Environmental Impact Assessment: Main Report

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UZB: Power Generation Efficiency Improvement Project

Prepared by State Joint Stock Company UzbekEnergo for the Asian Development Bank.

Environmental Impact Assessment

Fifth Draft - November 2017

Republic of Uzbekistan: Power Generation Efficiency Improvement Project (Second Talimarjan Power Project)

ADB Project Reference 49253-002

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Abbreviations and Acronyms

ACC	Air Cooled Condensers
ADB	Asian Development Bank
BAP	Borrow Pit Action Plan
BAT	Best Available Technology
BGL	Below ground level
CAREC	Central Asia Regional Economic Cooperation
CAP	Corrective action plan
CAPEX	Capital Expenditure
CCGT	Combined Cycle Gas Turbine
CEMS	Continuous Emissions Monitoring
CFC	Chlorofluorocarbon
CIS	Commonwealth of Independent States
CO	Carbon monoxide
CO_2	Carbon Dioxide
Cr	Chromium
dBA	decibel
DDP	Distillation and deionization plants
EA	Executing Agency
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EM	Environment Manager
EPC	Engineering, Procurement and Construction
ERP	Emergency Response Plan
ES	Executive Summary
ESMS	Environmental and Social Management System
FE	Iron
g CO_2-e/kWh	Grams of CO2 equivalent per kilowatt hour
GDP	Gross Domestic Product
GHG	Greenhouse Gases
GoU	Government of Uzbekistan
GOST	Technical Standard
Goskompriroda	State Committee for Nature Protection
Goskomgeodezkadastr	State Committee for Land Resources, Surveys, Cartography and the State Cadastre
Goskomgeologia	State Committee for Geology and Mineral Resources
Glavgosekoexpertiza	Goskompriroda SEE Department
GLC	Ground Level Concentration
GT	Gas Turbine
GWh	Gigawatt hour
H_2S	Hydrogen Sulfide
ha	Hectare
HDGT	Heavy Duty Gas Turbines
HC	Hydrocarbons
HRSG	Heat recovery steam generator
IBA	Important Bird Area
IBC	Intermediate bulk storage containers
IEE	Initial Environmental Examination
IES	International Environmental Specialist
IUCN	International Union for Conservation of Nature
km	Kilometer

Km^2	Square kilometer
KMK	Karshi Main Canal
kV	Kilovolt
mg/l	Milligram per liter
mg/m^3	Milligram per cubic meter
m^3/s	Cubic meters per second
m^3/d	Cubic meter per day
m	Meter
m^2	Square meter
m^3	Cubic Meter
MAC	Maximum Allowable Concentrations
MAWAR	Ministry of Agriculture and Water Resources
MDE	Maximum design earthquake
MMCS	Mott MacDonald / Corporate Solutions
MPE	Maximum Permissible Emission
MPD	Maximum Permissible Discharges
MHRUz	Ministry of Health Republic of Uzbekistan
MW	Megawatt
NES	National Environmental Specialist
NGO	Non-Governmental Organization
NH_4+	Ammonium
Nm^3	Normal cubic meter
NOx	Nitrogen oxides
NO_3	Nitrate
Ni	Nickel
OBE	Operating basis earthquake
Oblast	Province
OCGT	Open Cycle Gas Turbine
OEM	Original Equipment Manufacturer
OHS	Occupational Health and Safety
OTC	Once Through Cycle
OVOS	Uzbek EIA
PA	Pascals
PAH	Polycyclic aromatic hydrocarbons
PCR	Physical and cultural resources
Pb	Lead
PM	Particulate matter
PO_4	Phosphate
PMU	Project Managing Unit
PPE	Personal Protective Clothing
PPTA	Project Preparatory Technical Assistance
PPM	Parts per million
PZVOS	Draft Statement on Environmental Impacts
RUz	Republic of Uzbekistan
SanPiN	Sanitary Regulations and Standards
SEE	State Environmental Expertise
SGCC	Shurtan Gas Chemical Complex
SPM	Suspended Particulate Matter
SniP	Construction Standards
SNPC	State Nature Protection Committee
ST	Steam Turbine
STD	Sexually transmitted diseases (such as HIV/AIDS)

SSEMP	Site Specific Management Plan
SO_2	Sulfur Dioxide
SPZ	Sanitary Protection Zone
TOR	Terms of Reference
TPP0	Talimarjan Unit 1
TPP1	Talimarjan Units 2 & 3
TPP2	Talimarjan Units 4 & 4
TPC	Talimarjan Power Complex
TSP	Total Suspended Particulates
UE	Uzbekenergo
UE TPP	Uzbekenergo TPP
UNEP	United Nations Environment Program
UNG	Uzbekneftegaz
USAID	United States Agency for International Development
USD	United States Dollar
WB	World Bank
WHO	World Health Organization
WMP	Waste Management Plan
WWTP	Waste Water Treatment Plant
°C	Degrees Celsius
$\mu g/m^3$	Micrograms per cubic meter
ΔT	Delta T – Temperature Difference

Currency Exchange Rates as of 13th January, 2017:
1 US$ = 3243 UZS (Uzbekistan Som)
($ refers in this report to US-Dollars)

Executive Summary

A. Introduction

1. This Environmental Impact Assessment (EIA) is part of the process of compliance with the ADB guidelines in relation to the Power Generation Efficiency Improvement Project (the Second Talimarjan Power Project), or the "Project".

2. The EIA provides a road map to the environmental measures needed to prevent and/or mitigate negative environmental effects associated with the Project. The EIA provides a detailed description of the direct and indirect environmental effects associated with the proposed Project during key periods of work. The EIA:

- Describes the extent, duration and severity of the impacts;
- Analyzes all potential impacts, both positive and negative;
- Formulates the mitigation actions and presents it all in the form of an Environmental Management Plan (EMP).

3. Based on the existing ADB Environmental Safeguards Policy (2009), this Project falls under ADB's project **Category A**. This category is defined as:

"*A proposed project is classified as category A if it is likely to have significant adverse environmental impacts that are irreversible, diverse, or unprecedented. These impacts may affect an area larger than the sites or facilities subject to physical works. An environmental impact assessment is required."* [1]

B. Description of the Project

4. The Project is the construction of two new 450 MW Combined Cycle Gas Turbines (CCGT) units (Units 4 & 5) in the Kashkadarya region of Uzbekistan.

5. TPP2 will form part of the Talimarjan Power Complex (TPC) which, to date, comprises the following two components:

- TPP0 – the existing 800MW gas-fired steam power plant completed in 2004 (Unit 1).
- TPP1 – the 900MW 'phase 1' Combined Cycle Gas Turbine (CCGT) project currently under construction (Units 2 & 3).

6. The TPC is located seven kilometers to the north of the Talimarjan reservoir on the right bank of the Karshi Main Canal (KMK) in Nishon district of Kashkadarya. The nearest housing settlement is Nuriston approximately one kilometer to the north east of the TPC.

7. Approximately 7 hectares of land are required for TPP2, all of which are located within the existing boundaries of the TPC which was developed in 2004. TPP2 will be situated adjacent to the eastern boundary of TPP1 which itself is located to the eastern boundary of TPP0.

8. A summary of the key TPP2 characteristics is provided in **Table ES-1**.

[1] https://www.adb.org/site/safeguards/safeguard-categories

Table ES-1: Key Project Characteristics	
Characteristic	**Description / Value**
Type of Technology	Advanced 'F-class' Combined Cycle Gas Turbine
No of CCGT units	2
CCGT configuration for each unit	1 GT + 1 HRSG + 1 ST on separate shafts
Output of each CCGT unit	450 MW
Fuel	Natural Gas
Condenser cooling type	Water cooled
Cooling Tower Type	Mechanical draft
Raw water – cooling water	Raw water to be sourced from the existing KMK intake canal
Process water – boiler water	Process demineralized water will be supplied from the existing demineralized water plant via connection to the demineralized water distribution system
Combined heat and power system	Steam extraction system and heat exchanger to provide alternative heat sources for heat only boiler in TPP0
Height of stack at HRSG	85m
Noise attenuation	80 dBA at 1 meter distance
Minimum service life of the power block (GT, ST and HRSG)	Minimum 25 years. The design life of the structural works shall be a minimum of 40 years

C. Alternatives

9. Several alternatives have been assessed as part of the Project, including:

- ''No Project" Alternative – The 'No Project' alternative would mean that the project does not go ahead. In this case there would be no impact associated with the Project (air quality, noise, water use, etc.). However, all the long term benefits of the Project would be lost, such as job creation and increased energy security. 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 TPP2 as long as this EIA demonstrates that it will produce an overall impact that is compatible with, controllable by and fits 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.

- Alternative Sites – Existing infrastructure has already been constructed for a power plant of 3.2GW. Choosing an alternative location would require this infrastructure to be rebuilt at an alternative location at extra cost. In addition, the TPC site itself was allocated and sized specifically to accommodate this further development, and as such no additional land acquisition is required for TPP2, or the resettlement of any people. Using the existing site also prevents the need to disturb other undisturbed land uses or habitat. Accordingly, the site allocated to TPP2 is deemed the most appropriate location for the new power plant and no other alternative locations are recommended.

- Alternative Thermal Power Sources – Given the abundance of natural gas available in Kashkadarya, the use of other fuel types is considered inappropriate. A summary assessment of alternative fuel types also indicates that combined cycle natural gas plants produce the lowest levels of emissions and waste streams when compared to coal and oil-fired power plants.

- Alternative Technology Options - There are multiple technologies which are able to operate on natural gas for the generation of electricity, these include:
  - Reciprocating gas engines,
  - Conventional gas-fired boilers with Steam Turbines (STs),
  - Open Cycle Gas Turbines (OCGTs), and
  - Combined Cycle Gas Turbines (CCGTs).

  Due to the number of units in service and hours of operation of F-class CCGTs, they are considered a proven technology, for this reason F-class CCGTs are recommended for the project, over the only slightly more efficient G, H and J class units.
- Alternative GT Manufacturers - During the TPP2 tender process it is likely that GTs from each of the four major Original Equipment Manufacturers (OEMs) will be offered by bidders. For the purpose of this EIA we have concentrated on configurations utilizing the Mitsubishi 701 F4 gas turbine, as this is the unit installed in the neighboring TPP1 and to enable direct comparison between TPP1 and TPP2.
- Alternative Water Cooling Options - The potential cooling methods for the TPP2 include:
  - Once-Through Cooling (OTC) system. For projects with access to sufficient water, OTC provides the best all year round performance. However, the variable flow in the KMK (especially in the winter months) limits periods of the year when OTC can be used.
  - Cooling Towers Dedicated for TPP2. The volume of water required for a cooling towers is dramatically less than that required for a OTC project of similar size, as water is only needed to be made up into the tower to replace water lost by evaporation or blow down (required to maintain water quality).
  - Atmospheric Sprays. The current atmospheric spray system at TPP0 appears to be inefficient, ineffective and already compromising the whole KMK cooling system, plus a similar system would be a very high capital cost. This system has not been given further consideration.
  - Dry Air Cooled Condensers (ACC). ACCs are not compatible with wet cooling methods, and therefore would have to operate all year round i.e. an ACC could not be used in unison with the once through system. While the performance of the ACC may be considered comparable to wet methods during periods of cold ambient temperature, performance suffers considerably in periods of high ambient conditions.

  The recommendation for the cooling configuration (which is discussed in detail under section **G.6.6 – Surface Water Hydrology**) would be:
  - OTC for summer periods when there is adequate water available,
  - Dedicated cooling tower operation during the winter months when the availability of water is less and also during summer months to manage thermal discharge issues.
- Pollution Control Technologies - Based on the results of the air dispersion model prepared for the Project there is no requirement for further NOx abatement to be installed. This would not be considered BAT for this project. It should also be noted that the assessment has been carried out assuming the NOx emission limit guarantee of 25ppm and during operation it is likely that the turbines would perform significantly below this guarantee meaning that the assessment results are very conservative. BAT is a specific concept which is related to EU requirements and is not a concept adopted by the IFC in their guidelines. Projects funded in accordance with IFC guidelines should meet Good Industry Industrial Practice which this project does by meeting 25ppm. The air quality assessment indicates that the impacts are acceptable and therefore no additional abatement is required as the cost of that would not be justifiable based on the impacts.

D. Existing Conditions

10. Air Quality – Routine monitoring of Carbon Monoxide (CO), Sulfur Oxide (SO_X) and Nitrogen Oxides (NO_X) from TPP0 emissions stacks indicates that stack emissions are within the limits specified for TPP0 by the State Committee for Nature Protection (Goskompriroda). Ambient air quality monitoring undertaken in 2017 at twelve locations in and around the TPC (including Nuriston and Mekhnatabad, the main receptors in the Project area) indicated that levels of NO_2 and CO were negligible. Additional monitoring of SO_2, NO_2 and CO was undertaken in November 2017 in Jayrun and Navruz. All of the parameters measured were well below the national standards. Levels of dust were elevated above national standards, but this is considered a natural occurrence in this region of Uzbekistan.

11. Approximately 70 km southwest of Karshi, and 15 km east of the TPC in the Gouzar District, Uzbekneftegaz (UNG) owns and operates the Shurtan Gas Chemical Complex (SGCC) which went into operation in 2001. The main and backup fuel for the TPC is natural gas from Shurtan gas fields (approximately 30km north east of the TPC) which is then processed at the SGCC. Supply of gas to the TPC is provided by two independent gas pipelines. Production output of each gas-distribution station ensures 100% of gas supply to satisfy the capacity of a power plant equal to 3,200MW.

12. The SGCC is supervised by the State Nature Protection Committee's (Goskompriroda) monitoring service in Karshi, and according to the TPP1 EIA their published results show that the cumulative impacts from a combination of emissions from the two facilities (TPC and SGCC) are insignificant. Baseline monitoring of a range of air quality parameters was undertaken as part of the Oltin Yol Gas to Liquids Project EIA (located adjacent to the SGCC). The results showed that the majority of the monitored baseline data is considered low in comparison to air quality standards (national and IFC). However, two chemicals (benzene and SO_2) were identified in background air as chemicals of potential concern for inhalation of air by residents in the various settlements close to the SGCC (not Nuriston). Concerns relating to emissions from SGCC were raised by Nuriston residents during the consultation meetings for this EIA.

13. Air Quality Dispersion Model - Dispersion modeling was undertaken as part of the TPP1 EIA to determine the likely impacts of emissions from TPP1 and TPP0. The model concluded that the maximum predicted ground level concentrations of Nitrogen Dioxide (NO_2) and CO will not exceed any of the reference standards and guidelines for ambient air quality beyond the boundary of the TPC and that atmospheric emissions from TPP0 and TPP1 are not predicted to have a significant impact on ambient air quality, human health, and the environment.

14. Carbon Dioxide Emissions – Calculations prepared by MMCS indicate that Carbon Dioxide (CO_2) emissions from TPP0 are approximately 3.0m tons per annum and 2.4m tons per annum from TPP1. This gives approximate emission rates in grams per kilowatt hour of 511 and 344 for TPP0 and TPP1 respectively.

15. Climate Change - Future scenarios indicate that average warming in Uzbekistan over the next 20 years for the medium scenario will be about 1 – 2.5°C. According to a recent ADB report on climate change in Central Asia, the composition of the four components of stream flow (rainfall-runoff, snow melt, glacier melt, base flow) is very likely to change in the future. This will have major impacts on total runoff, but especially on seasonal shifts in runoff. The runoff peak will shift from summer to spring and decrease in magnitude. Total annual runoff into the downstream areas is also expected to decrease by 26-35% for the Amu Darya river by 2050.

16. Topography and Seismicity - The topography of the Project area can mostly be described as gently rolling to flat, with very few visually significant features occurring within or in close vicinity of the TPC. The site of TPP2 itself, is located approximately 380 meters above sea level. Based on the Russian Code MSK-64, the seismicity of the construction site is magnitude 8.

17. Water Supply – The Karshi Main Canal (KMK) flows alongside the northern boundary of the site and is the source of cooling water for the TPC. The KMK was constructed between 1967 and 1976 and intended originally to provide irrigation water to the Karshi region, only later in 2004 becoming a source of water for TPP0. The KMK is concrete lined and has a design capacity of approximately 180m^3/s, but maximum flow is currently limited to 150m^3/s which is well above its average flow of around 55 m^3/s. The other source of water for the TPC (potable water, make up water, etc) is the Talimarjan Reservoir located approximately 8km south of the TPC with a maximum storage capacity of 1,525 million m^3.

18. TPP0 requires water for a number of processes at the site. The largest requirement is for cooling water to cool the turbine (approximately 25 m^3/s). TPP0 was constructed to operate two systems; 1) OTC during periods of high flow in the KMK; and 2) re-circulating system during periods of low flow.

19. According to design documents, at full capacity TPP1 will require 16 m^3/s of water. That would result in a combined extraction rate from the KMK for both TPP0 and TPP1 of 41 m^3/s during the summer months. During the original planning phase for the TPC it was estimated that the total power output from the project would be 3,200 MW and as such it was envisaged that eventually more than 120 m^3/s would be extracted from the KMK. Therefore 41 m^3/s is well within the design capacity of the KMK, but as noted above, the average flow is around 55 m^3/s. During the winter months TPP1 will operate a re-circulating system via a newly constructed water cooling tower. Losses from the new system will be less that TPP0. However, there will still be seepage losses from the spray basins.

20. Thermal Pollution - Thermal plants, such as TPC that use an OTC system require a significant volume of water to cool and condense steam. The cooling water will be discharged from the TPC approximately 10°C warmer than the ambient temperature of the KMK. This discharge needs to be controlled to ensure that the higher water temperature does not result in thermal pollution.

21. The issue of thermal pollution was discussed as part of the TPP1 EIA. However, review of the EIA highlighted several inconsistencies in the analyzed data and the thermal discharge calculations. The TPP1 EIA concluded that the discharge water (from TPP0 and TPP1) would increase the KMK water temperature at the immediate mixing point by approximately 2.7 °C to an average of 18.7 °C. However, the TPP1 EIA calculations do not take into account the KMKs seasonal flow variations or the variations in the KMKs ambient temperature.

22. Water Quality - Water quality of the KMK is measured regularly by TPP0 staff at the water intake and discharge outlet of TPP0. The results show that most parameters are within national standards with the exception of sulfate and BOD which are both slightly elevated above the standards. However, the elevated levels of BOD and sulfate occur at both the intake and discharge points indicating that these higher levels are naturally occurring (as is the case of sulfate) or a result of some other activity downstream possibly within the Amu Darya river. Effluent discharge is also monitored at drain K-3-2. Discharged treated water from the Nuriston sewage treatment plant (which serves the TPC) and water from the TPC sludge pits flows into drain K-3-2. The most recent water quality tests from drain K-3-2 indicate that all parameters (with the exception of slightly elevated levels of mixed substances and dissolved minerals) are within the approved maximum allowable concentrations (see **Table E-6**). Recent water quality

monitoring of the discharge from the sludge pits also shows that all parameters measured are within the approved maximum allowable concentrations with the exception of iron (resulting from rusty pipes).

23. Soils - Consultations with TPP0 staff have indicated that the TPP2 site has not previously been used for the storage of any hazardous liquids or materials that may have led to soil contamination. The TPC site layout was prepared with the anticipation of a power plant of 3.2 GW, and as such the site of TPP2, like TPP1 before it, has been left unoccupied within the boundary of the TPC site with the exception of portions of the TPP2 site that were used as a lay down area for construction materials during the construction phase of TPP1. Although environmental management during the construction phase of TPP1 adjacent to the TPP2 site was far from ideal, no pollution events were noted in the area of TPP2, or adjacent to TPP2 site during the routine environmental monitoring of TPP1 construction activities by the TPP1 Engineer. Accordingly, no significant levels of soil contamination are assumed to be present within the TPP2 site.

24. Flora and Fauna - Within Uzbekistan there are 47 Important Bird Areas (IBAs) including the Talimarjan reservoir. Observations carried out in the vicinity of the reservoir in the last few years indicate that the breeding bird community of the reservoir is poor in species diversity.

25. The land around the TPC has been heavily disturbed by human activity in recent years and no special status flora or fauna has been observed in, or within the vicinity of the TPC. The site of the propose TPP2 itself comprises open land contained wholly within the boundary of the TPC site, no vegetation or habitat for wildlife can be observed within this area.

26. According to recent studies a number of fish species can be found within the KMK (silver carp, grass carp, carp, and pike perch) none of which are known to be special status. According to recent reports there is a commercial fishery in the Talimarjan reservoir, but there is no commercial fishing within the KMK. Some recreational fishing can be observed from time to time in the KMK close to the TPC. There are no protected areas within 100 km of the TPC.

27. Socio-economic - TPC is located in the relatively sparsely populated rural area of Nishon district, in Kashkadarya region. A significant economic activity of the province is agriculture, with cotton being the dominant crop. The KMK was constructed specifically to irrigate this part of Kashkadarya. Grains and livestock rearing also make contributions to the agricultural economy. The majority of the agriculture is irrigated agriculture supported by an extensive system of canals and pump stations which make up the KMK. TPC is one of two major industrial sites in the area, the other being the Shurtan Gas Chemical Complex (SGCC).

28. Health – Consultations with TPP0 medical staff indicated that he prevalent health conditions amongst the TPP0 workers are sore throats and chronic heart disease such as angina. Respiratory diseases are also quite common as a result of the high naturally occurring dust levels in the area. Consultations held in Nursiton and Mekhnatabad revealed that some locals are concerned about air emissions releases from SGCC (these concerns were also noted in an EIA prepared for the Oltin Yol Gas to Liquids Project in Shurtan). SGCC is not part of the Project itself and is owned and operated by Uzbekneftegas. Several people thought that SGCC had an un-official procedure to release emissions to air during the night which was leading to specific health issues including problems with kidneys, hair loss and headaches. Discussions with Doctors at the health facility in Nuriston indicated that it could be possible that air emissions from SGCC may be impacting upon the health of SGCC workers and potentially to the population living in the immediate vicinity of the SGCC. However, they also noted that no emissions related health impacts had been identified associated with the TPC.

29. Consultations in Mekhnatabad also revealed that villagers were drinking water sourced from the KMK, despite the availability of potable water provided to residents, at a cost, via water tanker trucks. Mekhnatabad is located upstream of the KMK.

30. A health impact assessment (HIA) was undertaken by a national consultant to assess the health and safety impacts/risks of the project, especially from air quality emissions of the project but also in terms of water quality and other impacts/risks, to the existing communities within the project area of influence, notably the communities at Nuriston and Mekhnatabad. As noted by the HIA, available data was limited and the quality of data provided for analysis poor. The HIA summarised that:

- Mekhnatabad inhabitants examined health indicators were worse comparing to Nuriston. Respiratory issues may be a result of naturally occurring dust in this area and also to indoor pollution as housing condition which are worse comparing to Nuriston community. However, data supplied only dates to 2011, as such no comparison with pre-TPC periods has been available. In addition, no disaggregation of impacts from TPC and SGCC has been completed due to a lack of data from 1995 onwards.
- Mekhnatabad community have difficulties to access for General Practice services. Nuriston medical facility is poorly equipped and has shortages in medical doctors.
- Mekhnatabad population has ever less access to gas, power; not connected to a water supply system and had to source their drinking water themselves directly from the KMK (upstream of TPC).

31. Noise – Noise monitoring was undertaken in January, 2017. The results of indicate that daytime and nighttime noise levels in Nuriston meet the IFC and Uzbek daytime and nighttime standards in all cases except two, and in those instances it was exceeded by only 1 and 2 dB. 72 dB(A) was recorded at a location on the southern boundary of the TPC. The nearest residential properties to this location are more than 800 meters away, within the Sanitary Protection Zone (SPZ) which prohibits residential properties in this area. According to TPC staff these properties have been constructed in the SPZ after construction of TPP0. Attenuation as a function of distance alone will be sufficient to limit the noise exposure of residents in the SPZ to less than 45 dB(A) from this location.

E. Impact Identification

32. Potential Air Quality Impacts - During construction of TPP2, air quality is likely to be degraded by a range of operational activities including:

- Exhaust emissions from the operation of construction machinery (e.g. NO_X, SO_X and CO);
- Open burning of waste materials; and
- Dust (Particulate Matter (PM)) generated from excavation works, borrow pits, concrete batching plants, haul roads, unpaved roads, exposed soils and material stock-piles.

33. The combustion of fossil fuel gives rise to a number of pollutants with the potential to negatively affect local air quality. With respect to natural gas (the proposed fuel for the Project), the primary pollutants of concern are:

- Oxides of nitrogen (NO_x).
- Carbon monoxide (CO).

34. The project will not lead to emissions of sulfur dioxide (SO_2). The specification of the natural gas provided in the EPC contract, which the plant has been designed for contains no hydrogen sulfide or sulfur. In addition, fuel samples undertaken during the commissioning phase confirmed that there was no monitored concentrations H_2S or Sulfur in the gas supply Therefore, at worst it is antiquated that there would only be trace levels in the fuel supplied.

35. The project will also not lead to emissions of particulate matter. This is confirmed by the European Commission's Best Available Technique Reference (BREF) document for large combustion plants which states "The efficient combustion of gaseous fuels does not generate particulates".

36. To account for the future operation of TPP1, ambient concentrations for a 'future baseline' have been assessed. In addition, the impacts of the Project in isolation and the cumulative impacts have also been considered. The following situations have been assessed:

- Operating situation 1 – The future baseline based on the operation of TPP and TPP1 firing on natural gas continuously all year.
- Operating situation 2 – The Project in isolation firing on natural gas continuously all year.
- Operating situation 3 – The cumulative impacts from the operation of the Project, TPP and TPP1.

37. Operating Situation 1 - The maximum results from the modeled grids indicates that the future baseline concentrations will be below the national air quality standards for NO_2. This demonstrates that the airshed will not be non-degraded with the operation of TPP and TPP1. In accordance with the significance criteria assigned to the assessment as the future baseline concentrations are all below 50% of the relevant standards and therefore the sensitivity of the airshed to future change is described as 'negligible'.

38. Operating Situation 2 - The Project's maximum predicted process contributions are below 25% of the national and international standards for all NO_2 averaging periods, with the exception of the 30-minute averaging period, where the maximum process contribution is 26.8%. The modeled top 10 results for the 30-minute averaging periods show that there are predicted to be only nine 30-minute periods in the worst meteorological year used in the assessment where the maximum predicted 30-minute average is above 25% of the national standard. The application of the IFC's 25% rule is a suggested approach to allow future sustainable development in an airshed. Therefore, the Project's process contributions are considered to meet the requirements of the IFC EHS guidelines based on:

- the limited number of times that the 30-minute concentrations are above 25% of the standard
- the maximum concentrations are only just above 25% of the standard
- the 30 minute Uzebek standard of 85µg/m^3 is considered extremely stringent when compared to the international standards, such as the EU one hour standard of 200µg/m^3

39. Operating Situation 3 - The cumulative maximum concentrations from the Project are well below the national legislated standards at all locations and therefore it can be concluded that the airshed will remain non-degraded. The contour plots prepared by the assessment show that the predicted concentrations at residential areas are well below national and international air quality standards.

40. CO_2 Emissions – Emissions from TPP2 will be approximately 350 g CO_2-e/kWh which would result in the emission of an estimated 2,363,130 CO_2-e/a for 7,500 hours of operation. Taking into account TPP0 and TPP1 his would give an average emission rate for TPC of 401 g CO_2-e/kWh. A review of gas fired power plants with a generation capacity over 500 MW in North America indicates that the average emission rate from these facilities is around 508 g CO_2-e/kWh. Given this value as a reference point it appears that the TPC as a whole produces considerably lower levels of CO_2 emissions than comparable gas fired power plants in North America.

41. According to the World Bank, Uzbekistan's total CO_2 emissions in 2013 were 103,226,000 tons, or 0.34% of global CO_2 emissions. Potential emissions from TPP1 and TPP2 would therefore increase the 2013 figure by 4.7m tons, or around 4.5%.

