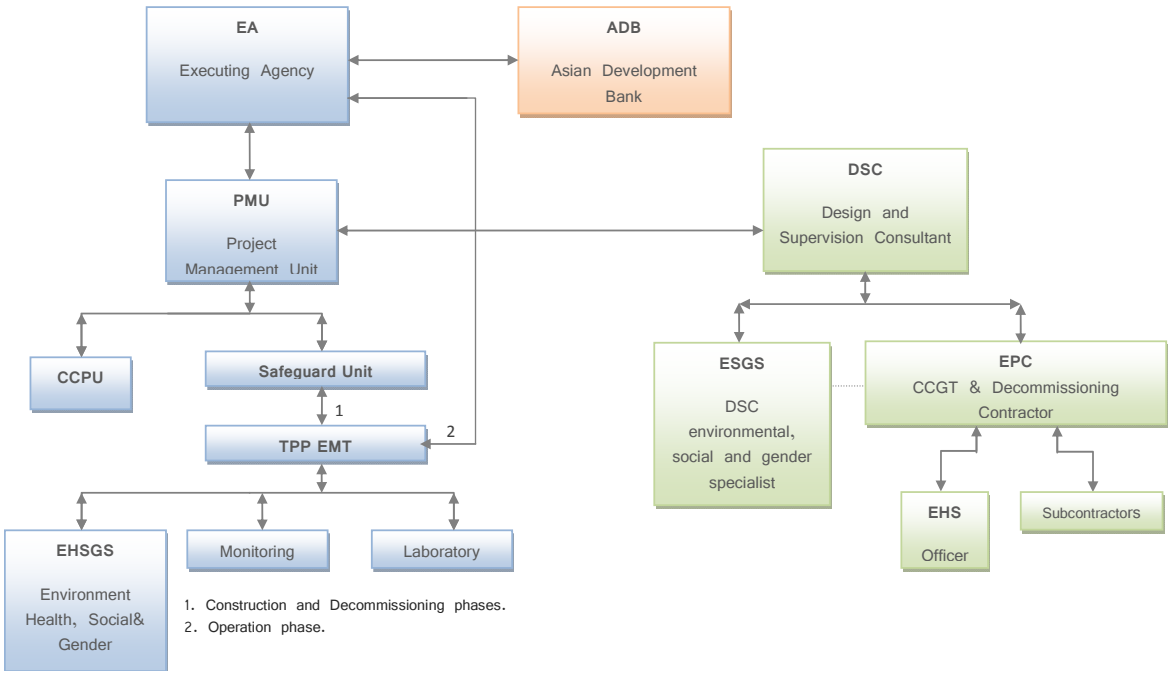


Figure 6. Project institutional organization flowchart

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 18th and 29th of April 2013 and on 8th 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.