42. Climate Change – The ADBs Climate Change Screening report prepared for the Project by the ADB indicates that the risk of climate change impacting upon the Project is low, and that the risks of precipitation increases or decreases in the Project area are low. However, other ADB reports suggest that water availability in the Amu Darya will decrease. The KMK is fed by water from the Amu Darya which in turn provides cooling water for the TPC.

43. Calculations undertaken as part of this EIA indicate that the percentage of water currently needed for TPC represents between 3% and 6% of total current Amu Darya flow. This would rise to 3% and 10% of total Amu Darya flow by 2041 – 2050 using climate change predictions provided in recent ADB reports. However, these figures are based on the worst case scenario, and any potential increase in the percentage of flow could in fact be lower.

44. Soils - Potential contamination of soils could occur during both the construction and operational phase of the Project resulting from poorly managed fuels, oils and other hazardous liquids.

45. Thermal Pollution - Thermal pollution is any discharge that will dramatically alter the temperature of a water source. If the temperature of discharge water is significantly warmer than the ambient water, it can negatively affect water quality. There are several significant consequences of thermal pollution, including diminished dissolved oxygen levels, fish kills and influxes of invasive species.

46. National regulatory requirements specify that water discharge from the TPC shall not increase more than 3°C in comparison with the monthly mean temperature of the hottest month of the year in the last ten years (26°C), so the discharge waste water temperature shall not exceed 29 °C. This regulatory requirement has been in place for a number of years, and as such it is assumed that the ecology of the KMK, an engineered irrigation channel, will have adapted to this temperature limit. In addition the IFC environmental guidelines for Thermal Power Plants state that "The effluent should result in a temperature increase of no more than 3°C at the edge of the zone where initial mixing and dilution take place. Where the zone is not defined, use 100 meters from the point of discharge when there are no sensitive aquatic ecosystems within this distance".

46. Accordingly, any thermal discharge from the TPC, whether it is from TPP0, TPP1 or TPP2 or a combination of all three, should not exceed 3°C at the edge of the zone where initial mixing and dilution take place and shall not exceed 29°C at the immediate mixing point. A sample of water temperature was undertaken in November 2017 as several points, including the 2km upstream of the TPC to establish ambient temperatures (17°C), at the water intake point to TPC (17 °C), at the immediate discharge point to the TPC feeder channel (20 °C) and at the immediate mixing zone with the KMK (19.4 °C). The results show that the current thermal discharge from TPP1 and TPP0 are within IFC and national guideline limits.

48. Calculations undertaken as part of the EIA indicate that there are substantial periods of the year when TPP0 and TPP1 would not be able to meet the national guidelines for thermal discharge whilst operating in OTC. The periods get even shorter when TPP2 is added to the equation along with the more stringent IFC guidelines.

49. Water Use **-** A cumulative total of 56 m^3/s of water will be required for operation of the TPC. Water losses during OTC mode would account for approximately 0.25 m^3/s, or less than 0.5% of the average KMK flow. This is not considered significant and will not impact upon downstream water users.

50. It should be reiterated, that the water in the KMK is provided for agricultural use, first and foremost. The TPC simply takes the water that is available and pumps it around the plant before discharging directly back to the KMK.

51. The distance between the intake and discharge points of the TPC and the KMK is no more than 500 meters. The water level in this point between the intake and discharge points never decreases below the water level in the KMK, accordingly a passage for the movement of fish always remains, even when flow is low in the winter periods (which is dictated by agricultural requirements, not the TPC).

52. Groundwater - There will be significant use of fuel and lubricant and other hazardous liquids such as paints during the construction and operational phases. Without standardized materials handling and storage protocols in place, spills and contamination of groundwater and soils is possible. Other impacts to groundwater could occur from the washing out of concrete mixers onto bare soils and a lack of oil and grease interceptor tanks in camp drainage systems. It has not been possible to determine if there are groundwater users within the vicinity of the K-3-2 drain. However, given the high salinity of groundwater in the region and the fact that a large portion of the population in this area are linked to networked potable water supplies it is considered unlikely that there are many groundwater users close to K-3-2.

53. Flora & Fauna - Potential impacts to flora are negligible due to the fact that the Project will be located inside the TPC site boundary within an area that is currently utilized as a lay-down area for TPP1 construction materials and comprises no vegetation.

54. Avifauna - The addition of four new discharge stacks to the TPC might have an effect on overflying birds following migration routes. However, any additional impact of this sort over that from the existing 270 m stack of TPP0, the two TPP0 stacks of the preheat and district heating boilers, and the four stacks of TPP1 is likely to be minimal.

55. Fauna - The KMK is an engineered watercourse, fed by a pumping system from the Amu Darya to supply irrigation water to agricultural areas around Karshi. The A number of fish species are present within the KMK, none of which are special status. There are no fisheries within the KMK and no livelihoods depend on fishing within the canal. The KMK does not constitute a natural freshwater ecosystem. TPP0 has been operational since 2004 and is regulated by a specific thermal discharge limit of 29°C. TPP1 and TPP2 will be constructed to operate within even more stringent IFC thermal discharge guidelines which will also apply to TPC as a whole. Given that no significant impacts to fish have been identified in the KMK during the last 13 years of operation, it is considered highly unlikely that operation of TPP1 and TPP2 will result in significant impacts to fish within the KMK, especially given the need to implement more stringent IFC guidelines.

56. Infrastructure - During the construction phase of TPP1 the access roads to the TPC and Nuriston have been degraded by the movement of heavy goods vehicles transporting equipment to the TPP1 site. It is possible that these roads will be further degraded by construction vehicles servicing TPP2. In addition, equipment for the construction of TPP2 will need to be transported long distances, often by road. During the TPP1 construction phase the Project was delayed significantly due to poor logistics planning, this could occur again without appropriate plans in place.

57. Waste Management - Non-hazardous and hazardous wastes will be generated that require transport and disposal in a manner that ensures protection of the natural and human environment. Improper storage, handling and transport of solid and liquid wastes at the power plant can lead to loss of containment and spillages which could give rise to soil contamination.

58. Waste sewage water from TPP2 will be disposed of to the existing sewage treatment plant, other waste waters will be treated internally and re-used in the TPC system and as such no potential pollution from these waste water streams is anticipated. Waste water from desalinization plant and chemical treatment plant is currently discharged to concrete lined sludge pits. These pits, and the pipeline the feeds the pits, require rehabilitation in order to prevent waste water leaking from the sludge pits and pipeline and into the surrounding soils. Due to the very slow filling process in the sludge pits sludge will remain in-situ within the pits for the lifecycle of the Project. There is no discharge of waste sewage water, or water from the sludge drying pits to the KMK. Consultations with UE indicate that there are no abstractions of water from K-3-2 drain itself.

59. Community Health and Safety - The presence of the Project could affect the health, safety and security of the local communities as a result of worker-community interactions, in-migration to the area, increased incomes in the local community that may be used for drugs, alcohol and prostitution, the risk of injury associated with construction and operational activities, increased pressure on health care resources and changes to the environment.

60. The Shurtan Gas Chemical Complex (SGCC) has also been identified as a potential source of harmful air emissions. The SGCC, which is owned and operated by Uzbekneftegas, provides processed gas to the TPP but is not part of the construction project and is not part of the TPC itself.

61. A HIA undertaken as part of this EIA lacked enough long term data to determine if SGCC was in fact the source of health issues in the Project area. However, it is clear that the local population feel that SGCC is the source of high levels of air emissions that are making people unwell.

62. The results of the air dispersion model indicate that the TPC will not be a source of air pollution that would affect the health of people living within the vicinity of the Project, including Nuriston and Mekhnatabad.

63. Residents of Mekhnatabad are also reportedly drinking water sourced from the KMK. However, the source is upstream of the TPC, and the residents also have an alternative supply of potable water from water tanker trucks, but they choose not to use it as the costs are higher than the free water from the KMK.

64. Occupational Health and Safety - Due to the nature of the activities being undertaken during construction, worker health and safety is a key risk with the potential for accidents that may result in injuries and fatalities as well as lost man-hours. In addition, long term exposure to elevated noise levels during the operational phase of the Project could result in negative health impacts to workers at the TPC, especially those working in noisy areas such as the power blocks.

65. Construction Noise - During construction and commissioning of TPP2 there will be short-term impacts to local residents caused by construction noise and vibration. Sources of noise will include increased traffic, construction equipment, venting of equipment during cleaning and testing, and test-running equipment (commissioning). Taking a random list of ten construction equipment items as a representative collection that might be operating at any one time (121 dB(A) total), the noise level in Nuriston would be approximately 60 dB(A) and 57 dB(A) in Mekhnatabad. It is unlikely that all equipment items would be operating at one time, and that all would be emitting the maximum noise levels at one time. It is also noted that TPP1 and TPP0 will act as noise barrier between TPP2 and Nursiton. This may lead to a reduction of between 3 and 5 dB which would reduce actual noise levels to around 55-57 dB(A) in Nuriston, broadly in line with IFC and Uzbek standards for daytime noise. To meet nighttime standards require stricter guidelines may be required, such as prohibiting certain types of noisy

equipment during the night. To meet nighttime standards stricter guidelines, such as prohibiting certain types of noisy equipment during the night would reduce noise levels in residential areas below the IFC limits for nighttime noise

66. TPP2 Operational Noise - For most gas-fired power plants, the major noise sources during base load operation are the air-cooled condenser (ACC) or cooling tower, steam turbine (ST), gas turbine, combustion inlet filter house, and the exhaust stack or HRSG. TPP1 includes contractual specifications stating that this equipment should not generate noise levels above 80 decibels within 1 meter of the source of the noise, and TPP2 will be constructed to similar specifications. Calculations of cumulative noise from an indicative TPP2 plant inventory list (assuming the noise levels from each of these areas in TPP2 is 80 decibels) indicate that the noise level from TPP2 would be approximately 92 dB(A) which should result in noise levels around 37 dB(A) in Nuriston, well below IFC and Uzbek standards for daytime and nighttime noise.

67. Cumulative Noise - Noise monitoring results undertaken for this EIA show maximum daytime noise levels at the boundary between TPP0 and TPP1 of 75 dB(A) and nighttime levels of no more than 60 dB(A). The TPP1 EIA of 2009 reported noise levels from certain pieces of TPP0 of more than 100 dB(A). If we take a relatively high level of 105 dB(A) as a representative noise level from TPP0 and combine with TPP1 and TPP2 noise levels (92 dB(A)) the cumulative noise levels from the TPC as a whole would be 101 dB(A). Over a distance of 1km noise levels from the TPC would reduce to around 45 dB(A) which is lower than IFC and Uzbek noise standards for both daytime and nighttime noise. Accordingly, no significant cumulative noise impacts to the residents of Nuriston or Mekhnatabad are anticipated during the operational phase of the TPC.

68. Compliance Impacts - In addition to the impacts associated with the construction and operation phases of the project several potential compliance impacts have also been identified including a lack of environmental clauses in contracts and a lack of construction compliance inspection and environmental training (e.g: if there is no one knowledgeable to undertake compliance monitoring, inspection and regular reporting, little of the EMP will be implemented or completed).

F. Environmental Audit Findings

69. An environmental audit was undertaken as part of the Project to:

- Provide an overview of TPP0 environmental aspects and potential impacts and make recommendations for corrective actions to TPP0;
- Review the TPP1 EIA to identify any potential mitigation measures that need to be strengthened to ensure compliance with ADB SPS (2009);
- Review the Contractors performance on TPP1 and identify the areas of regulatory and contractual non-compliance;
- Considering any regulatory and contractual non-compliance identified during the construction phase of TPP1, make recommendations to ensure the same issues do not arise during the construction phase of TPP2.

70. A range of potential and existing environmental impacts were identified during the audit, most of which related to the current construction activities at TPP1. **Section F** provides a corrective action plan to ensure that these impacts are mitigated and where relevant recommendations have been incorporated into the EMP for TPP2. The audit can be found in its entirety as **Appendix E**.

G. Mitigation Actions

71. Air Quality – The following key design features have been accounted for are:

- An exhaust stack height of 85 metres to ensure effective dispersion of emissions.
- Emission limits guaranteed to meet 51 mg/Nm³) for NO_x.

72. During operation emissions of NO_x will be monitored continuously via a continuous emissions monitoring system.

73. Although the modeling has demonstrated that impacts are below 25% of the standards applicable in the assessment with the exception of the 30 minute averaging period, the total thermal input is above 1200MWth. Therefore, ambient air quality monitoring will be undertaken at two ambient monitoring stations will take account of the following:

- Continuously monitor ambient concentrations of NO_x and NO_2 (as well as CO, SO_2 and Benzene) in accordance with internationally recognised approach.
- Include a dispersion model ready meteorological station in accordance with US EPA guidance which can monitor wind speed, direction and temperature.
- Be subject to regular calibration procedures and audits to ensure proper function.
- One to be located offsite, at the point of maximum impacts predicted by the dispersion modelling.
- One to be located offsite in the populated area.

74. The effectiveness and the need for the two monitoring stations will be reviewed annually and if monitored concentrations confirmed to be well below the standards it will be simplified or reduced.

75. Climate Change - The figures presented in this EIA suggest that, even in the worst case scenario, there will be enough water in the Amu Darya river by 2041-2050 to continue to supply the TPC comfortably in both OTC, when flow is high, and most importantly in recirculation mode when flow is low or thermal pollution limits are reached. It is important to note that the flow of the KMK is determined by agricultural requirements, the TPC simply uses the water for cooling and discharges it directly back to the KMK with minor losses. If anything, the demand for increased irrigation water in the Karshi region and the KMK may place a stress on the Amu Darya, but the TPC itself will not dictate this demand.

76. Notwithstanding the above, it is recommended that UE continues to assess the potential impacts of climate change on the TPC, including temperature increase in the KMK and its impacts to thermal discharge. Such an assessment should be undertaken every five years and could form part of an overarching assessment of climate change on all of UEs assets including their hydropower facilities.

77. Soils - The EPC Contractor will be responsible for the preparation of a Spill Response Plan prior to the start of construction. The plan shall specify the procedures for managing spills of hazardous liquids. During the construction phase the EPC Contractor will be responsible for a range of management measures including adequate fuel and chemical storage, filing and refueling areas, etc.

78. Thermal Pollution - There are certain parameters within which TPP2, and TPC as a whole has to function including water discharge temperature. First, and foremost, to meet the national regulatory requirements the water temperature discharge from the TPC must not exceed 29°C in the KMK. In addition, TPC should comply with the IFC guidelines for thermal power projects.

79. Looking at the data provided as part of this EIA for the immediate mixing zone we can see that the temperature in this zone varies with flow rate. Discussions with TPC staff indicated that additional flow in the KMK to supply the TPC can be provided, however flow rate is predominantly driven by water requirements in KMK irrigation system and it must be agreed with by the authority in charge of the KMK system. Pumping more water into the KMK raises several issues, such as; a) the need for new permits, b) diverting water from the Amu Darya and its downstream users and c) the additional water needed for the TPC may not be required in the irrigation system and would simply run out into the desert. Accordingly, it is recommend that flow rate should not be used as a tool to reduce the temperature in the KMK mixing zone. Instead, real time continuous monitoring stations should be provided within the KMK to determine when thermal pollution limits are reached and when the TPC, or a combination of units, should switch to re-circulation mode in order to meet the national regulations and international guidelines.

80. Four locations should be monitored:

1. Approximately 200 meters upstream from TPC to determine ambient water temperature.
2. At discharge point to KMK feeder channel.
3. At the immediate mixing point where the feeder channel meets with the KMK.
4. At a point 100 meters downstream of the immediate mixing point, i.e. the edge of the mixing zone.

81. If at anytime the discharge water temperature a) reaches 29 °C at the immediate mixing point all units; or b) reaches 3 °C above the ambient temperature at the edge of the mixing zone TPP2, or a combination of TPC units shall switch to recirculation mode. Adoption of such a monitoring program would ensure that water temperatures do not exceed national standards, or IFC guidelines, thereby preventing any significant impacts to fish within the canal, ensuring efficient use of the KMK water, eliminating impacts to water users downstream of the Amu Darya and also avoiding transboundary issues.

82. Notwithstanding the above, a detailed fish survey for baseline data on fish population (abundance and richness) and behavior in the KMK, will be conducted in May-June 2018 by the Engineer. This survey will be repeated annually to determine if the TPC is impacting upon the ecology of the KMK specifically fish mortality. Although the ADB commissioned fish study indicates that fish mortality is unlikely, further assessment of this issue for the first five years of operation of TPP2 is considered prudent If fish mortality is found to be occurring due to increased temperatures in the KMK then TPC will be responsible for ensuring thermal discharge temperatures are reduced below the current limits to eliminate fish mortality. This would be achieved through detailed assessments undertaken by UE and Goskompriroda and fish specialists and necessary.

83. Surface Water - The water intakes for the water pumps in the main pump-house designed and constructed for TPP2 will meet the IFC guidelines, including recommended intake velocity of 0.15 m/s and a mesh size of 9.5mm.

84. Effluent Discharge – Discharge water from the sewage treatment plant shall be monitored against both national and IFC standards. The concrete lined pit used for the chemical treatment plant discharge and desalinization plant discharge shall to be rehabilitated to ensure that there are no leaks from the pits that could contaminate the soils around the pits. Monitoring of effluent parameters specified in the IFC Thermal Power Plant EHS guidelines shall also be undertaken on a monthly basis at the TPC discharge point throughout the operational period of the Project.

85. Infrastructure - To mitigate potential impacts the EPC Contractor should prepare and implement a Traffic Management Plan. A road condition survey will also need to be conducted

prior to construction in order to gauge the damage to the road as a result of construction traffic. If the Engineer considers that the EPC Contractors vehicles have caused damage to access roads during construction he will be asked to rehabilitate the road to a condition acceptable to the Engineer. The size of equipment being transported may require overhead transmission lines to be lifted to allow access. The EPC Contractor should, as part of his traffic management plan, indicate how he intends to manage this issue to avoid delays.

86. Waste Management - To ensure waste management is adequately controlled during both the construction and operational phase of the Project, the EPC Contractor and UE TPP shall be responsible for a range of measures including the preparation of a waste management plan, implementing a program of recycling and re-use, adequate storage of hazardous wastes and liquid wastes and ensuring correct disposal of these wastes. TPP2 waste will not be disposed of in any landfill, including the location close to Nuriston, until all necessary licenses have been obtained by the landfill operator and the licenses have been reviewed by the Engineer.

87. Construction Camps & Concrete Batching – It is assumed that the EPC Contractor will use the same construction camp facilities currently in place for TPP1. In the event that this is not the case the EPC Contractor will be responsible for a range of mitigation measures including correct siting of facilities, adequate sewage and waste disposal, etc.

88. Borrow Pits - If the EPC Contractor intends to open his own borrow pit, he should follow the mitigation measures provided by this EIA, including measures to ensure correct siting of the borrow pit. If the EPC Contractor intends to use an existing borrow pit he shall provide to the Engineer the permits and licenses of the borrow pit. The Engineer shall also undertake a due diligence audit of the borrow pit prior to approving its use to ensure it complies with best practice guidelines.

89. Occupational Health and Safety - An Occupational Health and Safety (OHS) Plan and Emergency Response Plan (ERP) shall be prepared by the EPC Contractor to manage worker safety. UE TPP shall also prepare an OHS plan and ERP for the operational phase of the Project which should form part of an overarching Environmental and Social Management System (ESMS) for the operational phase.

90. Community Health and Safety – During the construction phase of the Project EPC Contractor will be responsible for preparing and implementing a traffic management plan (TMP). The TMP will include specific conditions for traffic management around Nuriston. The EPC Contractor shall also provide regular health and safety training to their workers and also sub-contract an organization to develop and implement an HIV/AIDS policy and information document for all workers directly related to the Project. No impacts to community health and safety are anticipated from the TPC during the operational phase of the Project as predicted noise and air emissions will be below national and international limits for noise and air quality.

91. As noted in the air quality assessment above, air emissions from TPC will not result in any levels of NOx or CO above national and EU air quality standards. In addition, real time monitoring of air emissions from the TPC stack (NOx and CO) and continuous ambient air quality monitoring in Nuriston shall be undertaken during the operational phase of the Project to continually assess air quality in the Project area and ensure that emissions to air from the TPC are not affecting the local community. The ambient air quality monitoring stations in Nuriston will measure NOx and CO as well as SO_2 and Benzene (elevated levels of which were identified in the Oltin Yol EIA which is located adjacent to SGCC). In addition, a public health monitoring plan has been prepared as part of the Health Impact Assessment. This plan will be followed throughout the construction and operational period of TPP2.

92. Residents of Mekhnatabad are drinking water from the KMK despite the fact that they can purchase potable water from water tanker trucks. Although a water supply system is beyond the scope of the Project, ADB may wish to consider future funding of such a project in Mekhnatabad to resolve this situation. However, this may not completely eliminate the issue which also requires an increased understanding within the population of the health issues associated with drinking non-potable water.

93. Noise - As part of the EPC contract, noise emission performance specifications will be set for all major equipment items and for the plant overall including the requirement that ensures 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. All major equipment items will be located in buildings that will provide further attenuation of noise. The design of any additional noise attenuation measures for individual equipment items or for the buildings in which they are located, can be undertaken once equipment has been specified and selected and the specific noise emission characteristics of each item are known.

94. During the construction phase the EPC Contractor shall be responsible for the preparation of a noise management plan which includes all of the mitigation measures specified in this EIA, such as working time restriction, provision of PPE, worker exposure limits, etc.

95. During the operational phase of the Project UE TPP shall be responsible for the following:

- Preparation of a noise management plan, including a routine noise monitoring program. The noise management plan should form part of an overarching ESMS.
- Install signs or warning boards in the area with noise levels higher than 80 dB(A).
- Provision of noise protection kits, such as ear plug, earmuff, for workers who are working in the area with sound level is higher than 80 dB(A). There must be sufficient amount of these kits.
- Regular maintenance machineries and selection of relevant noise source control methods to reduce loud noise properly such as installation silencers mufflers at acoustic wall together with control noise devices at HRSG and gas turbine.
- Sound levels received by workers should not be over 85 dB(A), during continuation of 8 working hours.

H. Monitoring Actions

96. To ensure that all of the above mitigation actions are completed according to the requirements of this EIAs EMP, monitoring shall be undertaken of Project works by the Engineer and by independent monitoring specialists. Specifically both observational monitoring and instrumental monitoring shall be undertaken as follows:

- Instrumental Monitoring – This will include routine air quality, water quality and noise monitoring during the construction and commissioning phases. Schedules, parameters, locations are indicated by the EMP. The Engineer shall be responsible for contracting the independent monitoring specialists. Instrumental monitoring was also be required during the operational phase of the Project and should be conducted by UE TPP environmental staff. During the operational phase of the Project instrumental monitoring shall include:
  - A continuous emissions monitoring system (CEMS) monitoring stack emissions.
  - Continuous monitoring of thermal discharge.
  - Continuous ambient air quality monitoring.
  - Routine noise and water quality monitoring.

- Observational Monitoring – The EPC Contractors actions shall be continually monitored by the Owner or it's Engineer throughout the Projects Construction phase. This will be achieved through weekly inspections of the EPC Contractors environmental performance by national and international environmental specialists engaged by the Engineer throughout the construction period. The Engineer shall have the right to suspend works or payments if the EPC Contractor is in violation of any of his obligations under the EMP and this EIA.
- Other Monitoring – UE will undertake the public health monitoring program.

I. Consultations

97. Stakeholder consultations were undertaken in November, 2016, January, 2017 and September 2017 in Nuriston and Mekhnatabad. The key issues discussed during the consultations related to potential noise, air quality health and water impacts. However, the consultations did not reveal any environmental impacts that could not be adequately mitigated by this EIA.

J. Implementation

98. Preconstruction, Construction and Commissioning Phase - The EMP, its mitigation and monitoring programs, contained herewith shall be included within the Project Bidding documents for project works. The Bid documents shall state that the EPC Contractor is responsible for the implementation of the requirements of the EMP through his own SSEMP which will adopt all of the conditions of the EMP and add site specific elements that are not currently known, such as the EPC Contractors final borrow pit locations. This will ensure that all potential bidders are aware of the environmental requirements of the Project and its associated environmental costs. The EMP and all its requirements will then be added to the EPC Contractors Contract, thereby making implementation of the EMP a legal requirement according to the Contract. The EPC Contractor shall then prepare his SSEMP with the oversight of the Engineers International Environmental Specialist. The SSEMP will then be approved by the PMU and monitored by the Engineer and the TPP2 PMU. Should the Engineer note any non-conformance with the SSEMP the EPC Contractor can be held liable for breach of the contractual obligations of the EMP. To ensure compliance with the SSEMP the EPC Contractor should employ a national environmental officer to monitor and report Project activities throughout the Project Construction phase.

99. Operational Phase – During the operational phase of the Project UE TPP will be responsible for ensuring that the mitigation and monitoring program specified in this EIA are implemented. International best practice suggests that the best way to organize these items is through an Environmental and Social Management System (ESMS). An ESMS is a dynamic process that requires a complete set of policies and procedures to be in place (e.g. waste management plans), such that all of the mitigation measures would become an integrated way to conduct the business while simultaneously reducing the risk of pollution events and accidents, and allowing UE TPP to monitor and report on its regulatory requirements. The initial set-up of the ESMS would require external assistance from an international environmental specialist who would also provide training to the UE TPP team in the maintenance of the system.

100. Decommissioning Phase - A detailed decommissioning and rehabilitation plan must be developed prior to decommissioning TPP2. This plan should include, but not be limited to, management of socio-economic aspects such as employment loss, removal, re-use and recycling of materials and vegetative rehabilitation to prevent erosion. The decommissioning activities will be similar to construction activities and therefore recommendations outlined to manage construction phase impacts should be adhered to during decommissioning.

A. Introduction

A.1 General

101. This section of the report outlines the purpose of the EIA and provides a summary of the project identifies and the project proponent. In addition, this first section of the report describes the scope of the EIA and the methodology used to complete the assessment.

A.2 Overview

102. The Asian Development Bank (ADB) has engaged Mott MacDonald in association with Corporate Solutions Consulting (collectively, MMCS) to provide Project Preparatory Technical Assistance (PPTA) through a series of studies to assess the viability and execution of an additional 900 MW Combined Cycle Gas Turbine (CCGT) power plant at the Talimarjan Thermal Power Plant site in Kashkadarya region of the Republic of Uzbekistan i.e. Talimarjan Power Plant 2 or TPP2. The overall series of activities, reports and deliverables to be undertaken by MMCS in providing PPTA are as shown in **Table A-1** below. The document in hand provides the Environmental Impact Assessment Report.

Table A-1: Summary of Major Activities and Reports / Deliverables

Major Activity	**Report / Deliverable**
I. Sector Review and Risk Assessment	Sector Assessment Report
	Procurement Capacity Assessment Report
	Risk Assessment and Management Report
	Commercialization Roadmap
II. Engineering Design and Cost Estimates	Inception Report
	Technical Due Diligence Report
	Government's Feasibility Study
III. Compliance with Environmental Safeguards	Environmental Audit Report and Corrective Action Plan
	Environmental Impact Assessment (EIA) Report
IV. Economic and Financial Analysis	Economic Analysis Report and Financial Analysis Report
	Financial Management Assessment Report
	Financial Structure Report
V. Preparatory Work for Procurement	Market Assessment Report
	Draft Bidding Documents

A.3 Purpose of the EIA report

103. This Environmental Impact Assessment (EIA) is part of the process of compliance with the ADB's Safeguard Policy Statement in relation to the Talimarjan 2 Power Generation Efficiency Improvement Project (TPP2), or the "Project".

104. The EIA provides a road map to the environmental measures needed to prevent and/or mitigate negative environmental effects associated with TPP2. The EIA also provides a detailed description of the direct and indirect environmental effects associated with the proposed subproject during key periods of work.

105. More specifically, the EIA:

- Describes the extent, duration and severity of the impacts;
- Analyzes all significant impacts;
- Formulates the mitigation actions and presents it all in the form of an Environmental Management Plan (EMP).

A.4 Identification of the Project and Project Proponent

106. The Project, funded by the ADB, is the construction of two new 450 MW Combined Cycle Gas Turbines (CCGT) units (Units 4 & 5) at the existing Talimarjan Power Project site, in Kashkadarya Region, Uzbekistan.

107. TPP2 will form part of the Talimarjan Power Complex which, to date, comprises the following two components:
1. TPP0 – the existing 800MW gas-fired steam power plant completed in 2004 (Unit 1).
2. TPP1 – the 900MW 'phase 1' Combined Cycle Gas Turbine (CCGT) project currently under construction (Units 2&3).

108. All three components, TPP0, TPP1 and TPP2 collectively will be referred to as the 'Talimarjan Power Complex', or TPC.

109. The Government of the Republic of Uzbekistan owns and manages the energy sector in Uzbekistan with Joint Stock Company (JSC) Uzbekenergo responsible for the sector. Unity Enterprise Talimarjan Thermal Power Plant (UE TPP) is the owner and operator of TPP0 and TPP1. With a view to commercializing the power sector, there is a possibility that TPP2 could be set-up to be developed and operated as a separate entity and cost-center to TPC.

A.5 Category of Project

110. Based on the existing ADB Environmental Safeguards Policy (2009), this Project falls under ADB's project **Category A**. This category is defined as:

"*A proposed project is classified as category A if it is likely to have significant adverse environmental impacts that are irreversible, diverse, or unprecedented. These impacts may affect an area larger than the sites or facilities subject to physical works. An environmental impact assessment is required."*

A.6 Scope of the EIA

111. Scoping is the process of determining which are the most critical issues to study in the EIA and involve community participation. The scope of the EIA in hand is based upon four factors; 1) the EIA requirements of the ADB and specifically the MMCS Terms of Reference (ToR) for the TPP2 PPTA; 2) the findings of scoping consultations; 3) the defined Project Area; and 4) other best practice guidelines, e.g. IFC Guidelines for Thermal Power Plants. The following section provides further details of each of these aspects.

A.6.1 Scoping Consultations

112. Scoping consultations were held in November, 2016 in two villages within the Project Area, Nuriston and Mekhnatabad. Participants in the consultations were given an overview of the proposed project and then asked what they thought may be the significant issues that would require detailed study as part of an EIA. The following summarizes the key comments received:

- Nuriston
  - Noise and air emissions are the key impacts that affect the local population in Nuriston.
  - The stack heights for TPP1 are not high enough and NO_X pollution is occurring.
  - Extreme noise events during TPP1 commissioning are disturbing children's sleep.
  - Local roads have been damaged from the TPP1 construction vehicles.

- Mekhnatabad
  - The stack heights for TPP1 are not adequate, NO_X does not seem to be dispersing correctly.

113. **Section I** provides the full details of the scoping consultations. **Section G** discusses these potential impacts in more detail and provides mitigation measures where warranted.

A.6.2 EIA Project Area

114. The Project area **Table A-2** indicates the assessment boundaries, or the 'Project area' adopted for the EIA.

Table A.2: Assessment Boundaries adopted for this EIA

Terrestrial Environment	Aquatic Environment	Air Shed	Acoustic & Human Environment
All construction activities will be limited to the existing TPC. Consideration will also be given to the terrestrial habitat of borrow pit areas.	The assessment of the aquatic environment shall include the Talimarjan reservoir and the KMK between the reservoir and 1 km downstream of the TPC.	15 km from the TPC.	2 km from the TPC.

A.6.3 ADB Requirements

115. According to the ADB Terms of Reference (ToR) for the PPTA Consultants (MMCS), the following actions are required:

- Assess environmental impact of the new project, including greenhouse gas emissions;
- Prepare EIA reports, including environmental management plan; and
- Conduct at least two stakeholder consultations.

116. Tasks include:
1) Collect baseline monitoring data for air and water quality, sufficient for an EIA. Conduct

detailed assessment of environmental impacts of the new project. This should include impacts on associated facilities operating for the existing TPP and Phase 1 project (meaning TPP0 and TPP1), cumulative impacts from those plants and other sources of similar impacts in the same geographical area, and greenhouse gas emission. Assessment should be based on the modeling of emission dispersion and effluent discharge of cooling water during the project operation phase.

2) Develop an EIA to meet the ADB SPS, following the outline in the Annex to Appendix 1 of the SPS. The EIA should include an environmental management plan (EMP) with cost estimate and institutional arrangements for EMP implementation.
3) Assist the EA in conducting at least two stakeholder consultations. Incorporate the outcomes of the public consultation in the final draft EIA report.

A.6.4 Best Practice

117. The International Finance Corporation (IFC) Environmental, Health and Safety Guidelines for Thermal Power Plants suggest key elements of any EIA for thermal power plants should include:

- Estimation of GHG emissions (tCO_2/year, gCO_2/kWh).
- Air quality impact:
  - SO_2, NO_2, PM_{10}, $PM_{2.5}$, heavy metals as appropriate, acid deposition if relevant.
  - Incremental impacts to the attainment of relevant air quality standards.
  - Isopleth concentration lines (short-term, annual average, as appropriate) overlaid with land use and topographic map.
  - Cumulative impacts of existing sources / future projects if known.
  - Stack height determination.
  - Health impact consideration.
- Water quality / intake impact:
  - thermal discharge if once-through cooling system is used.
  - other key contaminants as appropriate.
  - water intake impact.
- Noise impact:
  - Noise contour lines overlaid with land use and locations of receptors.
- Determination of pollution prevention and abatement measures.

A.6.5 Scope of the Report

118. Given the findings of the scoping consultations, the recommendations of the ToR, best practices guidelines and the defined Project area the following scope has been followed as part of the EIA:

- **Define the Legal, Policy and Administrative Framework within which the Project will operate -** This section of the report will present an overview of the policy/legislative framework as well as the environmental assessment guidelines of Uzbekistan that apply to TPP2. Specifically, the relevant Uzbek standards for noise, water quality and air emissions will be provided along with any other guidelines considered best practice, e.g. IFC guidelines for air emissions. In addition any relevant international agreements / protocols will be discussed. The section will also identify relevant Asian Development Bank Safeguard Policies.
- **Project Description –** This portion of the EIA will provide a detailed description of the Project in terms of construction and operational aspects.
- **Alternatives** - This section discusses Project alternatives, including alternative technology and water cooling methods.
- **Description of the Environment –** This section of the report will discuss the regional and local environmental baseline conditions. This section is divided into subsections relating

to physical environment, ecological environment, economic conditions and socio-cultural characteristics. Scoping has identified the following aspects to be considered in detail:
  - Air Quality
  - Noise
  - Water Quality and Quantity
- **Findings of the Environmental Audit** – This portion of the EIA will discuss the findings of the Environmental Audit that was undertaken prior to the EIA. The audit provides useful information that is important to consider during the assessment of cumulative impacts of the TPC.
- **Potential Environmental Impacts and Mitigation Measures –** This section of the report outlines the potential environmental and social impacts arising from the aspects identified in the project description and proposes mitigation measures to manage the impacts. Specifically, this section of the report will include:
  - Air dispersion modeling and mitigation measures, such as increases in stack dimensions.
  - Identification of noise impacts and any specific mitigation measures to reduce noise impacts to workers and the local population (Nuriston).
  - Impacts to water quality, including changes in water temperature in the KMK and any impacts arising from increased water consumption.
  - These three specific issues will also consider the cumulative impacts of the TPC as a whole.
- **Environmental Management Plan & Institutional Requirements –** This section will provide the EMP for the Project and the institutional requirements for its implementation. The EMP will be divided into design, construction and operational phases and will include any management measures for TPP0 and TPP1 as identified by the environmental audit.
- **Public Consultation, Information Disclosure & Grievance Mechanism –** This part of the EIA provides a summary of all of the stakeholder consultation activities undertaken. A grievance mechanism for project affected persons is also provided along with information regarding the EIA disclosure process.
- **Conclusions and Recommendations –** The final section of the report provides conclusions and any necessary recommendations

A.7 Methodology

119. The methodology is based on the ADB, Safeguard Policy Statement (2009) and the joint experience of the International and National environmental consultants involved in the EIA. Background data and information was obtained from published and unpublished sources, e.g., on: climate, topography, geology and soils, natural resources, flora and fauna, agriculture, and socio-economic data. Several site inspections were conducted jointly by the International Environmental Specialist and National Counterpart during September and November, 2016 January, 2017 and September, 2017. The site was inspected and areas of potential environmental significance assessed carefully. In addition, noise and air quality monitoring was undertaken along with air dispersion modeling to determine the impacts of air emissions during the operational phase of the Project. Discussions were held with a number of stakeholders in order to determine their perceptions of the level of impact from Project activities (see **Section I**). Data and information obtained have been included where appropriate in the EIA Report.

B. Project Description

B.1 Section Layout

120. This section of the EIA provides the Project description. More specifically it provides:

- The Project aims and objectives and a summary description of the need for the Project;
- An overview of the existing facilities at the TPC. This is important when considering cumulative impacts, and also that TPP2 will use certain TPP0 facilities; and
- The scope of work for TPP2, including a description of the construction works required and the plants operational phase.

B.2 Project Aim and Objectives

121. The aim of TPP2 is to expand the existing TPC through the design and construction of two additional 450 MW combined cycle gas turbines (CCGT) units. The objectives of the Project are twofold:

1. Reliable provision of heating energy and electrical power for consumers of the Samarkand – Bukhara region.
2. Reliability and cost effectiveness of the power plant, reduction of the specific power resources consumption for product supply, as well as, reduction of the impact on the environment.

B.3 Need for the Project

122. Uzbekistan is an energy intensive country. The investment in CCGT technology will assist Uzbekistan in moving towards a low carbon economy. 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. The introduction of CCGT technology will therefore begin the process in Uzbekistan of reducing the average greenhouse intensity of power generation. This process will accelerate as older less efficient plants burning coal or oil are retired and more CCGT plants are added to the total asset mix. Three CCGT projects currently planned, including Talimarjan, will add over 1600 MW of capacity to the 10,000 MW currently available, resulting in a significant reduction in the average greenhouse emissions per kWh of energy generated and invoiced.

123. Expanding clean technology is also a core operating area under the ADB Strategy 2020. ADB's *Energy Policy* also aims to help developing member countries provide reliable, adequate, and affordable energy for inclusive growth in a socially, economically, and environmentally sustainable manner.

124. In addition, Uzbekistan is actively involved in energy trading with neighboring countries and is an active participant of the Central Asia Regional Economic Cooperation (CAREC). In 2008, the CAREC countries defined their long-term strategy for developing the region's energy sector as ”to ensure energy security through the balanced development of the region’s energy infrastructure and economic growth through energy trade.” Uzbekistan would like to increase the amount of gas exported to the region, and so any reduction in domestic gas consumption means that there is more gas available for export.

125. The installation of efficient CCGT technology, combined with improvements in the efficiency of the transmission system, will reduce gas consumption per kilowatt hour (kWh) generated and invoiced. The reduction in gas demand will make more gas available for export and so increase foreign revenues.

B.4 Location and Key Characteristics

126. TPC is located 7km to the north from the Talimarjan reservoir on the right bank of the Karshi Main Canal (KMK) in Nishon district of Kashkadarya region of the Republic of Uzbekistan (see **Figure B-1** for the location within Uzbekistan and **Figure B-2** for the location of the TPC locally). The nearest housing settlement is Nuriston approximately one kilometer to the north east of the TPPO (which is the nearest portion of TPC to Nuriston).

Figure B-1: Location of TPC within Uzbekistan

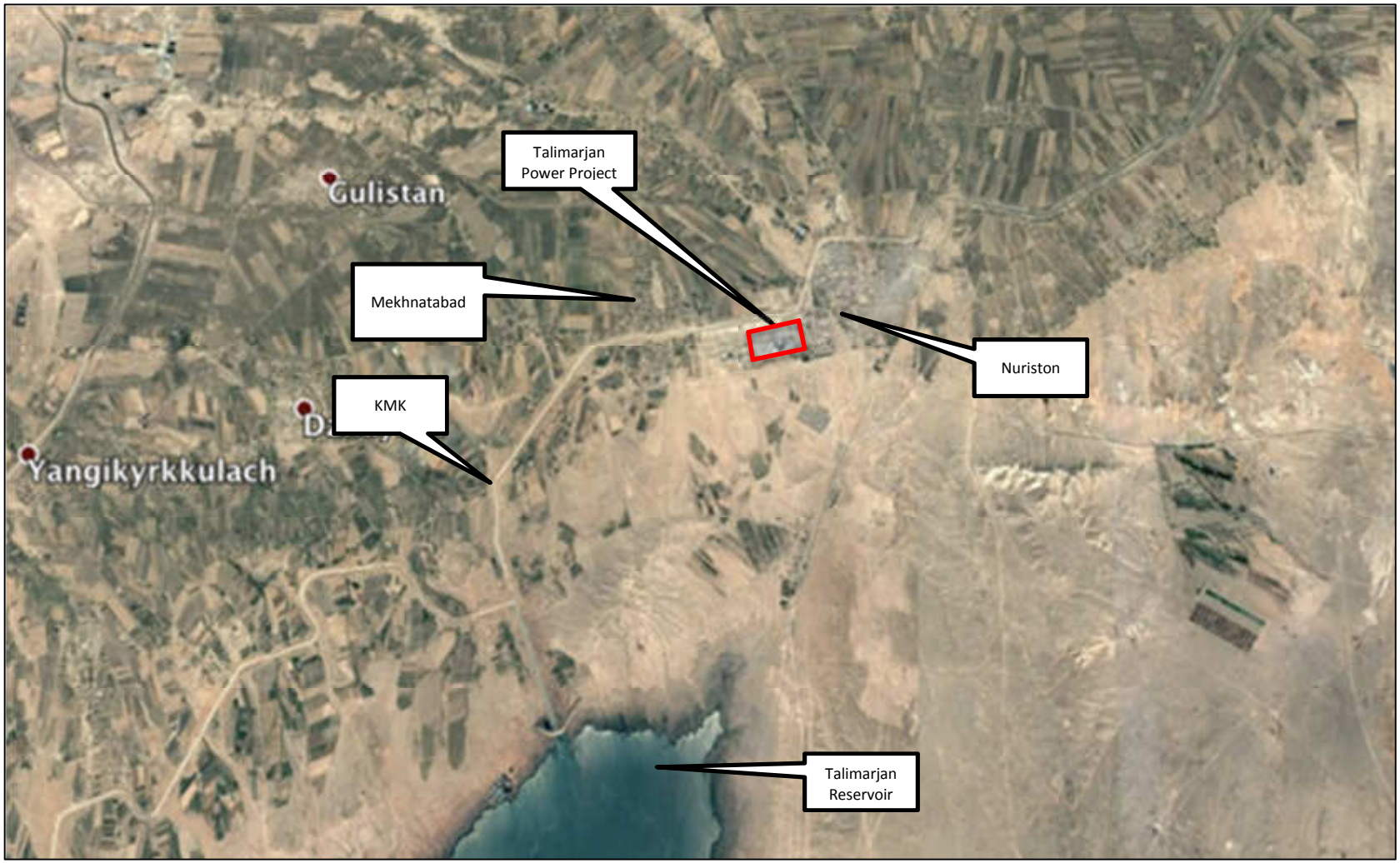


Figure B-2: Location of TPC

127. A summary of the key TPP2 characteristics is provided in **Table B-1**.

Table B-1: Key Project Characteristics	
Characteristic	Description / Value
Type of Technology	Advanced 'F-class' Combined Cycle Gas Turbine
No of CCGT units	2
CCGT configuration for each unit	1 GT + 1 HRSG + 1 ST on separate shafts
Output of each CCGT unit	450 MW
Fuel	Natural Gas
Condenser cooling type	Water cooled
Cooling Tower Type	Mechanical draft
Raw water – cooling water	Raw water to be sourced from the existing KMK intake canal
Process water – boiler water	Process demineralized water will be supplied from the existing demineralized water plant via connection to the demineralized water distribution system
Combined heat and power system	Steam extraction system and heat exchanger to provide alternative heat sources for heat only boiler in TPP0
Height of stack at HRSG	85m
Noise attenuation	80 dBA at 1 meter distance
Minimum service life of the power block (GT, ST and HRSG)	Minimum 25 years. The design life of the structural works shall be a minimum of 40 years

B.5 Existing Facilities

B.5.1 TPP0

B.5.1.1 Type of Plant

128. TPP0 is a conventional natural gas fired thermal power plant rated at 800 megawatts (MW), with one boiler and one steam turbine generator.

129. The TPP0 boiler uses flue gas recirculation within the firing zone, a distributed fuel burning system consisting of 36 burners distributed at three levels along the furnace walls, and 20% of total air fed as secondary air (overfire air) to reduce nitrogen oxide (NO_x) concentration in flue gases by up to 125 mg/m^3, which is up to 2.5 times less than boilers of similar size not equipped with an NO_x suppression system.

130. The combustion gases from the main boiler are discharged into the atmosphere through a 270 m high stack (see **Figure B-3**), which helps disperse flue gases thereby limiting impacts on the local area. The stack has one complete flue for TPP0.

Figure B-3: View from the Water Cooling Unit across to TPP1 and TTP0 beyond. TPP2 will be constructed in the area between these sites.

B.5.1.2 Fuel Supply

131. Natural gas to fire TPP0 boilers comes from the Shurtan gas fields east of Talimarjan. A gas treatment plant at Shurtan Gas Chemical Complex (SGCC) removes contaminants from the gas, including moisture, particulate matter and Hydrogen sulfide (H_2S). This ensures that the combustion gas from all boilers is almost completely free of Sulfur dioxide (SO_2) The gas from the treatment plant is sent to a gas distribution station 3 km south of TPP0 through two pipelines, each 1,020 mm diameter operating at 60 kg/cm^2 (approximately 60 bar or 6 MPa). The capacity of the gas distribution station is sufficient to supply the 3,200 MW of thermal power generation originally planned for the entire TPC. Gas is distributed from this station to TPP0 and other users. The supply to TPP0 is via two independent pipelines each 700 mm diameter operating at 12 kg/cm^2.

B.5.1.3 Water Supply & Use

132. Water for TPP0 is obtained from the KMK and the Talimarjan Reservoir. The KMK is a man-made irrigation canal originally constructed in 1972 that conveys water to the Karshi Irrigation Area. Cooling water for the steam turbine condensers is taken from the KMK when flows are adequate, and then returned to the canal after passing through the condensers. The original planning for TPC envisaged water supply from KMK for the total generating capacity of 3,200 MW, which would require up to 120 m^3/s during the summer irrigation period. Talimarjan Power Complex currently has a license to take water only for TPP0, up to 31.4 m^3/s from July to September. However, TPP0 only needs a maximum of 25 m^3/s for a once through

circuit (OTC) system. This license will need to be updated for TPP2. If the license cannot be obtained, TPP2 will be required to operate in re-circulation mode.

133. During the winter period when flow in the KMK is low (less than 5-10 m^3/s) cooling water is re-circulated and cooled using a spray system, with makeup water to compensate for evaporation, drift and leakage losses taken from the nearby Talimarjan Reservoir. During the winter, TPP0 has a license to take up to 10 m^3/s (but requires much less 2-3 m^3/s) from the reservoir to make up for losses from the recirculating spray cooling system. Six pumps (out of a total of eight needed for two 800 MW units) have been installed for circulating water through the spray system.

134. Boiler feed water is provided by distillation and deionization plants (DDPs). Two DDP units have been constructed for TPP0, each of which has sufficient capacity to supply demineralized water for an 800 MW unit. The DDP units are supplied with water from the Talimarjan Reservoir, which has lower sediment loads than the water in the KMK. Water from the reservoir is also used to feed a water treatment plant producing potable water for the TPP0 and Nuriston. Analytical systems for boiler feed water control have been installed within TPP0 and are adequate for two 800 MW generating units. The existing TPP0 boiler feed water system is provided with ammonia addition systems to maintain boiler feed water at pH 9.1± 0.2.

B.5.1.4 Effluent Treatment

135. Effluent treatment methods for TPP0 and TPP1 are described in detail under Section

E.1.4.1 – Surface Water Hydrology.

B.5.1.5 Water Treatment & Disposal

136. Sewage is generated from both TPP0 and the residential areas of Nuriston. A sewage treatment plant has been constructed to treat all the sewage from TPP0 and Nuriston. The plant is designed to treat 10,000m^3/day of sewage but only 3.5-4,000m^3/day is currently generated and treated. The sewage treatment plant operates a three stage process. The first stage of the process is mechanical screening and primary settlement. The effluent is then treated in an activated sludge process before the final disinfection stage. Water quality monitoring also undertaken at the plant. All of the results provided for review by Uzbekenergo to MMCS indicated that the water output from the sewage treatment plant is within the regulatory limits set for the TPP0 with the exception of salinity and 'mixed substances' which were slightly elevated above the set regulatory limits. The outflow from the sewage treatment works discharges to a drain known as collector drain K-3-2. Collector drain K-3-2 runs for 14km before discharging into the Kyzyl-Kum desert. Monitoring of water quality in drain K-3-2 is also undertaken with results being almost identical to the water quality discharge from the sewage treatment plant. According to UE there are no water users of drain K-3-2. It is also unlikely that there are many groundwater users in close proximity to the drain given the high salinity of groundwater in this region.

B.5.1.6 Solid Waste Storage and Disposal

137. A number of solid waste streams are produced by TPP0 including:

- Fluorescent Lamps (Hazardous)
- Oil Contaminated Waste (Hazardous)
- Oily rags (Hazardous)
- Scrap metal
- Paper

- Plastic
- Rubber
- Thermal Insulation
- Wood
- Food waste
- Domestic waste
- Glass

138. Solid waste is managed according to the procedures contained in the Law about Waste of RUz (2000) and approved by SNPC licenses on "Wastes placement limits". All wastes are collected for final disposal by licensed waste management contractors.

B.5.2 TPP1

B.5.2.1 General

139. The principal activity of TPP1, which is currently in its commissioning phase, is the generation of electricity. This will involve (per annum):

- The use of approximately 1.3 billion Nm^3 of natural gas per annum from the Shurtan gas fields;
- Supply of 6,860 GWh of electricity to the grid over 7,500 hours of operation;
- Discharge of approximately 700 tons [2] of nitrogen dioxide into the atmosphere;
- Discharge of approximately 2.4 million tons CO_2 of greenhouse gases into the atmosphere;
- Taking an additional 14 m^3/s of water from the KMK during the cropping season (March to November) for cooling in the condensers and returning it downstream at a higher temperature;
- Taking additional water from the Talimarjan Reservoir to produce boiler feed water for the CCGT units, and to replace evaporative and other losses from the recirculating cooling water system used during the non-irrigation season; and
- Employment of 72 additional personnel for operation of the new CCGT units.

140. The higher thermal efficiency and better environmental performance of TPP1 means that the use of fuel, and the emissions of greenhouse gases and pollutants such as NO_X, will be lower than for the existing TPP0, and for other existing thermal power plants operating in Uzbekistan.

141. Waste generated from the operation of TPP1 is expected to be managed in the same way as waste from the existing TPP0. Wastes are expected to include waste water, waste oils and scrap metals, all of which can be disposed of through the existing waste disposal systems.

B.5.2.2 Processes

142. Two CCGT units in TPP1 will use a gas turbine burning natural gas with air to drive a generator and produce electrical power. The burner design and other emission control technologies have been selected to minimize the generation of NO_x in the combustion products.

143. The hot exhaust gas from the gas turbine is passed through a heat recovery steam generator (HRSG) to recover more of the energy released by the combustion process that occurs in the gas turbine. The HRSG heats water and generates high pressure steam, or

[2] Based on 6,000 operational hours and a NOx emission rate of 31.67 g/s

provides additional superheat to intermediate pressure steam. The steam produced in the HRSG is used to generate more power in a steam turbine, thus recovering much of the energy left in the exhaust from the gas turbine. The exhaust gas from the HRSG is discharged into atmosphere at a much lower temperature than when it leaves the gas turbine.

144. Steam is supplied to the various stages of the steam turbine at different pressures and is passed out of the turbine at correspondingly lower pressures after releasing its energy. Intermediate pressure steam passed out of the turbine is sent through the HRSG to be superheated again before releasing this additional energy in another stage of the turbine, further increasing the overall efficiency of the process.

145. The low pressure exhaust steam from the steam turbine is condensed using cooling water and passed though a de-aerator where low pressure steam is used to remove any air dissolved in the steam condensate that might cause corrosion in the steam circuit. De-aerated condensate is returned to the HRSG to generate more steam, completing the steam cycle.

146. The CCGT units at TPP1 can also operate in bypass (open cycle) mode during start-up, with the exhaust from the gas turbine discharged directly into the atmosphere, with no steam generation. Whilst this does offer operational flexibility, open cycle operation is undesirable from an environmental perspective since the emissions per kWh for the power block are higher.

147. The design of TPP1 is intended to ensure safe and efficient operation in all different operating modes including start-up, full load, load change, shut-down, and emergency shut-down. This is achieved through the options of closed and open cycle operation, the selection of thermal plant operating pressures and temperatures and associated HRSG and steam turbine configurations, and the control systems proposed.

148. The two CCGT units, each with a capacity of 450 MW, consist of the following main equipment items:

- One gas turbine unit with electrical generator.
- One HRSG, or exhaust-heat boiler, with three steam generating circuits and intermediate superheating.
- One steam turbine unit with electrical generator.
- One de-aerator unit.
- One steam condenser.
- Cooling water systems, including additional pumps for straight-through cooling water from the KMK and cooling towers for recirculating cooling water.
- Other ancillary equipment, including a generator transformer, electrical switching systems, and control systems.

149. The efficiency of the system is 57.4%. This should be compared to the efficiency of the existing TPP0, which is typically 34-37%.

B.5.2.3 Buildings and General Arrangement of Equipment

150. The TPP1 turbine building houses the gas turbines and steam turbines of the two CCGT units, oriented in a north-south direction (across the length of the turbine hall). This building also houses electrical and control equipment and ventilation systems. There are air intakes aligned with each turbine that extend through the northern wall of the new turbine hall, with intake air filters located outside the turbine hall.

151. A de-aerator building is located behind the turbine hall. It incorporates HRSG bypass stacks with a height of 85 m and diameter of 8.0 m that will allow the units to start up in open cycle mode without steam generation. The stacks will extend approximately 6 m above the top of the boiler house building facade.

152. The boiler house building behind the turbine hall and de-aerator building is approximately 84 m long and will house the HRSG unit for each CCGT unit.

153. Behind the boiler house and the HRSG units are the stacks for the exhaust gas from the HRSG for each CCGT unit, each identical to the HRSG bypass stacks, 8 m in diameter and 85 m high.

154. The generator transformer for each CCGT unit is located outside the north wall of the turbine hall. Their purpose is to increase the voltage of the electricity generated by the CCGT units to the transmission line voltage of 500 kV. They will be connected via overhead lines to a new 500 kV switchyard that will be located outside the northern boundary of the TPP0, north of the KMK. Construction of this new switchyard and the connections to the nearby 500 kV transmission line will all be undertaken as part of a separate project.

B.5.2.4 Fuel Supply

155. The gas consumption for the two CCGT units at TPP1 will be a total of 153,426 Nm³/h at base load. Annual gas consumption will be 928.5-953 million $Nm^{3.}$ The composition of the natural gas based on 2007 analyses is: methane (CH_4)-98.45%; ethane (C_2H_6)-0.57%; nitrogen (N_2)-0.96%; carbon dioxide (CO_2)-0.017%; with all other components (including H_2S) being undetected (0%). The lower heating value of the gas is quoted as 7,939.2 kcal/m³

156. Gas supply to TPP1 requires an additional gas conditioning plant to remove moisture and particulates, commercial metering of fuel consumption, and three gas compressors (1 operational, 1 spinning reserve and 1 backup) to ensure continuous supply of gas to the two CCGT units at 25-34 kg/cm² (25-35 bar or 2.5-3.5 MPa) in accordance with the gas turbine manufacturer's requirements.

157. The gas conditioning and compression station includes gas filters/separators, electrically driven compressors and gas cooling units located on a common foundation frame.

B.5.2.5 Boiler Feed Water Systems

158. The same boiler feed water system is used as that in TPP0 requiring hydrazine and ammonia additions to maintain boiler feed water at pH 9.1± 0.2 and to scavenge oxygen in order to prevent corrosion and scaling (Two DDP units were constructed for TPP0, each of which has sufficient capacity to supply demineralized water for an 800 MW unit.). However, according to the TPP0 Environmental Manager Hydrazine is no longer used at TPP0. If this is the case another chemical is required to replace the hydrazine, perhaps Carbohydrazide. Regardless of which chemical is used, they must all be stored and handled according to the requirements of their Material Safety Data Sheets (MSDS). Each CCGT unit requires a demineralized water supply of 355 tons per hour.

159. No significant additions to the range of hazardous chemicals already used for the operation of TPP0 will be required for TPP1. Most of these hazardous chemicals are used in the distillation and deionization plants, which will not be modified as part of this project.

B.5.2.6 Process Water Systems

160. During the irrigation season when water flow in the KMK is high, water will be taken from the KMK and used in a straight-through system to provide water for the TPP1 condenser systems before being returned to the KMK, using the same system used for TPP0. There are no irrigation intake channels within 100 meters of the immediate mixing zone).

161. The water requirements for TPP1 using the straight-through cooling system are estimated to be 8 m³/s for each unit, or around 16 m³/s in total. The existing TPP0 use is 25 m^3/s. The maximum KMK flow is 150 m^3/s, limited by the capacity of the pump stations bringing water from the river (however, UE have reported that the KMK flow can be as much as 180 m³/s). TPP0 is currently permitted to take a maximum of 710 million m^3 per annum (approximately 31 m³/s).

162. The requirements of the original TPC (with the capacity of 3,200MW) in cooling water (up to 120 m^3/s in summer period) were approved by Ministry of melioration and water economy by the letter "About selection of the site for thermal power plant" No 8-418 dated 15.11.76 and by "Glavsredazirsovhozstroi" by the letter about approval for the site and water consumption as per KMK No 11-29-347 dated 12.04.79 and No 022-1992 dated 27.03.79.

163. At the present time the approval for water consumption was issued only for TTP0 with water intake (for strait-through arrangement) in summer period (June - September) up to 31.4 m^3/s, and in winter period (circulating arrangement) – up to 2.3 m^3/s. This license will need to be updated for TPP2. If the license cannot be obtained, TPP2 will be required to operate in re-circulation mode.

164. Water for utility and drinking needs is pumped from the Talimarjan Reservoir to the TPP0, TPP1 and Nuriston.

165. Process water and fire-fighting water is delivered from the process water supply system (intake channel) providing for constant water supply to fire-fighting pumps installed at the TPP0 block pumping house. Process and fire-fighting water network is constructed as per GOST 10704-91 standards.

B.5.2.7 Power Evacuation

166. Power is evacuated from TPP1 via the existing 500 kV transmission line from Guzar to Karakul substations. This transmission line has adequate existing capacity to evacuate the power from TPP1. To connect TPP1 to the 500 kV network, a 500 kV substation was constructed as part of the TPP1 project on the left bank of the KMK to the north of the TPP0 site.

B.6 Scope of TPP2 Work

B.6.1 Location & Layout

167. Approximately 7 ha of land are required for TPP2, all of which are located within the existing boundaries of the TPC. TPP2 will be situated adjacent to the eastern boundary of TPP1 westward of the main building side of TPP1 block No. 2 (see **Figure B-4**). From the north side the site borders on the KMK tailrace canal, from the south side it is open land, from east side the site partially borders on a military camp. All territory has an approximate dimension 140 x 435 meters and has relatively flat surface with the continuous gradient from south to north and elevation changes from 378 to 375 meters.

B.6.2 Project Components[3]

168. TPP2 will be comprises several components which are more or less similar to TPP1 and are described below. **Table B-2** provides a summary of the buildings and facilities. **Figure B-4** also provides a schematic of TPP2 and **Figure B-5** provides the TPP2 elevations.

B.6.2.1 Main Building

169. The main equipment of two combined cycle gas turbines are interconnected: emissions stack, HRSG and gas turbine plant are located in-parallel to the numerical axis. Steam turbines are situated along the letter axis and perpendicularly to the gas turbine plants. The above ground part of the building for the combined cycle gas turbine is divided structurally and falls into two volumes by height:

- Block A includes the machinery compartments of gas and steam turbines with sizes in plan of 183 x 28 m and height of 26 m, where in each block are located the steam turbine generator, gas turbine, steam condensing turbine and repair area;
- Block B includes the compartment for gas turbine generator with sizes in plan of 183 x 18 m and height of 19 m, where in each block are located the gas turbine generator, package (complete) air-cleaning plant.

170. Block A is equipped with the overhead (bridge) crane of 110/35 t lifting capacity (auxiliary set of 60/25 t lifting capacity), has roof coating on the double pitch girders. Block B, where the gas turbine generator is housed, has comparatively low roof. Air-cleaning plant are installed above the roof. Oil supply stations for gas turbine, pumps and heat exchangers of the closed-circuit cooling water system, firefighting ramps for each power-generating unit are also located in this area.

Table B-2: Description of Buildings and Facilities

#	Description of buildings and facilities	Dimensions of building (facility), (width × length × height, m)
1	Block A Gas and Steam turbine machinery compartment: • steam turbine generator • gas turbine • steam condensing turbine • repair area	183×28×26
2	Block B Gas turbine generator room: • gas turbine generator • air-cleaning machinery package	183×18×19
3	Heat-recovery steam generator including: • foundations for heat-recovery steam generator • elevator • shed for feed pumps for heat-recovery steam generator • shed for acid-washing station with a tank • Tent shed for heat-recovery steam generator	hoisting capacity1000 kg 15×19×38,5
4	Building of Unit condensate purification plant	19,5×12×5
5	Shed for storage tanks for clean and dirty lube oil	11,5×9×4
6	Underground tank of emergency oil drain from Gas Turbine and Steam Turbine	4,5×1,5×3 l.m.

[3] This is a preliminary list of equipment provided by the TPP2 Preliminary Feasibility Study. There may be some changes to this list once the exact configuration of the equipment is approved.

7	Back-up diesel-generator 500 kW (container)	12×4×3
8	Building of joint control panel and main switchboard with domestic compartments	46×24×18
9	Area for gas turbine control block	7,5×14,5
10	Underground drain tank for cleaning purposes water for gas turbine blades	3×2,5×2
11	Gas fuel skid (container) under shed	10×15×4
12	Building of sampling of the power-generating unit № 3	4×16×4,2
13	Building of express laboratory	6×16×4,2
14	Building of chemical dosing package: hydrazine, ammonia, phosphate	12×12×7,2
15	Shed for air cooler with fuel gas heater	11×5×4
16	Smoke stack	H=85.0 m, □8.0 m
17	Underground tank of emergency oil drain from transformers 300 m³	

171. The balance-of-plant switchgears are located in the lower part of Block A under the air-cleaning plant. The gas turbine control units are located near the building of each block behind the A1 row.

172. Installation of the heat-recovery steam generators (HRSGs) is provided in the outdoor area with a roof. There is also an area for for feed-pumps for the heat-recovery steam generator, and an area for acid-washing. In close proximity to the HRSGs are freight elevators of for general purpose (1,000 kg lift capacity).

173. The building for the joint control panel and main switchgear with domestic compartments is adjacent to the main building. The building is a four-floor building of 46×24×18 m dimensions. Besides the control switchboard the premises for cables, switchgears, offices, laboratories, canteen, domestic compartments are located in this building. Two emergency ladders are provided in the building.

174. Metal structures are used in the frames of all buildings. The longitudinal stability of the frames is provided by installation of vertical bracing for all rows of columns. Lateral stability and frame strength is provided by the bracing and bridging system, as well as, by rigid fixing of the columns in foundations. Building girders are hinged to the columns.

175. Foundations for frames are free-standing, cast-in-place, reinforced-concrete, manufactured from concrete on the basis of sulfate-resistant portland cement.

176. Gas turbine, steam turbine and generator bases are built from cast-in-place, reinforced-concrete from concrete of sulfate-resistant portland cement. Bases are free-standing structures independent from the building where they are placed.

177. Elements of auxiliary equipment of gas and steam turbines shall be installed on the separate bases built from cast-in-place, reinforced-concrete of sulfate-resistant portland cement.

178. HRSG foundations shall be cast-in-place, reinforced-concrete from concrete of sulfate-resistant portland cement.

Figure B-4: TPP2 Layout

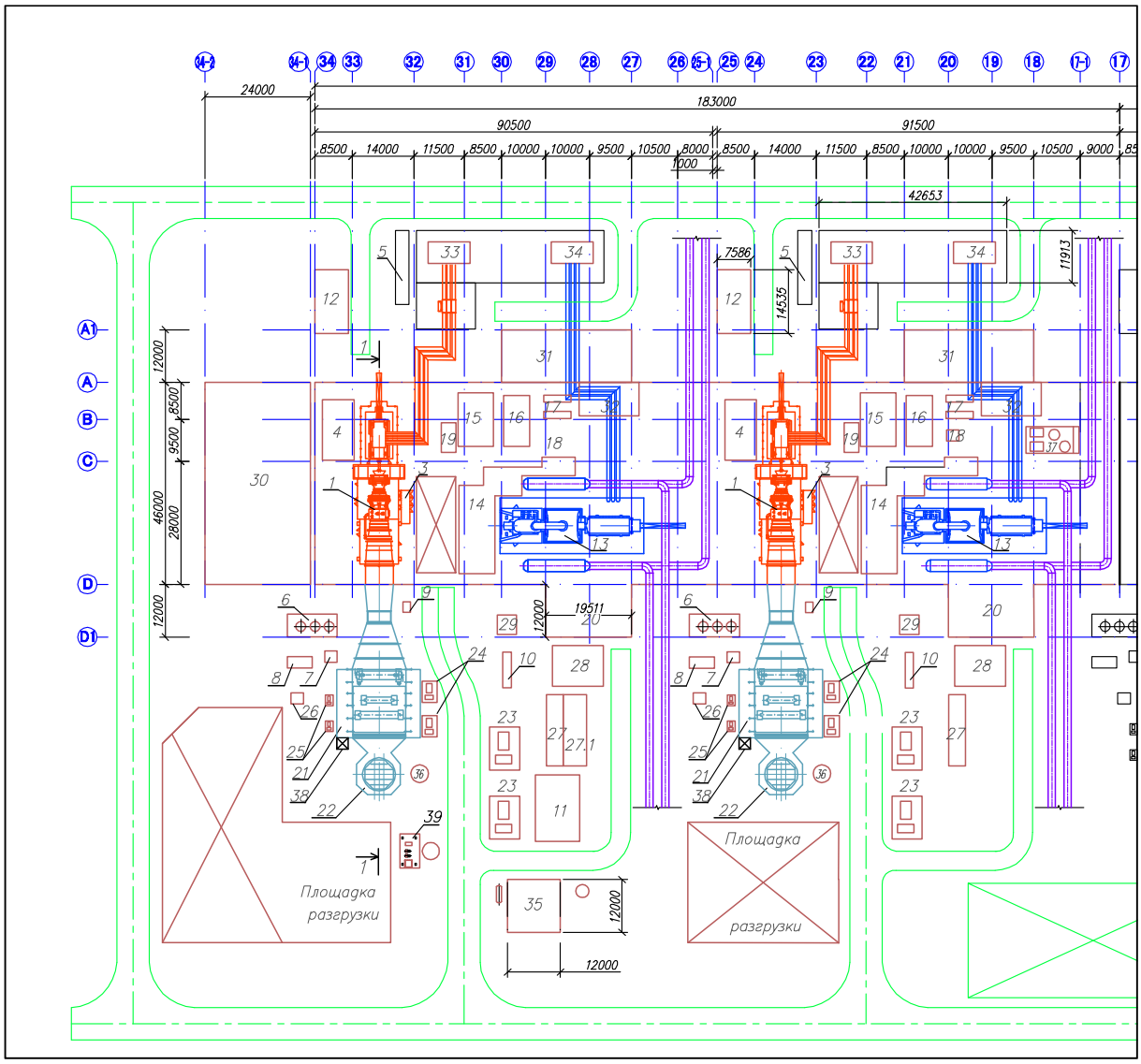
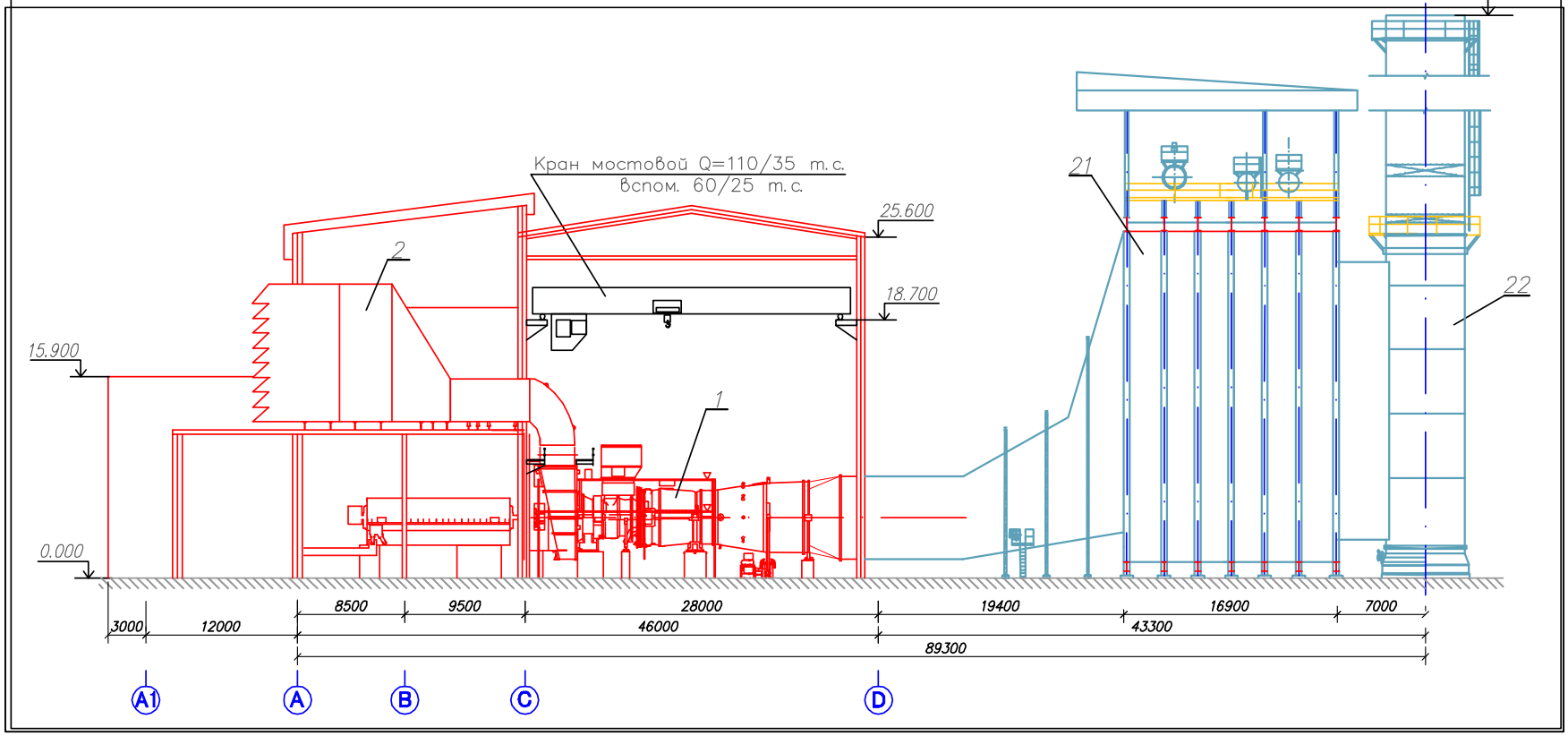


Figure B-5: TPP2 Elevations



179. Areas for equipment technical maintenance and supporting structures of air conduits shall be made of metal. Steel grades and structural shapes for steel structures are applied in accordance with the regulations of the Republic of Uzbekistan.

180. External walls of the main building are three-layer coating, mounted sandwich panels with fire-resistant mineral-cotton warmth-keeping jacket between two layers of shaped sheet. Insulation thickness is 100 mm.

181. Rolled roofing material shall be applied for the roof, a membrane with fire-resistant mineral-cotton insulation of 200 mm overall thickness shall be provided. Fire-escape ladders are provided.

182. Fire protection of the frame load bearing elements that provides the building stability during fire is performed by the fireproofing materials of various thickness. Load bearing elements of the ladder intermediate floors on the escape ways shall be coated with the fire-retardant paint.

183. Doors shall be of various designs (structures) in accordance with premises functional purpose and categories as per fire and explosion danger. Windows in the production premises shall be in the plastic-coated metal cross casements with glazing by one-chamber glass and triple-pane glass.

184. In areas continually occupied by workers windows shall be plastic-coated metal cross casements with triple-pane glass, energy-saving coating or filled with argon, combined opening.

185. External doors and gates shall be steel and heat-insulated. Internal doors shall be steel, wood and special (fireproof).

186. The interior finish is performed in accordance with the required purpose:
- simple finish – in production premises;
- improved finish – in personnel space.

187. The floor type shall be in accordance with premises required purpose:
- concrete with topping coat – in machinery compartment;
- concrete with surface grinding and coating with paint on epoxide base – premises for electrical devices;
- concrete with surface grinding of W8 grade – premises with possible oil spill;
- cement-concrete – ventilation premises;
- coating with acid-resistant tile – battery charging room;
- coating with ceramic tile - toilets, laboratories;

B.6.2.2 Emergency Oil Drain Tanks

188. Underground tanks of emergency oil drain from Gas Turbine and Steam Turbine are provided for behind the building for gas turbine generators. Tanks will be double skinned, comprising cast-in-place, reinforced-concrete structures, manufactured from concrete on the basis of sulfate-resistant portland cement lined with a steel inner tank. The tanks will be routinely monitored to detect leaks.

B.6.2.3 Emissions Stacks

189. Emissions stacks are located behind the boiler room, in the heat-recovery steam generator location; smoke stacks are made of metal, height is 85m, mouth diameter is 8.0m. Smoke stack foundations in the load bearing towers are manufactured from concrete on the basis of sulfate-resistant portland cement.

B.6.2.4 Fuel Supply

190. The main fuel for TPP2 is natural gas to be supplied via the two existing pipelines from Uzbekneftegas. Uzbekenergo has received a letter from Uzbekneftegas confirming that an additional 4.4 million m^3/day can be provided via the existing infrastructure to the new plant scheduled for operation in 2021 and that their projections for gas reserves to 2030 are sufficient to supply Uzbekenergo's facilities.[4] The stated quantity is sufficient to supply an additional power plant of similar size and efficiency as TPP1, assuming the available quantity is stated for 1.013 bar and 25°C.

191. Uzbekenergo's pre-Feasibility Study provides the composition for the gas and supply pressure is stated as 9 bar; therefore, gas compressors will be required in order to supply the fuel to the gas turbines at the desired pressure.

192. Part of TPP1 project was construction of a new gas header with provisions for off take to future phases; therefore, the interface point for gas supply to TPP2 has been provided. Dedicated fuel metering facilities would be required for TPP2. Other fuel supply considerations are necessary for emergency diesel generator; however, these are considered minimal. No back-up fuel is foreseen.

B.6.2.5 Water Supply and Use

193. According to water balance data (provided by UE) TPP0 requires approximately 25 m^3/s of water from the KMK for water cooling during the OTC. TPP1 will need an additional 14 m^3/s. TPP2 will require slightly more cooling water than TPP1 – 16 m^3/s. In addition approximately 1 m^3/s of water will also be pumped from the Talimarjan reservoir pumping station to the TPC for other water uses. This gives a cumulative total of 56 m^3/s. The KMK has a maximum flow rate of 150 m^3/s. Data provided by UE indicates that the average monthly flow in the KMK is currently less than 57 m^3/s. In spring and autumn the flow rates can be significantly lower than this average figure. Accordingly, the TPC will be operated taking into account the flow of the KMK, this may require a combination of units operating in re-circulation mode to avoid thermal pollution impacts. This issue, and its impacts, are discussed in detail in **Section G.6.6 – Surface Water Hydrology**.

194. During re-circulation mode 2.39 m^3/s will be pumped from the Talimarjan reservoir pumping house to the Talimarjan power complex. According to the TPP0 staff, TPC has a license to take up to 10 m^3/s from the reservoir to make up for losses from the recirculating spray cooling system.

B.6.2.6 Wastewater

195. Wastewater includes:

- Demineralizer wastewater;
- Water from laboratory drains;

[4] TPP2 pre-Feasibility Study Attachment 11

- Water from HRSG drains, blowdown, sampling system drains, stack drains;
- Steam turbine plant drains, start up drains, heater drains; and
- Oil/water separator plant drains (from transformer bunds, ST and GT enclosures, the paved and kerbed roadways and oily water from the fuel gas system).

196. A water treatment plant was constructed during the construction of TPP0. It is designed with sufficient capacity to supply water to a facility of 3,200 MW in size, including water to:

- The gas turbine evaporative coolers
- The potable water system
- The demineralized water to the steam cycle make-up
- The closed cooling water system make-up
- The water treatment chemical dosing systems
- The gas turbine washing system
- Laboratory use

197. The EPC Contractor will be responsible for ensuring that all systems are connected to the existing TPP0 system for treatment and discharge.

198. Domestic sewage will be discharged to the existing sewage water treatment plant used by TPP0.

199. An oily water separator was also constructed as part of TPP0. The EPC Contractor will be responsible for connecting all oily water drains to the existing system. The separators will be constructed to ensure that no more than 10 mg/m^3 oil and grease discharges from the separators to the waste water ponds. The EPC Contractor will also be responsible for contracting a licensed third party waste management contractor to remove the excess oil and grease. As part of the Project, the EPC Contractor will also be responsible for preparing an effluent management and disposal plan that should be submitted to TPP2 PMU and the Engineer for approval prior to the commencement of construction of TPP2. The plan shall detail the quality and quantity of all waste streams generated within the plant and shall show how each stream will be treated before discharge.

200. Waste water will be transferred to the existing TPP0 waste water evaporation pit (sludge pit) located in the southern area of the TPC. The existing sludge pit has been in operation since TPP0 started operation in 2004 and is currently only half full. The volume of the existing pit is around 8,000 m^3. A further seven sludge pits were constructed for the planned 3.2GW TPC, none of these pits has been utilized to date. The seven pits have a capacity of more than 15,000 m^3. No removal of the sludge is anticipated. Waste water will simply be pumped to the next available empty pit when the existing pit becomes full. **Figure B-6** provides an aerial image of the sludge pits.

201. In the event that new pits will be required in the future they will be constructed to the flowing specifications:

- Sized for a 1:100 year annual exceedance probability.
- Liner shall be ultraviolet resistant HDPE, or equivalent.
- The pond a liner must be suitable for high total dissolved solids water and elevated pH levels.
- The EPC Contractor will be responsible for obtaining any approvals related to the construction of the ponds.

B.6.2.7Chemicals & Hazardous Materials

202. The chemicals to be used in TPP2 include chemicals used in the main processes of

the power plant, for example, raw water treatment, demineralized water production system, steam circulating system and cooling water system. The main chemicals used at TPP2 include:

- Phosphate – Used in the HRSGs.
- Ammonia – Used in the condensate pumps (amination).
- Sodium hypochlorite – Used for bacterial treatment from "micropollutants" (bacteria, slime, algae, etc.).
- Hydrazine – used for feed water.
- Sulphuric Acid – Used in the waste water treatment process.
- Ethelyne Glycol.

203. Phosphating – To prevent calcium deposits along with make-up water softening correctional treatment of boiler water by phosphating is carried out.

Figure B-6: Aerial Image of Existing Sludge Pits

204. Amination – For amination ammonia-water mixture is used, the concentration is determined during adjustment and approximately constitutes within 0,5 ÷ 2 %. Ammonia dose is regulated automatically by the pulse of make-up water consumption. Ammonia is entered in head pipeline of the condensate pumps for the purpose of protection of the feed circuit against carbon dioxide corrosion by increase of pH value of feed water and condensate up to 9-9,5. For storage of pure liquefied ammonia in quantities >100m3 ammonia will be stored in double-walled underground pressurized tanks. Tanks of lesser capacity shall be manufactured using annealing processes.

205. Hydrazine treatment - Hydrazine treatment of feed water is carried out permanently. The process is regulated automatically by pulse from feed water consumption. Monitoring is carried out by determination of ammonia content and hydrazine excess in feed water upstream of the economizer.

206. Sodium Hypochlorite – Sodium hypochlorite is added to the cooling tower tank depending on concentration of residual chlorine in the cooling tower discharge. Dosing of sodium hypochlorite is located in the onshore pumping station premise and 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 system.

207. The following hazardous materials shall not be used:

- Cadmium;
- Electroplated zinc coated carbon steel;
- Asbestos;
- Cupro nickel, except for generator air coolers;
- Chromium;
- Paint containing lead;
- Chlorinated solvents and thinners;
- Halon and other CFCs;
- Poly-chlorinated Biphenyls;
- Heavy metals, including mercury and arsenic; and
- Any other materials where there are significant questions as to their environmental impact in manufacture, use or upon disposal.

208. Contaminated effluent shall receive the appropriate treatment at the source before being discharged into the drainage system. The most probable sources of pollution and the required treatment are listed below:

- Transformer compounds – possible oil spillage – transformers to be located within impermeable bunds;
- Power plant drainage, effluent from HRSG cleaning and other non-oily contaminated sources – oil separators, chemical treatment and evaporation sludge pits.
- Feedwater treatment plant – effluent will be neutralized as part of the treatment process and no further treatment will be required; and
- Workshop, laboratory and store – possible oil spillages and contaminated effluent from laboratory – discharged into existing oil separators and.evaporation sludge pits.

209. The plant effluent drains will not be connected to the sewage system.

B.6.2.8 Bunding, Containment and Drainage System

210. The EPC Contractor shall provide a bund and drainage system to collect and deal with all effluents from any areas of the site including the turbine / generator area, water treatment plant, oil storage and chemical dosing areas. Chemical, oil and fuel storages shall be bunded in accordance with the following guidelines:

- All chemical bulk and drum storage areas and oil and fuel drum storage areas must be bunded so that the capacity of each bund is sufficient to contain at least 110% of the maximum design storage within the bund;
- All petroleum product storage must be designed, constructed and maintained in accordance with international and national standards;
- All chemical tankers loading/unloading areas must be bunded so that the capacity of the bund is sufficient to contain 120% of the net capacity of the largest compartment/any tank using the area;
- For flammable liquids bund capacity should be at least 133% of the net capacity of the largest tank using the area. If an automatic sprinkler is installed in or over bunded areas the bund capacity must be increased by a volume equal to or more than the output of the sprinkler system for at least 20 minutes.
- All bunding shall be sufficiently impervious to allow retention and recovery of material being stored within the bund.
- All required pipe-works in and out of the storage vessel from each bunded area must be directed over the bund wall, not through it.
- Removal of accumulated rainwater should be done with a manually operated pump of by

bailing from the sump. This water maybe contaminated and must not be disposed of in the storm water drainage system.

B.6.2.9 Waste Management

211. Waste produced by TPP2 will be stored and disposed of according to the same requirements and conditions as TPP0 and TPP1.

B.6.2.10 Seismic Requirements

212. The seismic design of all buildings, equipment, piping, storage of spare parts, control and electrical systems will be based on a two tiered approach of an operating basis earthquake (OBE) shaking levels and a maximum design earthquake (MDE) level. This is similar to the seismic design approach normally used for nuclear power stations.

213. TPP2 shall be designed so that in the event of an MDE:
- An immediate and safe shutdown of all plant and equipment takes place;
- Control equipment critical to the continuation of the safe shutdown shall remain operational;
- Damage to buildings, items of plant and equipment is limited in order to minimized duration of repairs;
- The building structures shall continue alt all times to provide adequate weather protection to prevent environmental damage to plant and equipment; and
- An adequate factor of safety against the collapse of any buildings and or equipment that would endanger personnel is maintained.

B.6.2.11 Fire Safety

214. TPP2 will be constructed in accordance with SniP 21-01-97 ‘Fire safety of buildings and structures’ and class of constructive fire safety of danger CO-C1. The HRSG steelworks fire protection shall be in accordance with international codes and GT enclosure steelworks shall be as per OEM proven design. Evacuation and emergency exits, personnel evacuation passages and exists shall be designed to the requirements of SniP 21-01-97 ‘Fire safety of buildings and structures’.

B.6.2.12 Staff Facilities and Medical Center

215. On-site staff accommodation will be provided for 126 people. In addition a canteen and medical aid station of 36 m² will be provided for. The equipment of medical aid station is accepted in accordance with the local health authority regulations.

216. Household services for the maintenance staff of the power plant are arranged based on the minimum requirements of the Construction Norms & Regulations 2.09.04-09 “Administrative and Domestic Building of Enterprises”.

217. The following domestic premises are provided for:
- men’s changing room equipped with one shower cabin (at the rate one shower for maximum 15 persons of shift);
- men’s changing room with separate storing clothing, equipped with one shower cabin (at the rate one shower for 5 persons of shift);
- men’s changing room with separate storing clothing, equipped with two shower cabins (at the rate one shower for maximum 5 persons of shift);
- women’s changing room with separate storing clothing, equipped with two shower cabins (at the rate one shower for maximum 5 persons of shift);

- warming-up room;
- overalls drying room;
- storage room for dirty and clean overalls.

B.6.2.13 Power Evacuation

218. Power is evacuated from TPP2 via an existing 500 kV substation that was constructed as part of the TPP1 project on the left bank of the KMK to the north of the TPP0 site. Approximately 500 meters of new overhead cables will be needed connecting TPP2 to the substation.

B.6.2.14 Combined Heat and Power System

As is typical in Central Asia, TPP0 incorporates a district heating facility. For steam power plant, the most efficient method of district heating is to employ 'extraction' of heat from the steam turbine plant (and thereby have combined heat and power (CHP)), but this was not done at TPP0 due to its extended construction period (1990 to 2004) combined with the need to provide heating to the local community. As such, two gas-fired boilers are provided within the TPP0 site, separate from the power plant equipment. Within our studies we have considered the viability to district heating via CHP by TPP2 in order to potentially displace the TPP0 district heating supply by more efficient means.

Utilization of some of the steam used to generate electricity in the steam turbine to extract heat, for example for district heating, could be considered in particular as an alternative to the ageing and lower efficiency hot water boilers at TPP0. The existing district heating infrastructure would still be used to supply heat to TPP0, TPP1 and to Nuriston village. Modelling shows that reduction in electricity generation and efficiency of TPP2 would not be significant: approximately 14 MW or 1.5% reduction in power output and approximately 98 kJ/kWh or 1.5% increase in heat rate for a 440 t/h (hot water) district heating supply.

It is designed to implement CHP scheme as an alternative to the existing hot water boilers, it is recommended to review the remaining life of the hot water boilers as to whether replacements are required as part of the TPP2 project. In our preliminary assessment of this options we aimed to match the capacities of the existing hot water supply facilities at TPP0. The design figures are 440t/h and maximum temperature of supply 115°C.

With this in mind, the simulation results showed that overall efficiency in CHP mode rises to 58.8%, which an increase of 1.4% relative to the plant's electrical efficiency and increase of 0.6% relative to a plant that does not have such facility but everything else is the same. With configuration of 1x1 the resultant efficiency per block would be 60.3% (increase of 2.9% and 2.1% respective to the earlier comparisons).

Environmental Impact

The proposed concept of the combined heat and power (CHP) system is to install heat extraction system and heat exchangers within the compound of TPP2 so that the new CHP system can provide an alternative heat sources to the ageing and low efficiency hot water boilers at TPP0. The heat generated from TTP2 will be fed into TPP0 as alternative source, which does not require modification of existing heat supply system and heat distribution network. It is unlikely there will be negative environmental impact by the CHP system in TPP2.

B.6.3 Construction Activities

219. Due to the fact that TPP2 is not a new build power plant, but an extension of an existing plant, and in view of the fact that TPP2 will be located at the same site as TPP0 and TPP1, 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. A description of the construction phase of TPP2 and the new infrastructure required for operating it is detailed below.

Phase 1: Civil Works

220. Prior to the construction commencement it is necessary to carry out the land development of the site:

- Disassemble the Checkpoint-2 building with the adjacent concrete guard rails and mesh wire fencing;
- Dismantle the concrete sites on the territory of former construction base, as well as, disassemble the crane ways for the overhead crane;
- Backfill a portion of the spray pond and tailrace canal in situ of construction of the cooling tower pump station and construct a culvert in the eastern portion of the spray pond to effectively channel cooling water from TPP1 cooling towers into the cooling lagoon without impacting upon the effective spray basin area of TPP0; and
- Carry out the site leveling operations, provide the grade elevation of 375m for the combined cycle gas turbine.

221. Grade elevations of the construction site are determined by the grade elevations of the existing building system, as well as, by arrangement of surface water drainage from the buildings and facilities, and arrangement of the access ways. Actual elevations are constituted 378 – 375m. After leveling operations the grade elevation of 375m shall be reached.

222. Projected buildings and facilities are arranged on the general layout complying the fire and sanitary break in accordance with the Construction Norms and Rules II-89-80. The minimum distance between buildings is accepted as 12 meters in accordance with the III category for fire resistance of buildings and facilities.

223. Foundations will be prepared where required for the major equipment items. Major equipment items and auxiliary equipment will then be installed in the turbine hall, deaerator building and boiler house extensions, including bypass stacks and main exhaust stacks.

Phase 2: Assemblage

224. As soon as the civil engineering phase has been completed, the various machines that constitute TPP2 will be assembled. Sequencing will be as follows: 1) Mechanical assemblage, 2) electrical assemblage and; 3) instrument assemblage.

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

226. Before commissioning, ventilation and chemical cleansing of the boiler 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

227. Phase 3 includes:

- Testing the various types of equipment (pumps, valves, etc).
- Systems trials.
- Operation guarantees trials of the new plant.

B.6.4 Construction Activities, Materials and Supply

B.6.4.1 Site Access

228. Road and rail access to the site for construction equipment, construction materials and power station equipment already exist and were used for TPP1 construction. It is expected that heavy equipment and major CCGT plant items would be brought to the area by rail from the north, given that the condition of roads in the area would slow the transport of heavy items considerably. Construction cranes remain at the site from the original construction program.

B.6.4.2 Concrete Batching

229. There is an operational concrete batching plant remaining at the power plant, so all concrete needed for TPP2 can be produced on-site. Cement will be delivered from Navoi Cement Plant (located in Navoi Province of Uzbekistan) by rail; gravel would be delivered from Tashkent Province and Shahrizabz (Kashkadarya Province) by rail; and sand is available locally.

B.6.4.3 Borrow Pits

230. The borrow pit currently used by TPP1 is located approximately 500 meters south of Nuriston. However, the borrow pit is now closed and will be used as a landfill site. Accordingly, the EPC Contractor will have to make arrangement to source materials from another licensed borrow pit, or open his own borrow pit and obtain the necessary permits and licenses to operate the borrow pit.

B.6.4.4 Construction Worker Accommodation

231. Temporary worker accommodation will be required for the construction workforce. Up to 800 construction workers may be engaged at any one time on the project. It is assumed that the same accommodation will be used as for the existing TPP1 construction works.

B.6.4.5 Construction Water Supply

232. Based on the figures for TPP1 construction, during the construction period, the water requirement per month will be as follows:

- Non-potable water – 8,500 m^3
- Potable water – 2,000 m^3

233. Both potable and non-potable water are supplied to the site from the Talimarjan reservoir via an existing pipeline.

B.6.4.6 Construction Waste

234. Waste resulting from construction of TPP2 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. 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.

235. Data provided by TPP1 EPC Contractor indicates that the following types and volumes of wastes will be generated during the construction phase:

Table B-3: Estimated Volumes of Construction Waste

Type	Volume per Month
Domestic (kg)	3,400
Paper (kg)	75
Plastic (kg)	1,500
Scrap Metal (kg)	4,000
Wood (m^3)	8
Food (kg)	1,200
Construction (kg)	59,000
Fluorescent Lamps (EA)	20
Glass (kg)	40

236. The data does not indicate if how much of the waste is classified as 'hazardous'. As an estimate, approximately 2-3% of the total waste generated may be classified as hazardous.

B.6.5 Commissioning

237. Commissioning of equipment will be ongoing during the construction phase, and will continue until final handover of TPP2 by the EPC contractor. Commissioning activities will include test running of the CCGT equipment to ensure that it meets performance guarantee requirements, in particular the rated electrical output, efficiency and the emission of airborne contaminants and noise, and performance of the cooling system and other ancillary plant at relevant loads.

238. Testing is likely to involve repeated starting and shutdown, and running at various loads, which may result in unusual short-term noise or atmospheric emissions.

B.7 Contracting and Institutional Issues

B.7.1 Contracting Procedures

239. Contracting Procedures are an essential aspect of the Project Design. The Project shall incorporate procedures which include important safeguards, most notably the Site Specific Environmental Management Plan (SSEMP), the purpose of which is to make explicit the EPC Contractor's documented and detailed understanding of the requirements of the EMP and to make their implementation both site-specific (e.g., where water quality monitoring will be conducted pursuant to the requirements of the Contract) and time-specific. It is important to note that, to be meaningful, the recommendations of the EMP must go beyond recommendations and become legally enforceable and incorporated in the bid and contract documents.

B.7.2 Monitoring and Supervision

240. Supervision and monitoring are an equally important part of Project design. Supervision and monitoring provisions will be primarily the responsibility of the following:

- Engineer. The Engineer will be tasked with specific responsibility to ensure safeguard compliance of civil works – with particular emphasis on the monitoring of implementation of SSEMP and related aspects of the Project. The Engineers team will include one national environmental specialist (NES) and one international environmental specialist (IES).
- EPC Contractor's Environmental Specialist. The EPC Contractor will be required to retain expertise to do this work and must keep that person/firm to oversee the operation throughout the contract period.
- TPP2 PMU. Responsible for overall EMP implementation and will be assisted by the Engineer. Their tasks include, but are not limited to supervision for overall compliance with SPS 2009 requirements, preparation and submission of environmental monitoring reports and update of EIA during construction in case of technical design changes or unanticipated impacts.

241. More specific recommendations in regard to monitoring and supervision roles and responsibilities are included in **Section H: Environmental Management Plan** and **Section J: Conclusions and Recommendations.**

B.8 Proposed Schedule for Implementation and Cost

B.8.1 Schedule

242. The current outline implementation schedule for the Project is:

- EPC contract approval – Month 0
- Civil works commence – Month 6
- Unit 1 commissioned – Month 36
- Unit 2 commissioned – Month 42

B.8.2 Cost

243. The estimated cost of the Project is between $650 - $800 million depending upon the GT model and configuration.

C. Alternatives

244. One of the objectives of an EIA is to investigate alternatives to the Project. In relation to a proposed activity "alternatives" means different ways of meeting the general purposes and requirements of the proposed activity. The following section provides an assessment of alternative technologies, GT manufacturers, equipment configuration and water cooling as well as an assessment of the 'no project' scenario.

C.1 No Project Scenario

245. The 'No Project' alternative would mean that the project does not go ahead. In this case there would not be any impact associated with the Project (air, noise, water use, etc.). However, all the long term benefits of the Project would be lost, such as job creation and increased energy security.

246. 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 TPP2 as long as this EIA demonstrates that it will produce an overall impact that is compatible with, controllable by and fits 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.

C.2 Alternative Sites

247. TPC was originally intended to be a 3.2GW gas fired power plant that would be built in various phases, starting with TPP0, TPP1 and then TPP2. Construction of TPP0 included of a range of other infrastructure to accommodate these extra units, such as sewage treatment plant and sludge drying pits that was set in place awaiting the new units. Existing infrastructure, such as gas supply pipelines, and substations are also in place at the TPC site

248. The TPC site itself was allocated and sized specifically to accommodate this further development, and as such no additional land acquisition is required, or the resettlement of any people. Using the existing site also prevents the need to disturb other land uses or habitat. Accordingly, the site allocated to TPP2 is deemed the most appropriate location for the new power plant and no other alternative locations are recommended.

C.3 Alternative Sources of Thermal Energy

249. 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 900 MW by an oil-fired conventional plant.
- Generation of 900 MW by a coal-fired conventional plant.
- Generation of 900 MW by a combined cycle power plant CCPP.

250. Generation of 900 MW by an oil-fired conventional plant. - 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.

251. The combustion of fuel oil is not complete in comparison with natural gas and will produce CO_2, NOx, 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 NOx, SO_2 and particulate emissions.

252. 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 NOx, SO_2 emissions.
- Water and additional chemical products consumption from the facilities to control emissions.
- Gypsum treatment and disposal.
- Appropriate fuel oil storage and handling.

253. Generation of 900 MW by a coal-fired conventional plant - 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 NOx, SO_2 and particulate emissions than fuel oil.

254. 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 NOx, 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.

255. Generation of 900 MW by a combined cycle power plant - 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 insignificant 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 NOx and CO_2 emissions.

256. 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.

257. 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 CCPP does not need additional expenditure for emissions control and fuel storage in comparison with fuel and coal.

258. Based on the above, the best combustion technology chosen for the new power generation unit, from the environmental point of view, is the combined cycle option.

C.4 Alternative Technology Options

259. Whilst the remit of MMCS is to consider TPP2 on the basis of CCGT technology, there are multiple technologies which are able to operate on natural gas for the generation of electricity, these include:

- Reciprocating gas engines,
- Conventional gas-fired boilers with Steam Turbines,
- Open Cycle Gas Turbines (OCGTs), and
- Combined Cycle Gas Turbines.

260. Below commentary on why CCGT is the recommended solution for TPP2 is provided, with compliance with Best Available Technology (BAT) being a key factor.

Table C-1: Technology Options

Technology Choice		Advantages	Disadvantages
Reciprocating Engines	Multiple slow speed engines (c. 50 MW) with waste heat boilers and steam turbines.	Fast starting and very high flexibility. Very low Minimum Stable Generation (MSG). Low operation and maintenance costs.	Poor efficiency, higher emissions (than CCGT) and lower quality steam cycle. Space requirements and number of units required to reach 900 MW. Not Best Available Technology (BAT).
Conventional Boiler	Single gas fired boiler and steam turbine, replicating the existing 800 MW unit.	Traditional technology. Economy of scale due to single unit. Low maintenance costs.	Slow start-up time and low flexibility. Poor efficiency, high MSG, higher emissions (than CCGT). High operation staff numbers. Not BAT.
Open Cycle Gas Turbines	Multiple F-class gas turbines. F-class selected as being proven technology.	Fast starting and high flexibility. Low MSG. Low emissions. Minimal operating staff.	Poor efficiency. High maintenance costs. Not BAT.
Combined Cycle Gas Turbines	Two F-class gas turbines with heat recovery steam generators and steam turbine(s).	BAT.* Highest efficiency and moderate flexibility.	High maintenance costs.

* GHJ are more advanced model but with “larger output” of typically 400-500MW (SC, 50Hz), which is oversized for the project in terms of, among others, transmission line capacity, fuel usage and heavy equipment transportation restriction. Furthermore, argument is there on the “commercial proveness” of the advanced gas turbine technology as those came into market only in recent years. The adoption of commercially unproven model will heighten the risk of project, which cannot be also imposed to client, over and above the technical restrictions. Although gas turbine model is collectively referred to as “F” class, each model of F class turbine also has gone and is undergoing upgrades to improve the performance. The project will adopt the most recent F class technology.

C.4.1 Reciprocating Gas Engines

261. Reciprocating gas engines use spark ignition to fire natural gas, the engines have a typical automotive piston and cylinder arrangement. Power output per engine varies, among other things, on the speed, swept capacity and number of strokes per cycle. Typically, speeds vary from 150 to 3,000 rpm and power per unit from 2 to 50 MW. Therefore, in order to achieve the desired capacity multiple engines would be required.

262. The use of waste heat recovery steam generators allows for combined cycle operation, however, the temperature of the waste heat will generate low quality steam for use in the ST, limiting the output and efficiency of the ST

263. The use of multiple reciprocating gas engines allows for a highly flexible plant, start/stop engines as required. Although, the CAPEX is expected to be low, relatively small capacity of each individual unit means that the number of units and the associated footprint (site size) makes the selection of reciprocating gas engines impractical.

C.4.2 Conventional Boilers

264. Conventional gas-fired boilers raise steam in a boiler which is used to power a steam turbine and is the technology used in the existing Talimarjan facility. Although the lowest CAPEX amongst the considered technologies, conventional boilers do not compete with the gas-fired configurations in terms of efficiency, and would not be considered BAT for a gas fired solution.

C.4.3 OCGT

265. OCGT plants gas discharge the exhaust flue gas direct to the atmosphere. By not having the steam cycle, OCGT plants have a relatively short construction period and provide rapid start up and loading profiles, and are therefore normally used for providing peak power, or where the project is developed in phases: first open cycle is constructed, before the steam cycle is added to allow combined cycle operation.

266. A typical OCGT plant has approximately two thirds of the efficiency of the same OCGT plant in combined cycle. Adding a Heat Recovery Steam Generator (HRSG), ST and condenser to the OCGT closes the cycle, improving plant output and efficiency

267. CAPEX and OPEX of an OCGT plant are lower than that for a CCGT, but the power output and efficiency are both lower. The inclusion of a bypass stack in the HRSG or dry running capability is required to allow the GT to run with the ST shutdown; a bypass stack allows full maintenance of pressure parts, in comparison dry running reduces the maintenance tasks which can be completed while the GT is operating.

C.4.4 CCGT

268. Heavy Duty Gas Turbines (HDGT) are referenced by generic type or class. GTs of the F-class have dominated the HDGT market since the mid-1990s and have only recently begun to be superseded by the advanced classes of GTs (G, H and J).

269. Due to the number of units in service and hours of operation of F-class GTs, they are considered a proven technology, for this reason F-class GTs are recommended for the project, over the only slightly more efficient G, H and J class units. All of the major GT OEMs have well proven F class units.

C.5 Alternative Configuration Options

270. CCGTs can be configured in two distinct configurations, either single shaft or multi-shaft as follows.

- Single shaft – The GT and ST are connected via a solid shaft, or through a Synchro-Self-Shifting (SSS) clutch, to a common generator.
- Multi shaft (1-on-1) – The GT and ST have their own dedicated generators, and are often installed in separate buildings.
- Multi shaft (2-on-1) – Each GT has its own dedicated HRSG, which raise steam for use in a common ST.

271. A single shaft configuration incurs lower CAPEX and Operations & Maintenance (O&M) costs due to the reduced amount of hardware; compared to multi-shaft configurations which have extra generator, transformer, lube oil systems, and substation equipment. The reduced hardware contributes to slightly better reliability as there are fewer parts required for operation, the efficiency is slightly better due to reduced auxiliary loads.

272. The single larger ST used in the 2-on-1configuration will have a better full load performance than the smaller ST used in single shaft or 1-on-1 configuration. Likewise, the single condenser of the 2-on-1 allows for economies of scale in the condenser and cooling pipework. However, a fault on the ST shuts will stop both GTs unless bypass stacks are provided, while a fault on the ST in a single shaft unit only stops that powertrain. Commissioning time is shorter due to the reduced amount of plant and the need to commission the common equipment.

273. The footprint of a single shaft configuration is smaller although a single large generator is necessary whereas multi-shaft designs use two (or more) smaller generators which may be advantageous for smaller grid systems. The layout of a single shaft design is fixed, the HRSG, GT, generator and ST are all in one line; a multi-shaft configuration allows for more flexibility in the placement of plant items and easier maintenance i.e. rotor removal.

274. Start-up times from standstill are slightly longer for multi-shaft configurations due to the size of the ST requiring longer hold times, however shutting down just one GT, while the ST remains on load, allows for a quicker addition of the second GT.

275. Finally, the choice of configuration is dependent on the OEMs preference at the time of bidding, what is their standard configuration for this size of plant, what manufacturing capacity is available may limit the choice of GT/ST which will ultimately decide single or multi-shaft configuration.

276. Selecting a multi shaft configuration allows the OEMS to propose a common configuration, removing the anomaly of clutches and solid shafts which various OEMs may offer.

C.6 Alternative Water Cooling Options

277. The cooling methods modeled for the TPP2 include a Once-Through Cooling (OTC) system, Cooling Towers Dedicated for TPP2 (CT-D), Cooling Towers with Canal Recirculation (CT-CR) utilizing the existing cooling water infrastructure and dry Air Cooled Condensers (ACC).

C.6.1 Once Through Cooling

278. For projects with access to sufficient water, once through cooling (OTC) provides the best all year round performance. The existing TPP0 pump house has two spare bays which could be utilized by TPP2. If OTC is to be employed for TPP2, in order to reduce CAPEX, it is proposed that subject to confirmation, that the remaining two spare bays in the TPP0 pump house are utilized to extract water from the intake pond. Hot water will be discharged back into the KMK along with hot water from TPP0 and TPP1 power plants.

279. **Section G.6.6 – Surface Hydrology** provides a in depth discussion on this issue, but to summarize, there are certain periods of the year, winter and early spring, late autumn, when the low availability of water in the KMK restricts the use of the OTC. The variation of flow in the KMK will also have environmental consequences in terms of thermal pollution.

C.6.2 Cooling Towers

280. Evaporative cooling towers are used in projects which have limited supplies of cooling water or restricted discharge limits. The performance of the cooling tower is limited to the ambient wet bulb temperature, and therefore cooling towers do suffer from a loss in performance during periods of high ambient temperature.

281. The volume of water required for a cooling towers is dramatically less than that required for a OTC project of similar size, as water is only needed to be made up into the tower to replace water lost by evaporation or blow down (required to maintain water quality).

282. Cooling towers are compatible with the condenser used in OTC projects. Circulating pumps are required to be installed in the basin of the cooling tower to circulate the water through the condenser.

283. If suction for TPP2 was taken from the intake lagoon, then the increase in lagoon temperature would affect not only the performance of TPP and TPP1 but also TPP2. Providing a stand-alone closed circuit cooling tower removes the impact on TPP2 performance if the performance of TPP0 or TPP1 cooling system deteriorates and removes the need to operate the large pumps in the TPP0 pump-house.

C.6.3 Atmospheric Sprays

284. TPP0 employs an atmospheric spray system for periods when OTC is not viable, although we understand that the system has not been used in recent years and Uzbekenergo has commented, "*Spray basins were developed during the Soviet Union time and were intended for use during maintenance of KMK of expected short duration in coldest months. Such installations were experimental (mainly these were used in the cold climate of Russia) and their effectiveness for local [Talimarjan] conditions had to be verified in operation. In operation the spray system showed low effectiveness in the local conditions. It was observed that water quickly overheated and operation of spray system could only happen with make-up from KMK (part of cooling water goes through spray system and the rest is added from KMK).*"

285. On the basis that the current atmospheric spray system appears to be inefficient, ineffective and already compromising the whole KMK cooling system, plus a similar system would be a very high capital cost, we have not given any consideration to using a similar system for TPP2.

C.6.4 Air Cooled Condenser

286. ACCs are used in projects which have limited supplies of cooling water or restricted discharge limits for the cooling water. Due to their construction, ACCs are not compatible with wet cooling methods, and therefore would have to operate all year round i.e. an ACC could not be used in unison with the once through system.

287. While the performance of the ACC may be considered comparable to wet methods during periods of cold ambient temperature, performance suffers considerably in periods of high ambient conditions.

C.6.5 Recommendations

288. Subject to further evaluation regarding the points below, the recommendation for the cooling configuration would be:

- OTC for summer periods when there is adequate water available.
- Dedicated cooling tower operation during the winter months when the availability of water is less and also during summer months to manage thermal discharge issues.

C.7 Pollution Control Technologies

289. Based on the results of the air dispersion model prepared for the Project there is no requirement for further NOx abatement to be installed. This would not be considered BAT for this project. It should also be noted that the assessment has been carried out assuming the NOx emission limit guarantee of 25ppm and during operation it is likely that the turbines would perform significantly below this guarantee meaning that the assessment results are very conservative. BAT is a specific concept which is related to EU requirements and is not a concept adopted by the IFC in their guidelines. Projects funded in accordance with IFC guidelines should meet Good Industry Industrial Practice which this project does by meeting 25ppm. The air quality assessment indicates that the impacts are acceptable and therefore no additional abatement is required as the cost of that would not be justifiable based on the impacts.

D. Environmental Laws, Standards and Regulations

D.1 General

290. This section of the EIA provides a summary of:

- Overall environmental legal framework of Uzbekistan;
- Uzbekistan's environmental impact assessment regulations;
- The administrative framework;
- National standards relating to noise, air quality, water quality and waste;
- A list of the required permits and licenses for the operational phase of the Project; and
- An overview of the ADB safeguard policies.

D.2 Overall legal framework

291. Environmental protection is administered in Uzbekistan by the State Committee for Nature Protection (Goskompriroda). Goskompriroda is the primary environmental regulatory agency, and reports directly to the Parliament, and is responsible for the implementation of The Law on Environmental Protection (1992). Specifically, it is responsible for supervising, coordinating and implementing environmental protection and controlling the usage and renewal of natural resources at the central, region and district levels. The mandate of Goskompriroda is based on the Regulation on the State Environmental Committee of the Republic of Uzbekistan (1996).

292. The overarching legislative framework that establishes the legal framework for environmental protection in Uzbekistan is The law "On nature protection" (Law No.754-XII, 1992). The law 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, Goskompriroda 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.

D.3 Environmental Impact Assessment

293. State Environmental Expertise (SEE), i.e. preparation of or the review and approval (or rejection) of developments on environmental grounds, is regulated by the Law on Ecological Expertise (2000) and by Decree of the Cabinet of Ministers No 491.31.12.2001: "On approval of the Regulation of the State Environmental Expertise". Goskompriroda, through its SEE Department (Glavgosekoexpertiza) reviews, inter alia; environmental impact reports, prepares and implements ecological regulations and standards, coordinates environmental programs and elaborates the structure for environmental monitoring and governance of nature reserves. It approves regulations and issues permits for pollutant emissions and may prohibit projects and construction works that do not comply with environmental legislation. According to the article 3 of the abovementioned law Ecological Expertise is carried out in order to determine:

- compliance of projected economic and other activities with environmental requirements in the stages preceding decision making on its implementation;

- level of ecological danger planned or carried out business and other activities, which may have or had a negative impact on the condition of the environment and public health;
- adequacy and reasonableness of the measures provided for the protection of the environment and rational use of natural resources.

294. The main responsible organization for state environmental review is the Main Directorate for State Ecological Expertise (Glavgosecoexpertiza) of Goskompriroda. 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

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

- Category I – Corresponds to ADB category A;
- Category II –Corresponds to ADB category B;
- Category III –Corresponds to ADB category B or C;
- Category IV – Corresponds to ADB category C. [5]

296. According to the paragraph 11 of the Regulation, evaluation stages of the environmental impact should include the following basic issues (depending on the type and nature of work):

- Stage 1: Draft Statement on Environmental Impacts (DSEI) ('PZVOS' is the national acronym) to be conducted at the planning stage of the proposed project prior to development funds being allocated. This stage is similar to the scoping stage used in EIA.
- Stage 2: Statement on Environmental Impact (SEI) ('ZVOS' is the national acronym) to be completed where it was identified by the Glavgosecoexpertiza at Stage I that additional investigations or analyses were necessary. The Statement must be submitted to the Glavgosecoexpertiza before approval of the project's feasibility study, and therefore before construction. The Statement is required:
    - Assessment of environmental problems of the chosen site on the results of engineering- geological investigations, modeling and other necessary researches;
    - Environmental analysis of technology applied to the issues identified on the site;
    - The results of the public hearings (if necessary);
    - Reasoned investigations of the nature-conservative measures to prevent the negative consequences of the expertising object.
- Stage 3: Statement on Environmental Consequences (SEC) ('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:
    - Correction of the design decisions and other taken measures on the consideration of the DSEI by the bodies of Goskompriroda, as well as on the proposals made at the public hearings;
    - Environmental regulations governing the activities of the expertising object;
    - Requirements for the organization of work and the implementation of measures for environmental guiding of the operation of the object.

[5] Based on the report "Uzbekistan Regional Roads and Development Project (P146334) Environmental and Social Management Framework" World Bank, March, 2015. Note – the WB and ADB EIA categories are broadly the same.

297. At Stage 3 Goskompriroda, working at both the state and oblast levels, defines the pollution limits the project is permitted to reach. Uzbekistan prescribes the maximum review period for Goskompriroda as 30 days review for Category I and II projects and 20 days for category III and 10 days for Category IV projects.

D.4 Administrative Framework

298. As stated above, Environmental protection is administered in Uzbekistan by the Goskompriroda which consists of a central body in Tashkent, and regional and district branches and agencies for scientific and technical support. Goskompriroda, through Glavgosecoexpertiza reviews, inter alia; environmental impact reports, prepares and implements ecological regulations and standards, coordinates environmental programs and elaborates the structure for environmental monitoring and governance of nature reserves. It approves regulations and issues permits for pollutant emissions and may prohibit projects and construction works that do not comply with environmental legislation.

299. The other State bodies within the Uzbekistan administrative framework with relevant environmental responsibilities are as follows:

- 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).

D.5 Air, Water, Noise and Waste

300. Uzbekistan has a large set of specific standards that refer to emission, effluent, and noise standards, as well as standard to handle and dispose specific wastes ranging from sewage to hazardous wastes. The following summarizes these laws and standards.

D.5.1 Air Quality Legislation and Standards

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

- Goskompriroda 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.

D.5.1.1 Legislation & Standards Relevant to the Project

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

- 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 GoU, Goskompriroda 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 of persons to a healthy environment and other associated with it, the rights and guarantees of their implementation.
- 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. Goskompriroda has overall responsibility for implementing this legislation through The Departments of Glavgosecoexpertiza and Gosecoexpertisa (which are both under Goskompriroda) and the Provincial branches of Goskompriroda.

303. The key sanitary rules and norms include:

- List of Maximum Allowable Concentrations (MACs) of pollutants in ambient air of communities in the Republic of Uzbekistan 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.
- List of Maximum allowed concentration (MAC) of pollutants into the atmosphere air of settlements in Uzbekistan SanR&N No 0293-11.
- List of maximum permissible concentration (MPC) – microorganism-producers in the air of settlement areas SanR&N No 0147-04.

D.5.1.2 Ambient Air Quality

304. **Table D-1** provides the ambient air quality standards set by SanPiN Ruz No.0179-04 – *'Hygienic norms: List Maximum Allowable Concentrations (MACs) of pollutants in ambient air of communities in the Republic of Uzbekistan'* and by the IFCs Environmental, Health and Safety Guidelines. All of these parameters are relevant to the construction phase of the Project. However, during the operational phase of the Project NO_X is the only parameter that will be monitored due to the fact that the TPC emits very low levels of CO and SO_2.

Table D-1: Ambient Air Quality Standards

Parameter	Unit	Averaging Period	Concentration	Source of Standard
Sulfur Dioxide (SO_2) – Hazard Class 3	$\mu g/m^3$	30 minute	500	Uzbekistan
		1 Day	200	Uzbekistan
		1 month	100	Uzbekistan
		1 year	50	Uzbekistan
		24 hour	20	IFC
		10 minute	500	IFC
Nitrogen Dioxide (NO_2) – Hazard Class 2	$\mu g/m^3$	30 minute	85	Uzbekistan
		1 Hour	200	IFC
		1 Day	60	Uzbekistan
		1 Month	50	Uzbekistan
		1 year	40	IFC/ Uzbekistan
Nitric Oxide (NO) – Hazard Class 3*	$\mu g/m^3$	30 minute	600	Uzbekistan
		1 Day	250	Uzbekistan

		1 month	120	Uzbekistan
		1 year	60	Uzbekistan
Carbon Monoxide (CO) – Hazard Class 4	µg/m^3	One time	5000	Uzbekistan
		1 Day	4000	Uzbekistan
		1 month	3500	Uzbekistan
		1 year	3000	Uzbekistan
Particulate matter PM_{10}	µg/m^3	1 Year	20	IFC
		24 hour	50	IFC
Particulate Matter $PM_{2.5}$	µg/m^3	1 year	10	IFC
		24 hour	25	IFC
Dust	µg/m^3	30 minute	150 – 500	Uzbekistan
		1 day	100 – 35	Uzbekistan
		1 month	80 – 20	Uzbekistan
		1 year	50 – 15	Uzbekistan
Ozone	µg/m^3	8 hour daily max	100	IFC

* NO_X is interpreted as NO within Uzbekistan.

D.5.1.3 Stack Emissions

305. For the existing units of TPP0, Maximum Allowed Emissions (MAE) have been calculated and approved by the State Committee for Nature Protection (Goskompriroda), see **Table D-2**.

Table D-2: Maximum Allowed Emissions for TPP0 (µg/m^3)

#	Parameter	Stack THP – 805 C3	Stack GM – 50	Stack PTVM – 30
1	NO*	36.4	15.6	10.4
2	NO_2	224.0	96.0	64.0
3	CO	12.5	12.5	12.5
4	SO_2	-	-	-

* NO_X is interpreted as NO within Uzbekistan.

306. Routine monitoring of these parameters is undertaken by TPP0. The results of monitoring during 2016 are provided by **Section E.1.1.6 – Current TPC Emissions**.

307. In addition to the MAE, the IFC provides a portfolio of Standards and Guidelines that should be adhered to for any project seeking IFC finance. The IFC PS3: Resource Efficiency and Pollution Prevention aims: *"to avoid or minimize adverse impacts on human health and the environment by avoiding or minimizing pollution from project activities".* To achieve this, the IFC provides both industry-specific and general guidance on Good International Industry Practice with respect to emissions to air.

308. Relevant IFC standards for emissions to air applicable for the project are presented in the WBG Guidelines for Thermal Power Plants. These Guidelines advise that, with respect to emission limits, when host country regulations differ from the levels presented in the Guidelines, projects are expected to achieve whichever is more stringent. **Table D-3** provides a summary of the relevant IFC emission limits applicable to the Project.

Table D-3: Summary of Applicable IFC Emission Limit Values (mg/Nm³)			
Fuel	Pollutant	IFC Guidelines[(a)]	
		Non-degraded airshed (NDA)	Degraded airshed (DA)[(b)]
Natural Gas	NO_x	51 (25ppm)	51 (25 ppm)

Notes: [(a)] WBG EHS Guidelines for Thermal Power Plants. Nm³ is at 0ºC, dry, 15% O2, 1 atmospheric pressure
[(b)] An airshed is considered to be degraded if nationally legislated air quality standards are exceeded.

Box 1 - Project Relevance

TPC shall ensure compliance during the construction phase with all of the parameters listed in **Table D-1. Table H-2** and **Table H-3** indicate which of the averaging periods shall be applied to each parameter during the construction phase monitoring so as to ensure compliance with national and IFC standards. During the operational phase, TPP0 will be required to continue to operate according to the emissions limits specified by **Table D-2** and TPP1 and TPP2 will be required to operate according to the IFC values presented in **Table D-3** (these levels are also the Guaranteed Values in the EPC Contract).

D.5.2. Water Quality Legislation and Standards

309. Water resources management, allocation and use in Uzbekistan are under the control of the Ministry of Agriculture and Water Resources (MAWR), which oversees national specialized associated, provincial and district departments of agriculture and water resources, and interprovincial and inter-district canal management authorities. The key law relating to water and water use is the 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:

- MAWR (surface water);
- State Committee for Geology and Mineral Resources (Goskomgeologia);
- State Inspectorate for Exploration Supervision, Operations Safety Supervision of Industry, Mining and Utilities Sector (or Sanoatgeokontekhnazorat).

D.5.2.1 Legislation & Standards Relevant to the Project

310. Key regulations relating to water quality and use for the Project include:

- 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).
- 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).

311. TPP0 is required to operate within water quality limits set by Goskompriroda. **Table D-5** indicates the limits set for effluent discharge from the TPP0 to the KMK after water cooling. In addition, Goskompriroda have set limits for effluent discharge from the sewage treatment plant used by TPC, see **Table D-6**.

Table D-5: TPP0 Effluent Limits for Discharge Water to the KMK

#	Parameter	Unit	TPP0 Limit
1	Dissolved Mineral	mg/l	1000
2	Mixed substances	mg/l	437.8
3	Sulfate	mg/l	167.2
4	Chloride	mg/l	300
5	Biological oxygen demand (BOD-5)	mg/l	3
6	Ammonium	mg/l	0.5
7	Nitrite ions	mg/l	0.058
8	Nitrate ions	mg/l	9.1
9	Iron	mg/l	0.28
10	Petroleum products	mg/l	0.05
11	Copper	mg/l	0.019
12	pH Indicator	*	7
13	Temperature	˚C	

Table D-6: Effluent Limits for Sewage Treatment Plant Discharge

#	Parameter	Unit	TPP0 Limit
1	Dissolved Mineral	mg/l	1000
2	Mixed substances	mg/l	30
3	Sulfate	mg/l	500
4	Chlorid	mg/l	350
5	Biological oxygen demand (BOD-5)	mg/l	6.5
6	Ammonium	mg/l	2
7	Nitrite ions	mg/l	25
8	Nitrate ions	mg/l	0.5
9	Iron	mg/l	0.5
10	Petroleum products	mg/l	0.3
11	Copper	mg/l	1
12	pH Indicator	*	7

312. In addition to the above standards, the IFC also have effluent guidelines that are applicable to cooling water and other power plant wastewater streams. **Table D-7** provides these guideline standards.

Table D-7: IFC Effluent Guidelines [6]			
#	**Parameter**	**Unit**	**TPP0 Limit**
1	pH	*	6-9
2	Total Suspended Solids	mg/l	50
3	Oil and Grease	mg/l	10
4	Total Residual Chlorine	mg/l	0.2
5	Chromium – Total	mg/l	0.5
6	Copper	mg/l	0.5
7	Iron	mg/l	1.0
8	Zinc	mg/l	1.0
9	Lead	mg/l	0.5
10	Cadmium	mg/l	0.1
11	Mercury	mg/l	0.005
12	Arsenic	mg/l	0.5

Box 2 - Project Relevance

Effluent discharge from the TPC to the KMK should meet the standards set for TPP0 (**Table D-5**) or the IFC (**Table D-7**), whichever is more stringent.

D.5.3. Noise Standards

313. In order to provide rules on acceptable noise levels for habitable areas Uzbekistan utilizes the law (SanPiN) number 0267-09. This law presents a table of noise levels for a variety of internal and external applications, the most relevant of which is replicated below in **Table D-8**. Uzbek standards are in line with IFC standards as indicated in **Table D-8**. IFC guidelines also recommend that noise levels should not result in a maximum increase in background levels of 3 dB at the nearest receptor location off-site and that noise levels at the boundary of an industrial property should not exceed 70 dB(A).

Table D-8: Noise Limits from SanPiN No. 0267-09 & IFC EHS Guidelines			
Location	**Time**	**SanPiN No. 0267-09**	**IFC Standards (7am – 11pm / 11pm – 7am)**
Areas adjacent to homes, clinics, dispensaries, rest homes, boarding houses, boarding homes for the elderly, childcare facilities, schools and other educational institutions, libraries	From 7 am to 11 pm	55 dB(A)	55 dB(A)
	From 11pm to 7 am	45 dB(A)	45 dB(A)
Living room of flats, bedrooms of resorts (inside).	From 7 am to 11 pm	40 dB(A)	-
	From 11pm to 7 am	30 dB(A)	-

[6] EHS Guidelines for Thermal Power Plants. IFC

314. In order to protect the health of staff in the workplace Uzbekistan utilizes the law (SanPiN) number 0120-01 – "Sanitary norms and rules to ensure acceptable noise levels in the workplace". This law presents a table of noise levels for a variety of internal and external applications, the most relevant of which is replicated below in **Table D-9**. In addition, the IFC provide noise limits for various working environments which are also illustrated in **Table D-9**.

Table D-9: Work Environment Noise limits

Type of Work, workplace	**SanPiN No. 0120-01 /**	**IFC General EHS Guidelines**
Performing all types of work on the permanent workplaces in industrial premises and in the enterprises operated from March 12, 1985	80 dB(A)	-
Heavy Industry (no demand for oral communication)	-	85 Equivalent level Laeq,8h
Light industry (decreasing demand for oral communication)	-	50-65 Equivalent level Laeq,8h

315. The UK Control of Noise at Work Regulations 2005 specify three action values for noise workers exposure over an 8 hour day with the upper exposure limit being 85 dB(A) and a peak sound pressure exposure of 137 dB (C-weighted). The Canadian Center for Occupational Health and Safety specify a limit of 85 dB(A) for an eight hour period up to 100 dB(A) for a 15 minute period.

316. For industrial equipment, such as that found in the TPC, the level of noise must not exceed 80 dB(A) in operational zone one meter apart from equipment on rigid foundation according to SanPiN No 0120-01 (Uzbek legislation).

Box 3 – Project Relevance

The Project shall comply with SanPiN No. 0267-09 and the IFC Guidelines for ambient noise limits. The Project shall also comply with SanPiN No. 0120-01 for work noise limits. Finally, the Project will comply with SanPiN No 0120-01 for noise levels from industrial equipment.

D.5.4 Sanitary Protection Zones

317. 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.

318. 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.

319. The following land uses are typically prohibited within an SPZ:

- Residential properties;

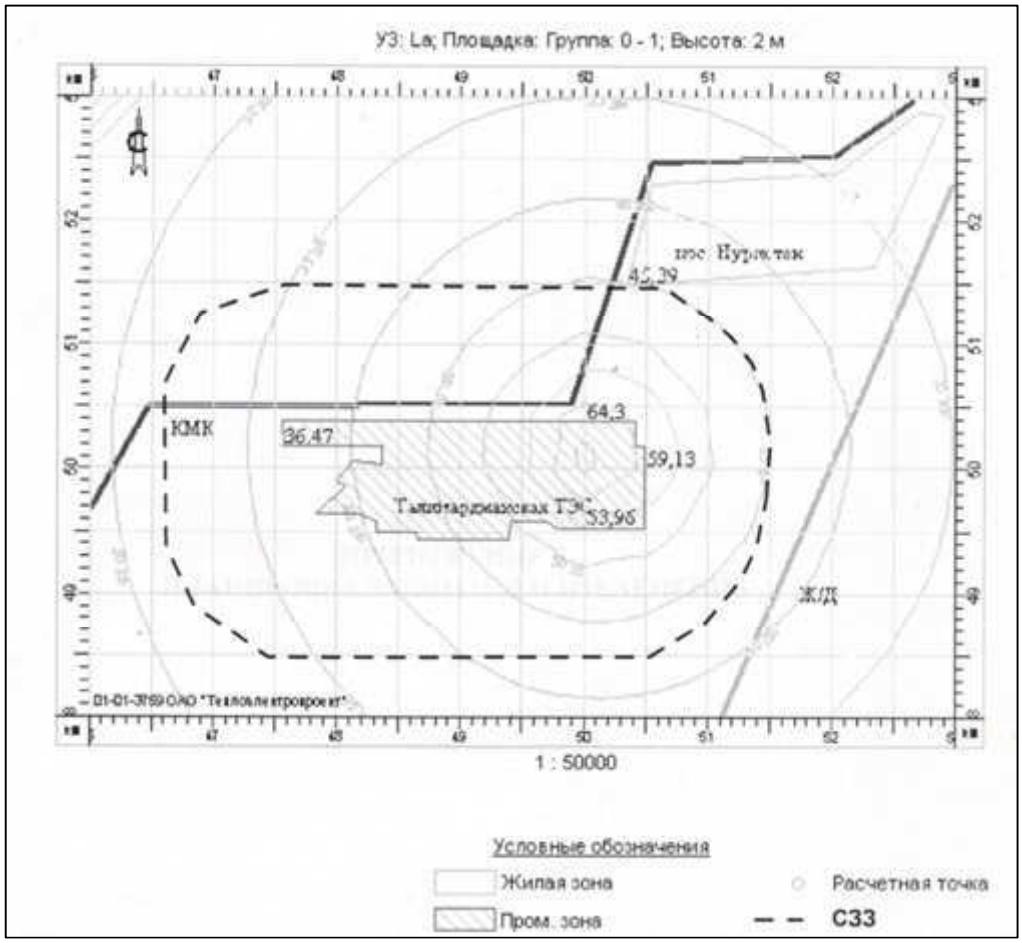
- Public or individual country houses;
- Production and storage of drinking water; and,
- Parks, sports, educational and medical facilities.

320. 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 stations, recycling water supply installations, gas stations and transport service stations.

321. The SPZ for TPP0 has been set at 1000m from the site boundary. The SPZ for TPP1 and TPP2 will be determined by the relevant environmental authorities. As yet, no determination has been made.

Figure D-1: TPP0 SPZ



D.5.5 Waste Regulations

322. The Cabinet of Ministers of Uzbekistan sets and approves national policies, strategies, programs 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.

323. The key law relating to waste is the 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 Goskompriroda concerning inspections, coordination, ecological expertise and establishing certain parameters with regard to the locations where waste may be processed. Dangerous waste that is transported domestically or internationally must pass ecological certification and be moved by special vehicles.

324. 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 GoU, Goskompriroda, 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.

325. 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).

326. Other relevant regulations, standards and norms include:

- Order of disposal of hazardous chemicals and hazardous materials on special landfills, their protection and maintenance, approved by Goskompriroda, 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.
- Sanitarian Rules of inventory, classification, storage and disposal of industrial wastes SanR&N No. 0127-02.
- Sanitarian requirements on storage and disposal of solid waste in special landfills SanR&N No. 0157-04.
- Sanitary regulations for collection, storage, transportation, disposal and recycling of municipal solid waste SanR&N No. 0068-96.
- GOST 17.0.0.05-93 – Unified system of standards for environmental protection and rational use of resources. Waste Data Sheet.
- 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.

327. The TPC 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 TPC 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.

328. Waste management of the TPC should be based also on chapter 1.6. of the General EHS IFC Guidelines.

D.6 Licenses, Permits, and Approvals for Operation

329. New licenses will need to be obtained from the Kashkadarya Province Nature Protection Committee and the State Nature Protection Committee. The licenses will cover the requirements of the following environmental legislation:

1. Law of the Republic of Uzbekistan on nature protection. 1992.
2. Cabinet of Ministers' Decree № 491 from 31.12.2001 on "Confirmation of regulation of governmental environmental expertise in the Republic of Uzbekistan".
3. Guidelines for calculation of the maximum allowed discharge of pollutants in water bodies and land, with due regard for the parameters for technically achievable waste treatment'" (OZ RH 84.3.5:2004).
4. Guidelines for development of water consumption and water discharge norms and standards for heating and power engineering enterprises (RD 34.02.401).
5. Construction norms and rules (CNR) "internal water supply system and sewage of buildings" (CNR (KMK in Uzbek) 2.04 01-98).
6. Sanitary norms and rules (SNR) "Internal water supply systems and sewage" (SNR 2.04.02-84, SNR 2.04.01.85).
7. Development and execution orders of project norms within the maximum allowed emissions of pollutants into water sources, including drainage water (guide document (RD 118.0027719.5-91).
8. Handling of manufacturing and consumption wastes. Instructions for the organization and conduct of waste inventory. (OZ RH 84.3.15:2005).
9. Handling of manufacturing and consumption wastes. Guidance for determination of waste placement limits. (OZ RH 84.3.16:2005).
10. Handling with manufacture and consumption wastes. Waste passport (OZ RH 84.3.18:2005).
11. Handling of manufacturing and consumption wastes. Guidelines for determination of waste formation norms (OZ RH 84.3.21:2005).
12. Instructions for conducting an air pollutant inventory and setting air pollutant standards for enterprises of Uzbekistan, 2006.
13. Guidelines for calculation of air concentrations of pollutants contained in enterprises' emissions, OND-86.

D.7 International Conventions and Agreements

330. The Republic of Uzbekistan has ratified the following international conventions that are part of this environmental examination.

Table D-10: International Conventions and Treaties

#	**International Conventions and Treaties**	**Date of ratification**	**Date of coming into force for Uzbekistan**
1	UN Framework Convention on Climate Change	20 June 1993 (acceptance)	21 March 1994
2	Kyoto Protocol to UNFCCC	20 October 1999	16 February 2005
3	Montreal Protocol on Substances that Deplete the Ozone Layer (with	18 May 1994 (succession) London – 01.05.1998;	18 May 1993 London – 08.09.1998;

	London, Copenhagen, Montreal amendments)	Copenhagen – 01.05.1998; Montreal – 07.09.2006.	Copenhagen – 08.09.1998l; Montreal – 29.01.2007.
4	Vienna Convention on the Protection of Ozone Layer	18 May 1993 (succession)	18 May 1993
5	Ramsar Convention on Wetlands of International Importance Especially as Wildlife Habitat	30 August 2001 (accession)	8 February 2002
6	UN (Rio) Convention on Biological Diversity	6 May 1995 (accession)	17 October 1995
7	Convention on International Trade in Endangered Species of Wild Fauna and Flora	25 April 1997 (accession)	8 October 1997
8	Convention on Migratory Species of Wild Animals	1 May 1998 (accession)	1 September 1998
9	Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal	22 December 1995 (accession)	7 May 1996
10	United Nations Convention to Combat Desertification	31 August 1995	29 January 1996
11	UNECE Convention on the Protection and Use of Transboundary Watercourses and International Lakes (UNECE Water Convention)	9 August 2007 (accession)	3 December 2007
12	Convention on the Law of the Non-Navigational Uses of International Watercourses	9 August 2007 (accession)	Has not entered into force yet
13	Paris Convention on Protection of the World Cultural and Natural Heritage	22 December 1995	15 June 1996

D.8 Asian Development Bank Safeguard Policies 2009

331. The ADB has three safeguard policies that seek to avoid, minimize or mitigate adverse environmental impacts and social costs to third parties, or vulnerable groups as a result of development projects [7] . The Talimarjan Project requires only the application of the environmental safeguard as there will be no resettlement or any impacts to indigenous people.

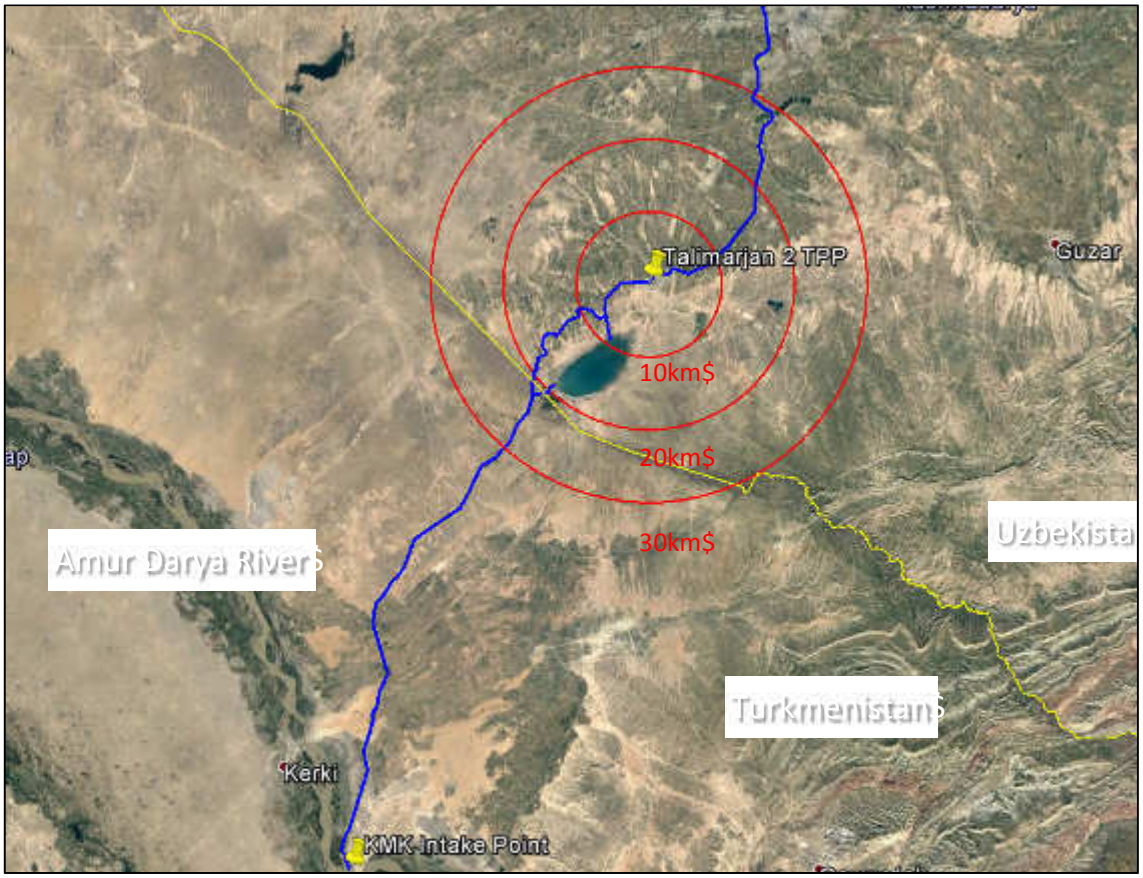
332. **Safeguard Requirements 1: Environment** – The objectives are to ensure the environmental soundness and sustainability of projects, and to support the integration of environmental considerations into the project decision-making process. Environmental safeguards are triggered if a project is likely to have potential environmental risks and impacts. Eleven 'Policy Principles' have been adopted as part of the SPS, including:

1. Use a screening process for each proposed project, as early as possible, to determine the appropriate extent and type of environmental assessment so that appropriate studies are undertaken commensurate with the significance of potential impacts and risks. (The Project was initially screened by the ADB and classified as a Category A project).

[7] ADB. 2009. Safeguard Policy Statement, Manila

2. Conduct an environmental assessment for each proposed project to identify potential direct, indirect, cumulative, and induced impacts and risks to physical, biological, socioeconomic (including impacts on livelihood through environmental media, health and safety, vulnerable groups, and gender issues), and physical cultural resources in the context of the project's area of influence. Assess potential transboundary and global impacts, including climate change. Use strategic environmental assessment where appropriate. (The EIA herewith provides the environmental assessment for the Project, including an assessment of climate change. The KMK takes it water from the Amu Darya river in Turkmenistan, however, this if for irrigation use, not soley for the purpose of TPC. TPP2 will operate in a mode that will not require additional water extraction from Amu Darya, accordingly transboundary water issues will not arise. The border with Turkmenistan is more than 20 km from TPC (see **Figure D-2**) and as such transboundary air quality impacts are also not applicable (see air quality model for further clarification of this issue)).

Figure D-2: Distance to Turkmenistan from TPC



3. Examine alternatives to the project's location, design, technology, and components and their potential environmental and social impacts and document the rationale for selecting the particular alternative proposed. Also consider the no project alternative. (Alternatives have been considered, including the 'no project' alternative in **Section C – Alternatives**).

4. Avoid, and where avoidance is not possible, minimize, mitigate, and/or offset adverse impacts and enhance positive impacts by means of environmental planning and management. Prepare an environmental management plan (EMP) that includes the

proposed mitigation measures, environmental monitoring and reporting requirements, related institutional or organizational arrangements, capacity development and training measures, implementation schedule, cost estimates, and performance indicators. Key considerations for EMP preparation include mitigation of potential adverse impacts to the level of no significant harm to third parties, and the polluter pays principle. (An EMP has been prepared for the Project and is outlined in detail in **Section H – Environmental Management Plans and Institutional Requirements**).

5. 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 nongovernment 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. (Consultations were held to discuss environmental issues, the findings of the consultations (and a description of the Project grievance redress mechanism) are presented in **Section I – Public Consultation, Information Disclosure & Grievance Mechanism**).

6. 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. (This EIA and its EMP will be disclosed on the ADB web-site).

7. Implement the EMP and monitor its effectiveness. Document monitoring results, including the development and implementation of corrective actions, and disclose monitoring reports. (The EIA and its EMP outline a plan to monitor the implementation of the EMP and the institutional responsibilities for monitoring and reporting throughout the Project lifecycle: **Section H.2 – EMP Institutional Responsibilities**).

8. Do not implement project activities in areas of critical habitats, unless (i) there are no measurable adverse impacts on the critical habitat that could impair its ability to function, (ii) there is no reduction in the population of any recognized endangered or critically endangered species, and (iii) any lesser impacts are mitigated. If a project is located within a legally protected area, implement additional programs to promote and enhance the conservation aims of the protected area. In an area of natural habitats, there must be no significant conversion or degradation, unless (i) alternatives are not available, (ii) the over all benefits from the project substantially outweigh the environmental costs, and (iii) any conversion or degradation is appropriately mitigated. Use a precautionary approach to the use, development, and management of renewable natural resources. (No critical habitats have been identified that would be significantly impacted by the Project).

9. Apply pollution prevention and control technologies and practices consistent with international good practices as reflected in internationally recognized standards such as the World Bank Group's Environmental, Health and Safety Guidelines. Adopt cleaner production processes and good energy efficiency practices. Avoid pollution, or, when avoidance is not possible, minimize or control the intensity or load of pollutant emissions and discharges, including direct and indirect greenhouse gases emissions, waste generation, and release of hazardous materials from their production, transportation, handling, and storage. Avoid the use of hazardous materials subject to international bans or phase-outs. Purchase, use, and manage pesticides based on

integrated pest management approaches and reduce reliance on synthetic chemical pesticides. (The EIA and its EMP outline specific mitigation and management measures to prevent and control pollution: **Section H – Environmental Management Plans and Institutional Requirements.** No pesticides will be used during the lifecycle of the Project).

10. Provide workers with safe and healthy working conditions and prevent accidents, injuries, and disease. Establish preventive and emergency preparedness and response measures to avoid, and where avoidance is not possible, to minimize, adverse impacts and risks to the health and safety of local communities. (The EIA and its EMP outline the requirement for specific health and safety plans and emergency response plans: **Section H – Environmental Management Plans and Institutional Requirements).**

11. Conserve physical cultural resources and avoid destroying or damaging them by using field-based surveys that employ qualified and experienced experts during environmental assessment. Provide for the use of “chance find” procedures that include a pre-approved management and conservation approach for materials that may be discovered during project implementation. (No physical and cultural resources have been identified that would be significantly impacted by the Project. A chance find procedure is provided in **Section E.9.4 – Physical and Cultural Resources**).

E. Description of the Environment

333. This section of the report discusses the existing environmental and social conditions within the Project area under the following headings:

- Physical Resources (air quality, hydrology, topography, etc.);
- Ecological Resources (flora, fauna, protected areas);
- Economic Resources (infrastructure, land use, etc.);
- Social and Cultural Resources (health, education, noise, cultural resources, etc.)

E.1 Physical Resources

E.1.1 Air quality

E.1.1.1 Regional Aspects

334. Uzbekistan is situated in the arid zone, which includes such large natural sources of dust from the Kara-Kum and Kyzyl-Kum deserts with their repeated windstorms, and the Aral Sea area zone (Priaralye) and the dried Aral seabed area (Aral-Kum). Soil and mineral particles are the main constituents of suspended particulate matter (SPM) from these sources. Sulfur Dioxide (SO_2), Nitrogen Dioxide (NO_2) and Carbon Monoxide (CO), as well as solid suspended particulates of different composition and origin are the main anthropogenic air pollutants.

E.1.1.2 Naturally Occurring Suspended Particulate Matter

335. The naturally dusty nature of the top-soils in the Project area, combined with the low precipitation and frequency of strong winds, results in frequent dust storms and high levels of SPM in the air for much of the time.

336. Dust created by strong winds (>6.48 m/s, the 95th percentile of recorded wind speeds) creates ambient concentrations of SPM up to 9 times the maximum permissible concentration (MPC) nearly the whole year, except during winter. With weaker winds (<6.48m/sec), SPM varies between 2-3 times MPC. Traffic, agriculture and construction work also contribute to SPM levels, although to a lesser extent.

E.1.1.3 Receptors

337. Two villages have been identified within the Project area that are considered sensitive receptors to environmental impacts, including degraded air quality. **Table E-1** lists the receptors and their distances from TPP2. These locations are also shown on the contour plots provided as part of the dispersion model, see **Section G.2.**

Table E-1: Human Air Quality Receptors

#	Receptor	Type	Direction	Approximate Distance
1	Nursiton	Residential	North east	1km
2	Mekhnatabad	Residential	West	1.5km

E.1.1.4 Baseline Ambient Air Quality

338. Monitoring of ambient air quality was undertaken in January, 2016. **Appendix C** provides a map illustrating the locations of the monitoring points. **Table E-2** provides the results of the Monitoring.

Table E-2: Ambient Air Quality Monitoring Results											
Parameter	**Monitoring Location**										**Uzbek Limit – One day (µg/m³)**
	1	2	3	4	5	6	7	8	9	10	
NO_2	0	0	0	0	0	0	0	0	0	0	40
CO	0	0	0	0	0	0	0	0	0	0	3,000
Dust	280	280	270	270	270	270	270	270	270	270	150

339. The results show that levels of NO_2 and CO are within the national limits at all of the monitoring locations, including those in Nuriston and Mekhnatabad. However, dust levels exceed the national standards. This is due to the naturally high levels of dust in the atmosphere as described previously by **Item E.1.1.2**.

340. Additional monitoring of ambient air quality was undertaken in Naruz and Jayran on November 3rd and 4th 2017. The following table shows that the results are well within the national standards with the exception on dust.

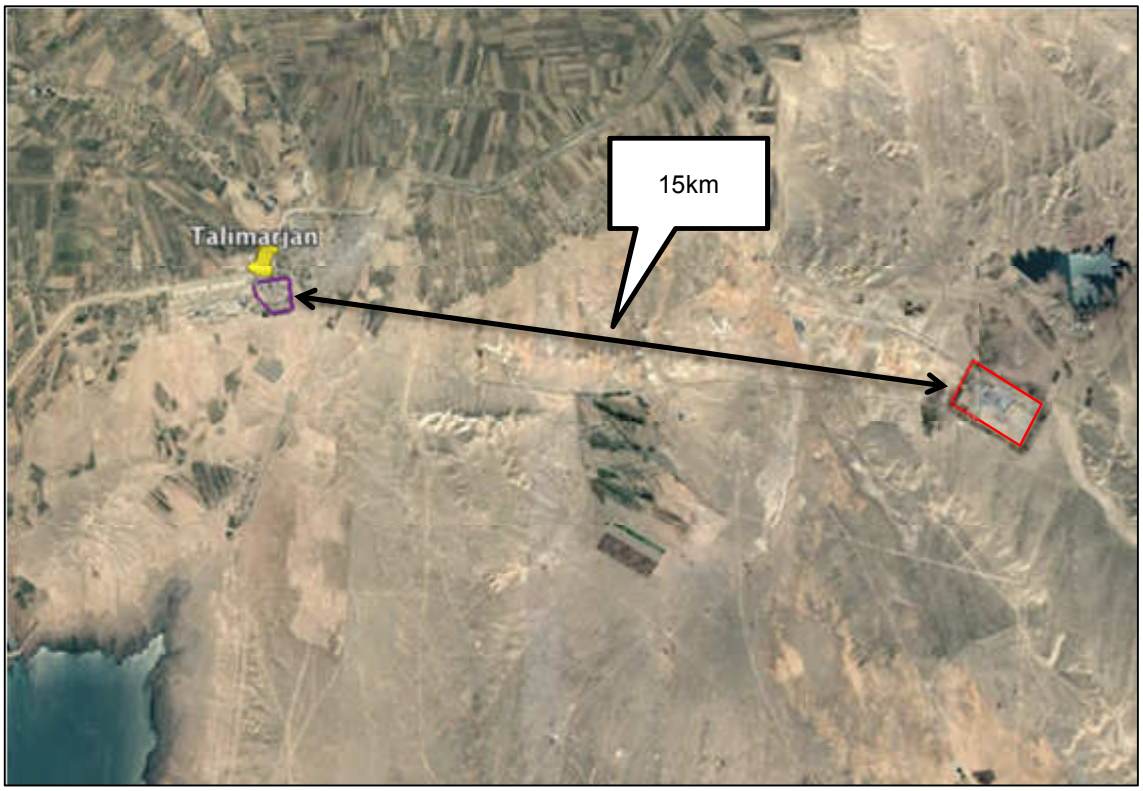
Table E-3: Ambient Air Quality Monitoring Results, November 2017

Selection date	**Place of selection**	**Time selection**	**NO_2, mg / m³**	**SO_2, mg / m³**	**CO, mg / m³**	**Dust, mg / m³**
3.Nov.17.	Mahalla “Navruz”	16:55	0.010	0.015	1	0.18
		17:35	0.020	0.006	1	0.20
	Mahalla "Jayran"	18:15	0.040	0.010	2	0.10
		18:50	0.020	0.005	2	0.16
4.Nov.17г.	Mahalla “Navruz”	10:00	0.008	0.028	1	0,11
		10:45	0.015	0.005	1	0,12
	Mahalla "Jayran"	11:30	0.036	0.012	2	0,21
		12:15	0.020	0.032	2	0,19
Wed.s.	Mahalla “Navruz”		0.013	0.014	1	0.15
	Mahalla "Jayran"		0.029	0.015	2	0.17
		National Limit	**0.04 mg / m³**	**0.05 mg / m³**	**3 mg / m³**	**0.15 mg / m³**

E.1.1.5 Shurtan Gas Chemical Complex and Shurtan Gas Fields

341. **General** - Approximately 70 km southwest of Karshi, and 15 km east of the TPC in the Gouzar District, Uzbekneftegaz (UNG) owns and operates the Shurtan Gas Chemical Complex (SGCC) (see **Figure E-1** for location of the SGCC). The issue of cumulative impacts and SGCC is addressed in **Section 6.3**.

Figure E-1: Location of Shurtan Gas Chemical Complex (in red box)



342. The main and backup fuel for the TPC is natural gas from Shurtan gas fields (approximately 30km north east of the TPC) which is then processed at the SGCC. Supply of gas to the TPC is provided by two independent gas pipelines. Production output of each gas-distribution station ensures 100% of gas supply to satisfy the capacity of a power plant equal to 3,200MW.

343. **SGCC** - The SGCC was completed in December 2000 and went into operation in March 2001 at a cost of $1 billion. The SGCC consists of gas treatment and separation units to supply gas to TPC and other components including a unit to produce 140,000 tons per years (t/yr) of ethylene project, a butene-1 copolymer production plant and a 125,000 t/yr low-density polyethylene plant. The SGCC supplies these products to a range of clients and as such is not an associated facility to the TPC.

344. The SGCC is supervised by the State Nature Protection Committee's (Goskompriroda) monitoring service in Karshi, and according to the TPP1 EIA their published results show that the cumulative impacts from a combination of emissions from the two facilities (TPC and SGCC) are insignificant.

345. Baseline monitoring of a range of air quality parameters was undertaken as part of the Oltin Yol Gas to Liquids Project EIA (located adjacent to the SGCC). The results showed that the majority of the monitored baseline data is considered low in comparison to air quality standards (national and IFC). However, two chemicals (benzene and SO_2) were identified in background air as chemicals of potential concern for inhalation of air by residents in the various settlements close to the SGCC (not Nuriston). SO_2 at Otkuduk (64,9 µg/m^3) and of benzene at SGCC Accommodation complex (2.3 µg/m^3) and at Oltin Yol Construction camp (2 µg/m^3) were slightly above guidelines values for an averaging period of 1 year. Additionally 24 hour average air concentration of SO_2 at Otkuduk (76.5 µg/m^3) was above Uzbekistan Guideline for an averaging period of 24 hour (20 µg/m^3).

346. During the Oltin Yol EIA public consultations some concerns were raised by local inhabitants (around Shurtan) about air quality and issues affecting breathing and odors. Concerns relating to emissions from SGCC were also raised by Nuriston residents during the consultation meetings for this EIA (see **Section I - Public Consultation, Information Disclosure & Grievance Mechanism**).

E.1.1.6 Current TPC Emissions and Air Dispersion Modeling

347. Natural Gas Emissions – 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 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 sulfur in its composition, so SO_2 emissions are insignificant. The low natural gas sulfur content is simply due to a small concentration of an odorant (Tetrahydrothiophene-THT), a mercaptan containing sulfur 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 a higher sulfur contents for short periods of time.

348. Taking into account all of the above, it can be concluded that the only pollutant emitted to the atmosphere in significant amounts from gas fired power stations is NO_X.

349. Existing Emissions – TPP0 is a conventional natural gas fired thermal power plant rated at 800 MW, with one boiler and one steam turbine generator. The combustion gases from the main boiler are discharged into the atmosphere through a 270 m high stack, which ensures the dispersion of flue gases without any significant impact on the local area. Emissions are measured from the TPP0 stack three times per month (The regulatory requirement for monitoring is only once per month). **Figure E-2** indicates that NO_2 and NO from the emissions stacks are both well within the limit specified for TPP0 by Goskompriroda (see **Table D-2**).

350. In addition to the main Unit 1 boilers, TPP0 has four boilers for generating preheat steam (50 t/h each at 40 kg/cm^2 or approximately 40 bar or 4 million Pascals (Pa)) for the TPP0 plant, and two for generating hot water (500 t/h each at 158°C) for a district heating system servicing Nuriston. Combustion gases from these boilers are discharged through two stacks, one 40 m high for the preheating boilers and one 30 m high for the hot water boilers. Monitoring is also undertaken from these stacks. The results show (**Figure E-3** and **Figure E-4**) that NO_2 and NO are well within the limit specified for TPP0 by Goskompriroda (see **Table D-2** for emissions limits).

351. Air Dispersion Model – As part of the TPP1 EIA a dispersion model was used to determine the likely impacts of emissions from TPP1 and TPP0. The overall conclusion of the air dispersion modeling exercise was that the maximum predicted ground level concentrations (GLCs) of NO_2 and CO, arising as a result of atmospheric emissions from the TPC, will not exceed any of the reference standards and guidelines for ambient air quality beyond the boundary of the power station and that atmospheric emissions from TPP0 and TPP1 are not predicted to have a significant impact on ambient air quality, human health, and the environment.

Figure E-2: Emissions from the main TPP0 Stack (mg/m^3), 2016

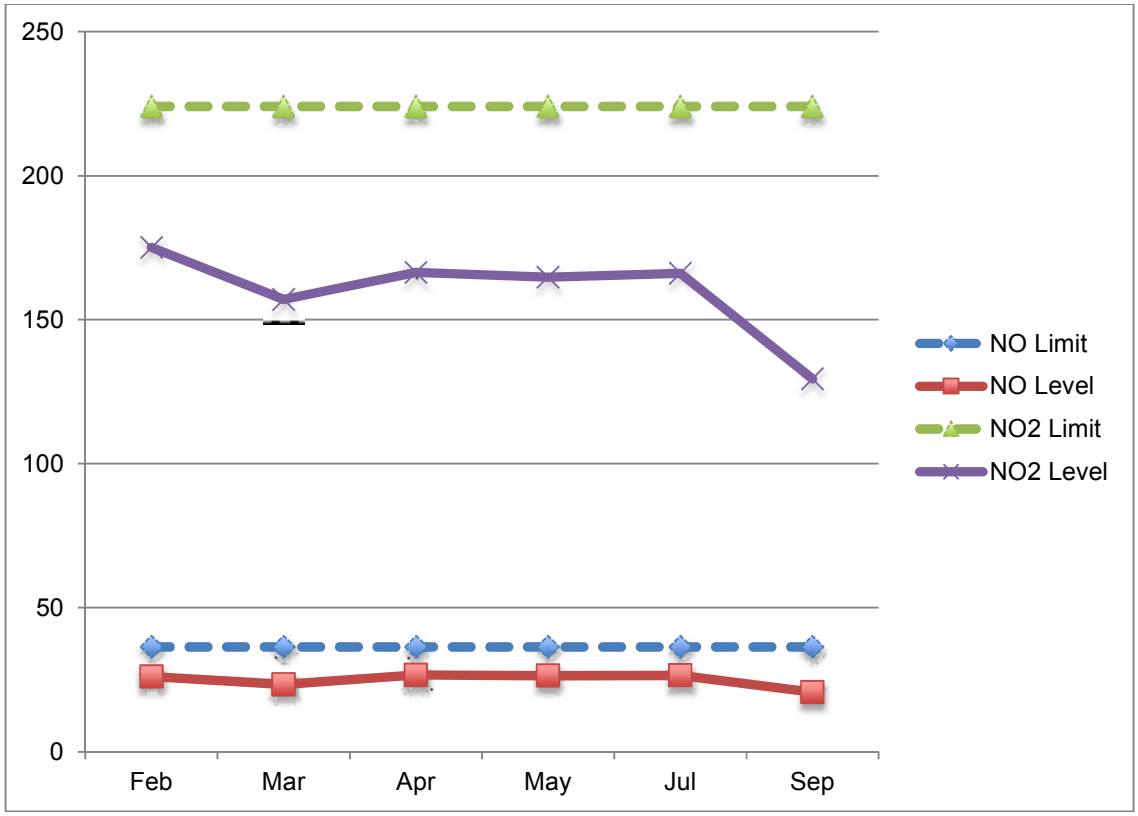


Figure E-3: Emissions from TPP0 Pre-heating boiler Stack (mg/m^3), 2016

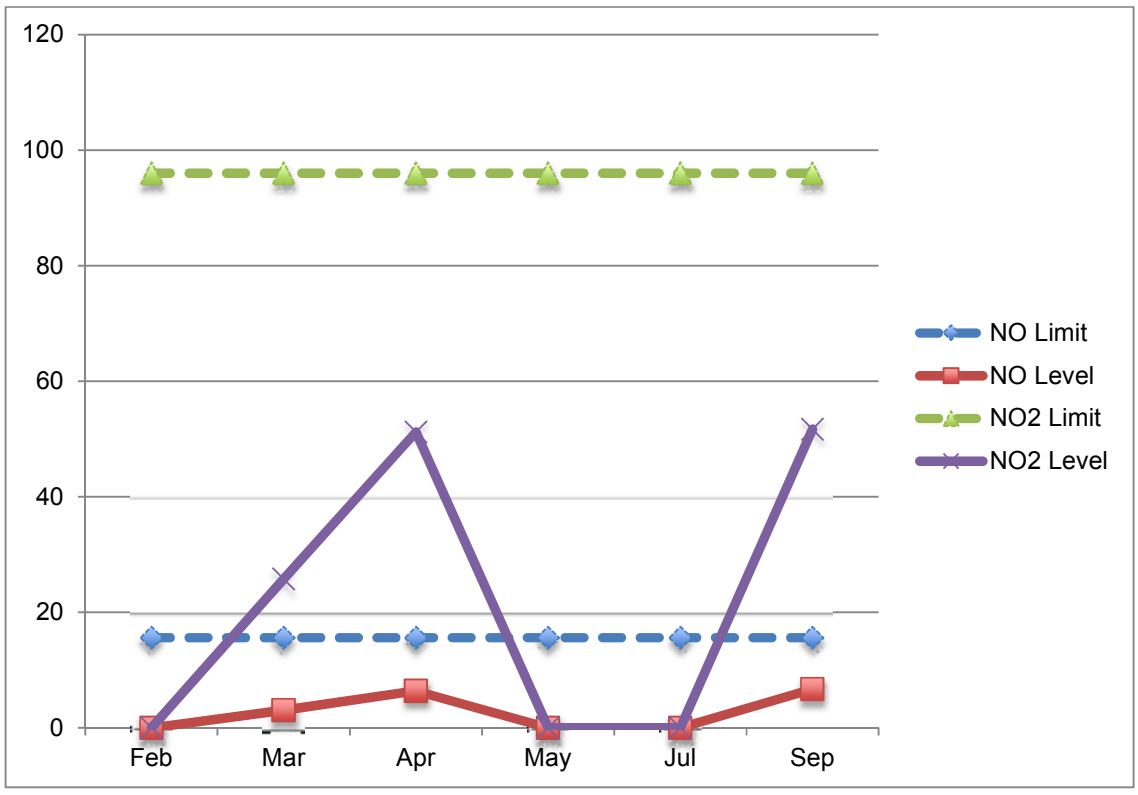
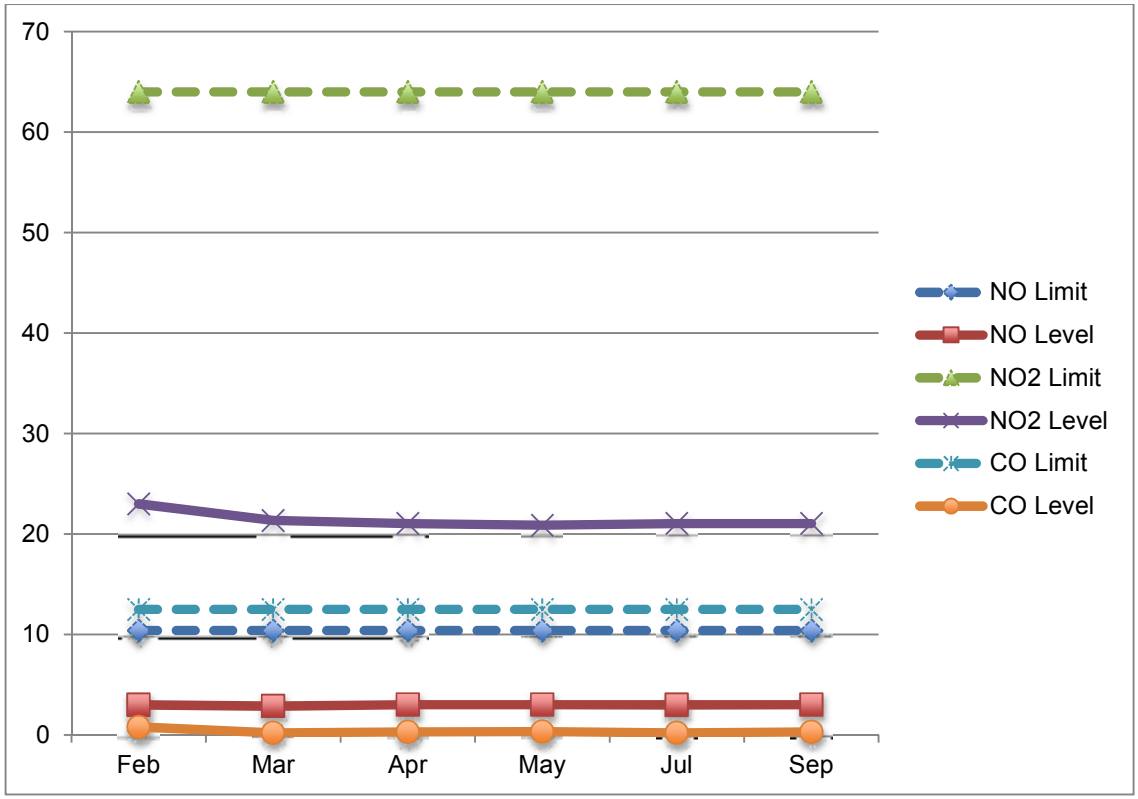


Figure E-4: Emissions from the TPP0 Hot Water Boiler Stack (mg/m^3), 2016



E.1.2 Climate

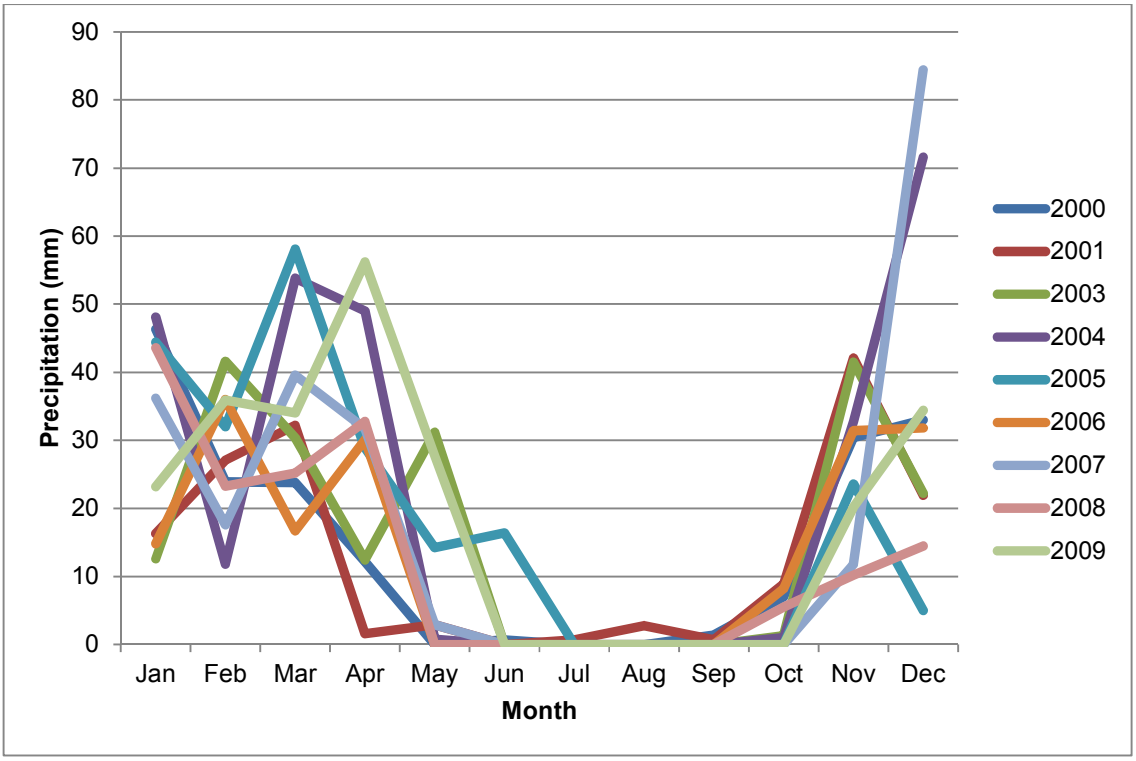
E.1.2.1 Regional Context

352. Uzbekistan's climate is classified as continental, with hot summers and cool winters. Summer temperatures often surpass 40°C; winter temperatures average about −2°C, but may fall as low as −40°C. Most of the country also is quite arid, with average annual rainfall amounting to between 100 and 250 millimeters (mm) and occurring mostly in winter and spring. Between July and September, little precipitation falls, thereby limiting the growth of vegetation during that period of time.

E.1.2.2 Precipitation

353. Precipitation will suppress dust entrainment i.e. prevent it from becoming airborne, and increase wet deposition. **Figure E-5** shows the average monthly and annual precipitation data for Karshi Meteorological Station between 2000 and 2009. The average annual rainfall over 10 years was 225 mm, with precipitation mainly occurring between November and May. The period from June to October is a dry month period with minimal precipitation and thus a higher likelihood of dust releases.

Figure E-5: Precipitation, Karshi, 2000-2009

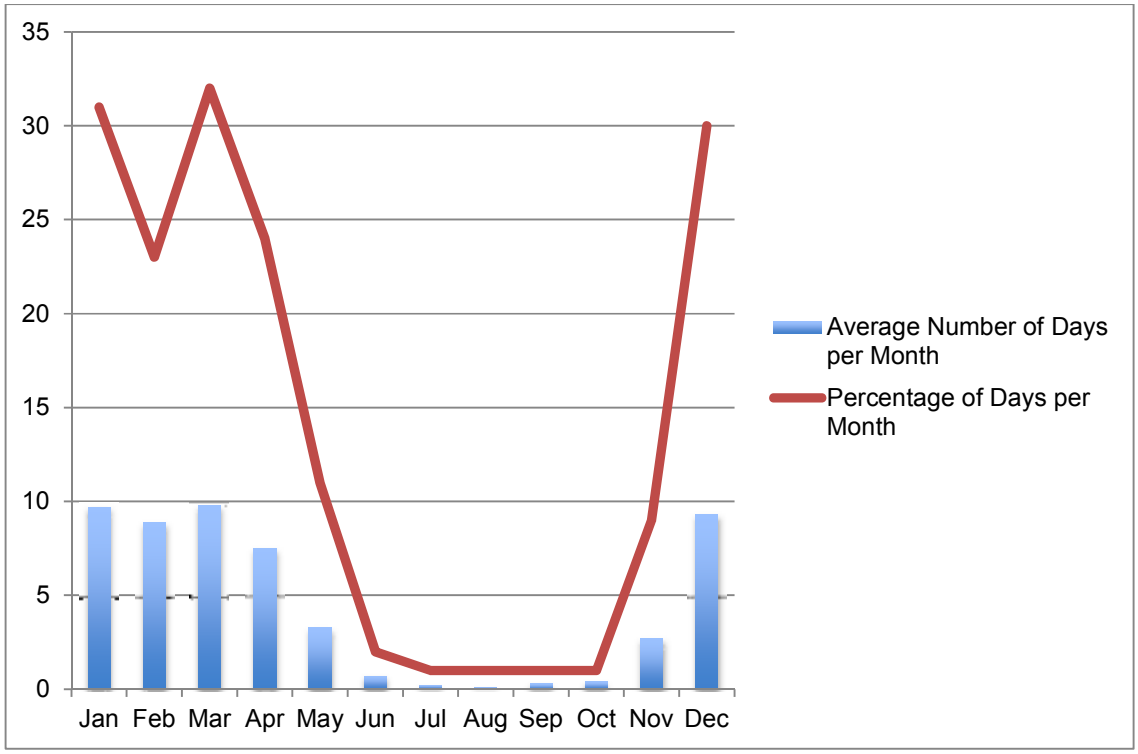


354. Precipitation levels of >0.2 mm/day are considered sufficient to effectively suppress wind-blown dust emissions[8] [9]. **Figure E-6** details the number of days showing >0.2 mm/day rainfall. On average each year, less than 10 such days occur between June and October. Over the entire 10 year period considered, potentially dust suppressing precipitation levels occurred on 16% of all days.

Figure E-6: Precipitation levels of >0.2 mm/day, Karshi

[8] IFC (2007). Environmental, Health and Safety Guidelines. General EHS Guidelines: Environmental. Air Emissions and Ambient Air. April 2007.

[9] Office of the Deputy Prime Minister (2005). *Planning Minerals Policy Statement 2: Controlling and Mitigating the Environmental Effects of Minerals Extraction in England. Annex1: Dust*.



E.1.2.3 Prevailing Winds

355. Wind strength, direction and frequency is shown in **Figure G-1** as part of the Projects air dispersion model. The wind roses illustrate that the dominant wind direction is from the north and indicates that the Project emissions will be dispersed to the south and therefore will have a minimal impact on populated areas.

356. Estimates of annual mean wind speed from 2000 to 2009, taken from Karshi are presented in **Table E-3**.

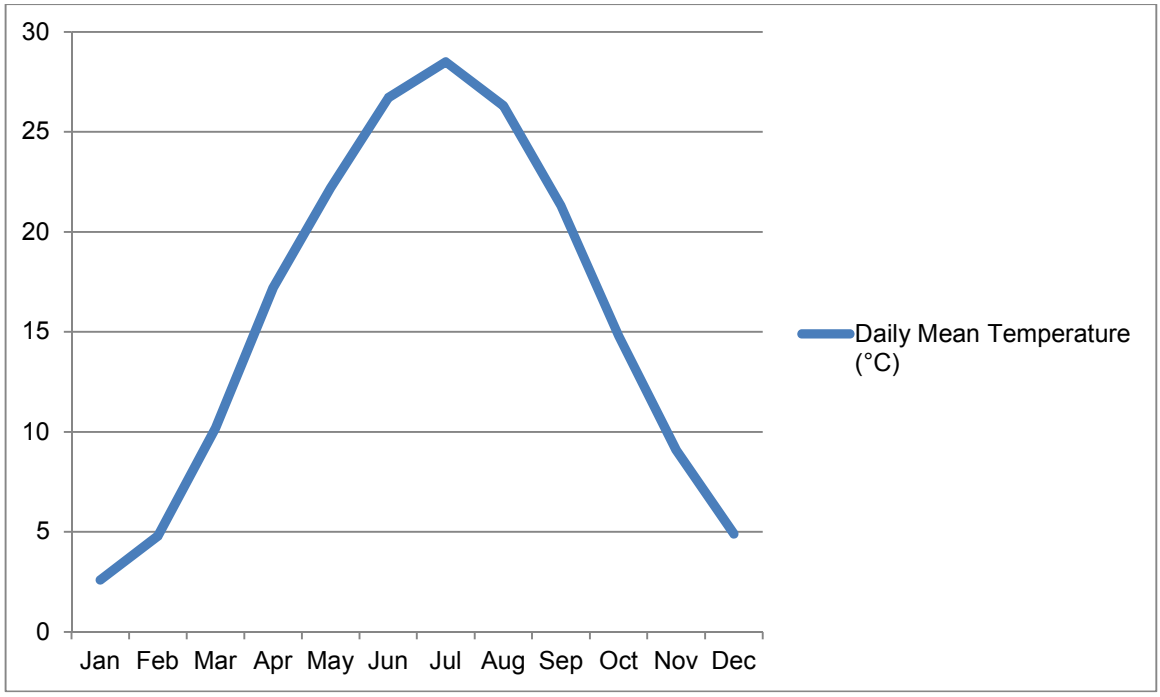
Table E-3: Average Annual Wind Speed

2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
2.8 m/s	3.5 m/s	2.7 m/s	2.5 m/s	2.3 m/s	2.2 m/s	2.5 m/s	2.3 m/s	2.3 m/s	2.5 m/s

D.1.2.4 Temperature

357. **Figure E-7** illustrates the monthly temperature for Karshi.

Figure E-7: Monthly Temperature, Karshi



E.1.2.5 Climate Change

358. General - In Uzbekistan climate change is projected to lead to higher temperatures, changes in precipitation regimes, and more severe and prolonged droughts with corresponding decreases in water availability.

359. Temperature - Measurements of seasonal temperatures by district show that the average annual temperature has increased in Uzbekistan by 0.29°C since 1951. Furthermore, based on a comparison of two 30-year periods (1951–1980 and 1978–2007), data shows that the number of days with temperatures lower than –20°C has declined by more than 50% throughout Uzbekistan. Similarly, the number of days with temperatures lower than 15°C has declined by 28–48% in the northern and mountainous regions of the country. On the other hand, the number of days with high temperatures (higher than 40°C) increased near the Aral Sea by more than 100%, and in other regions by 32–70%, except for foothills, where increases were more moderate (10–12%).[10] Future scenarios indicate that average warming over the next 20 years for the medium scenario will be about 1 – 2.5°C (see **Figure E-8**).

360. Water Availability – According to a recent ADB report on climate change in Central Asia,[11] the composition of the four components of stream flow (rainfall-runoff, snow melt, glacier melt, base flow) is very likely to change in the future. This will have major impacts on total runoff, but especially on seasonal shifts in runoff. The runoff peak will shift from summer to spring and decrease in magnitude. Total annual runoff into the downstream areas is also expected to decrease by 26-35% for the Amu Darya river by 2050. According to the report the strongest decreases in stream flow are expected for the late summer months (August, September, October), where inflow into downstream areas decreases around 45%. **Figure E-9** illustrates the average change in monthly inflow into downstream areas for Amu Darya basin

[10] Environmental Performance Review – Uzbekistan. Second Review. UN, 2010

[11] Regional Technical Assistance: Water and Adaptation Interventions in Central and West Asia. ADB, June 2012.

in 2041-2050.

Figure E-8: Temperature Change Scenario towards 2035 [12]

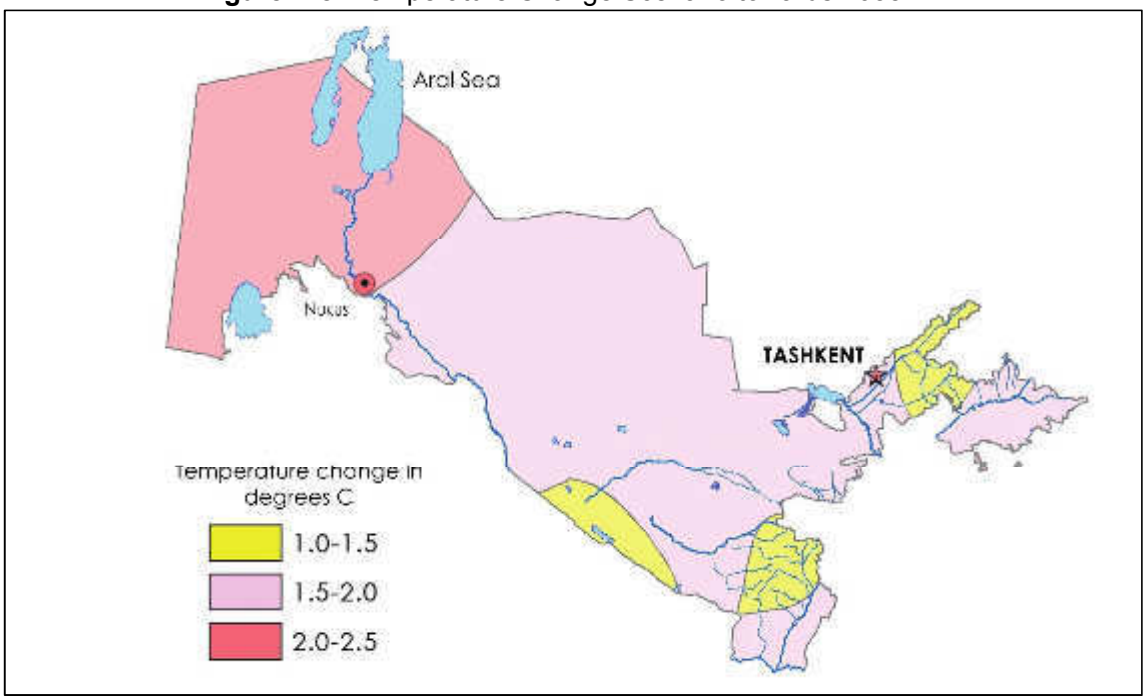
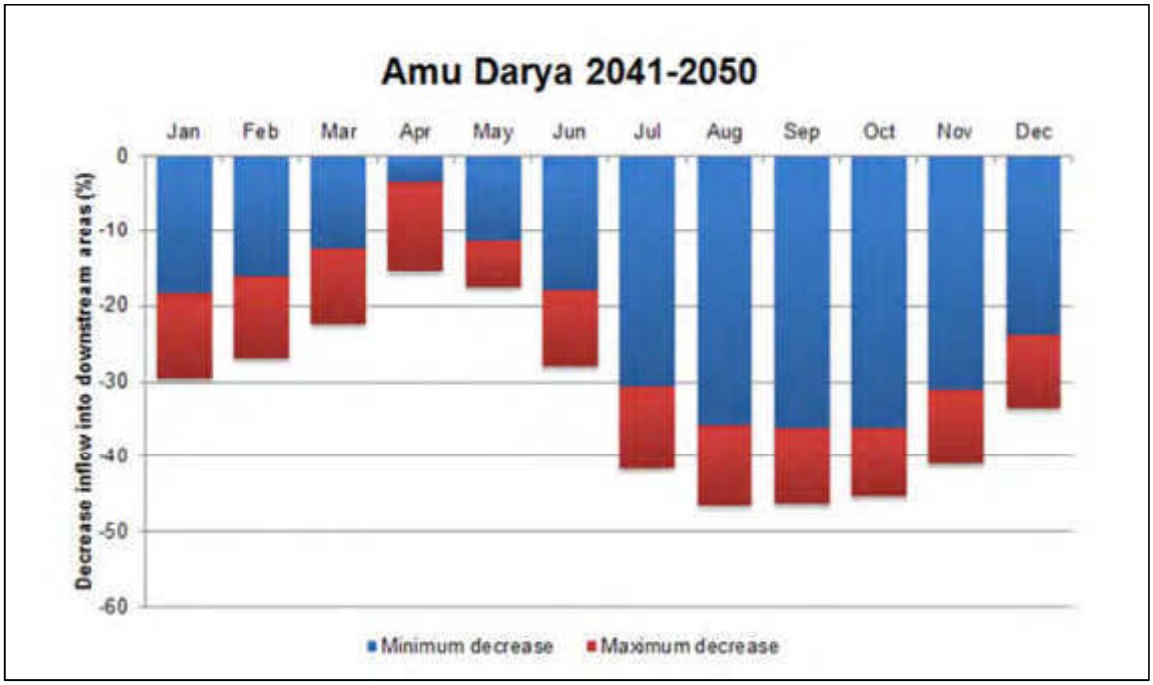


Figure E-9: Average change in monthly inflow into downstream areas for Amu Darya basin in 2041-2050. Range for model forced with five GCMs is shown



361. The precise Amu Darya flow data at the point where the Amu Darya and KMK join is

[12] Environmental Profile of Uzbekistan. UNDP, 2008

not known. However, two sets of flow data have been provided for that give an indication of the Amu Darya flow rates (see **Table E-4**). For the purpose of this analysis the figures provided by UE will be used as these figures are assumed to be more representative of the actual flow in the downstream area of the Amu Darya closer to the KMK. [13]

Table E-4: Monthly Amu Darya Flow rates.

Month	2001 – 2010 (source FCG International)	2016/2017 (source Uzbekenergo TPC EM)
January	1,200	300
February	1,500	500
March	1,800	1,000
April	3,100	1,500
May	4,000	3,000
June	3,800	2,500
July	4,800	2,000
August	6,000	3,000
September	5,100	2,000
October	3,100	1,000
November	1,800	1,000
December	1,300	700

362. ADB Climate Change Screening - Climate risk screening of the Project was undertaken by the ADB using their AWARE software. The screening report indicated that there is a 'little' potential for temperature increase to affect the Project, but that there is no risk of climate change leading to significant increases or decreases in precipitation levels that may affect the Project.

Greenhouse Gases

363. Data from the TPP1 EIA indicates that TPP0 generates around 2.8m tons of CO_2 per annum and TPP1 will generate around 1.7m tons of CO_2 when it becomes operational. The TPP1 EIA also states that the emission rate for TPP0 based on generated power was estimated at 496 g CO_2-e/kWh and 351.6 g CO_2-e/kWh for TPP1. However, an analysis of these figures highlighted some inconsistencies which have been corrected with updated information. **Table E-5** illustrates the TPP1 EIA data and the corrected CO_2 data as calculated by the MMCS team.

Table E-5: TPP1 EIA CO_2 Calculations and MMCS Re-calculated Values

Parameter	Units	TPP 1 EIA		MMCS Re-calculated Values	
		TPP0	TPP1	TPP0	TPP1
Operating hours (nominal)	hours		6,000		6,500
Generated power	MW		812		914.6
	GWh		4,872		6,859.5
Fuel use	Nm^3/a	1,507,397,000	920,750,000	1,621,813,000	1,278,750,000

[13] The MMCS team requested Amu Darya flow data at the point where the KMK and the Amu Darya join from the TPC Environmental Manager. The TPC EM provided the data outlined in Table 1 but did not confirm is this was at this precise point, as such it is assumed that the flow data was taken from an area close to the KMK.

Parameter	Units	TPP 1 EIA		MMCS Re-calculated Values	
		TPP0	TPP1	TPP0	TPP1
	GJ/a	50,072,110	30,585,105	53,519,829	42,198,750
The standard emission factor for natural gas (assumed lower heating value basis)	kg CO_2-e/GJ	56	56	56	56
CO_2 emissions	kg CO_2-e/a	2,804,038,160	1,712,765,880	2,997,110,424	2,363,130,00
	t CO_2-e/a	2,804,038	1,712,766	2,997,110	2,363,130
Emission rate (based on generated power)	t CO_2-e/kWh	0.000049647	0.0000351552	0.00005108	0.00003445
	g CO_2-e/kWh	496	351.6	510.76	344.5

E.1.3 Topography & Seismicity

E.1.3.1 Regional Environment

364. The physical environment of Uzbekistan is diverse, ranging from the flat, desert topography that comprises almost 80% of the country's territory to mountain peaks in the east reaching about 4,500 meters above sea level. The southeastern portion of Uzbekistan is characterized by the foothills of the Tian Shan mountains, which rise higher in neighboring Kyrgyzstan and Tajikistan and form a natural border between Central Asia and China.

E.1.3.2 Local Topography

365. The topography of the Project area can mostly be described as gently rolling to flat, with very few visually significant features occurring within or in close vicinity of the TPC. Other small rises occur throughout the landscape but are not prominent within the larger visual landscape. Although as mentioned above, more mountainous country is located east and southeast of the site, these features are too far away to be considered for the purposes of this assessment. The site of TPP2 itself, is located approximately 380 meters above sea level.

E.1.3.3 Seismicity

366. Uzbekistan is located in the middle of Central Asia within a zone of high seismic activity (see **Appendix D** for a seismic hazards distribution map). Based on the Russian Code MSK-64, the seismicity of the construction site is magnitude 8 (on a scale of 0-12) with a repetition rating of 3 (once every 3000 years). For comparison, Tashkent is magnitude 9 under the same code. In 1999, the country established a law on earthquake disaster preparedness and also special building codes for planning and construction (KMK 2.01.03-96 "Norms and Regulations for Construction in Seismic Zones" and KMK 2.07.01-94 "Town-planning, lay-out and building of urban and village settlements").

E.1.4 Hydrology

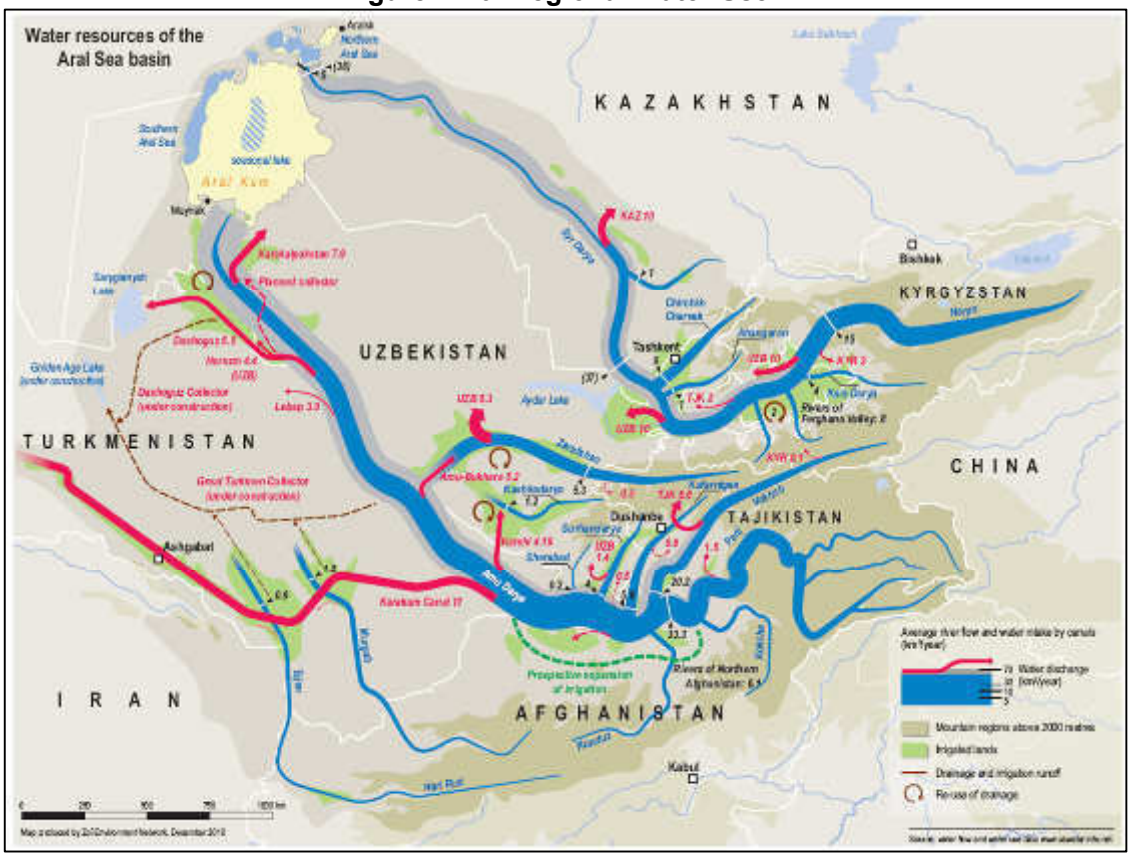
E.1.4.1 Surface Water

367. Regional Context – The Republic of Uzbekistan and the majority of the neighboring countries are situated in the Aral Sea internal drainage basin, transboundary waters of which are in shared use for economic and environmental needs. The largest amount of surface water

resources (about 90%) is generated in the mountainous areas of neighboring countries. The fresh waters of glaciers, rivers, lakes and reservoirs are used for irrigated farming, industrial and public utility sector needs. The use of low productivity saline lands for agricultural production, in-stream disposal of collector-drainage waters and inefficient wastewater purification systems is currently resulting in deterioration of Uzbekistan's water resource quality and in increase in water salinity.

368. The main rivers in Uzbekistan are the Amu Darya River, formed by the confluence of the Vakhsh and Pyandj Rivers, the Syr Darya River, formed by the confluence of the Narin and Karadarya rivers, and the Chirchik River near Tashkent. The Amu Darya River basin includes the Surkhandarya, Sherabad, Kashkadarya and Zarafshan rivers, but only the Kashkadarya and Sherabad Rivers are entirely located within the territory of Uzbekistan.[16] **Figure E-10** illustrates regional water use.

Figure E-10: Regional Water Use[17]



369. Water Supply and Use – The TPC is located on the Karshi steppe where the natural environment consists of semi-desert scrublands. As noted above, rainfall in the area is low and the resulting semi-arid environment means that there are very few natural water bodies in the region. The nearest natural water body to the TPC is the Amu Darya, about 70km to the south west of the TPC. Its catchment area is located in the Pamir Mountains, about 800km to the east of the TPC, and it flows to the Aral Sea, which is 900km north-west of the TPC.

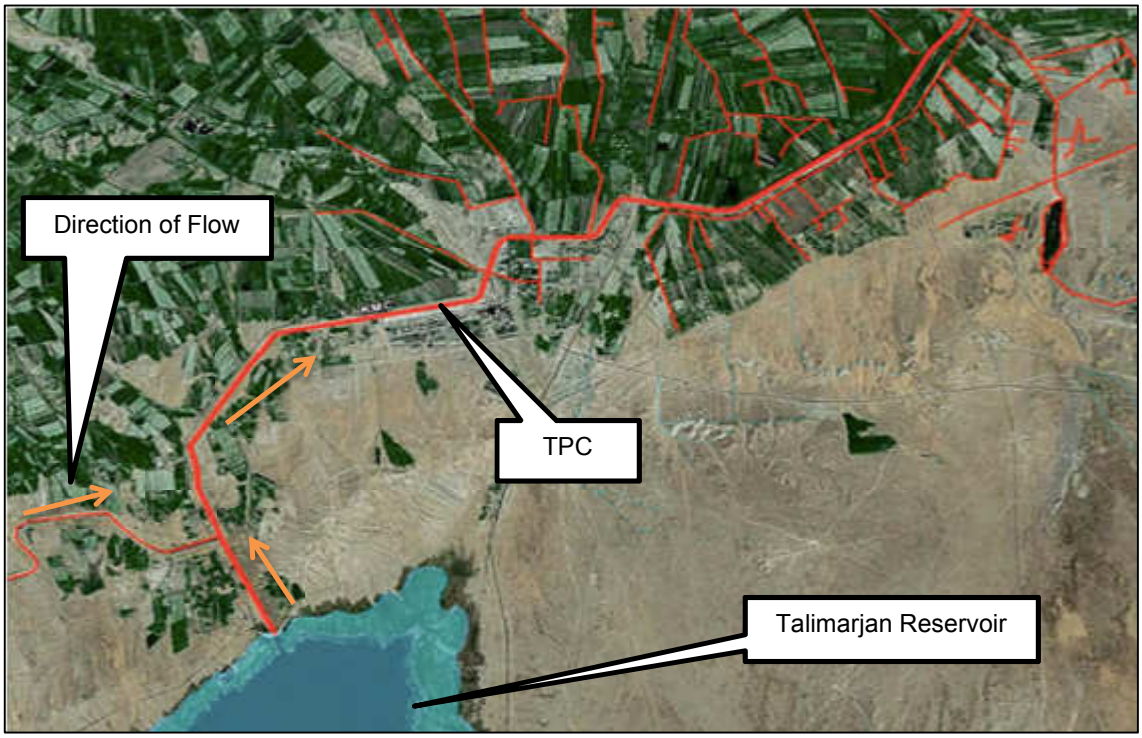
370. Soviet irrigation engineers developed an extensive system of canals and pump stations to exploit the water of the Amu Darya for irrigated agriculture, and irrigated cotton is still one

[16] Environmental Performance Review – Uzbekistan. Second Review. UN, 2010
[17] http://www.cawater-info.net/aral/i/vod-res-bam-e.gif

of Uzbekistan's major exports. Agriculture on the plains to the north and west of Talimarjan is fed by such a system, with the major component being the Karshi Main Canal (KMK). This flows alongside the northern boundary of the site and is the source of cooling water for the TPC.

371. **KMK System –** The KMK was constructed in the between 1967 and 1976 to provide irrigation water for the Karshi region (TPP0 was constructed later, becoming operational in 2004). The intake for the KMK is located some 70km south of Talimarjan at the town of Dostluk, Turkmenistan. A series of six pumping stations, each with a capacity of 150m^3/s, pump water to the Uzbekistan/Turkmenistan border where the water is discharged into the KMK. The KMK is concrete lined for much of its extent and has a design capacity of approximately 180m^3/s, but maximum flow is currently limited to the 150m^3/s capacity of pumping station No 6. The main canal feeds an extensive network of feeder canals and irrigation ditches that cover the Karshi steppe (see **Figure E-11** for the coverage around the TPC). The flow in the canal varies seasonally depending on demand for irrigation water. Demand is high during the spring and summer growing periods and low during autumn and winter. Flow during the autumn and winter can be as low as 10 m^3/s.

Figure E-11: KMK in the Project Area



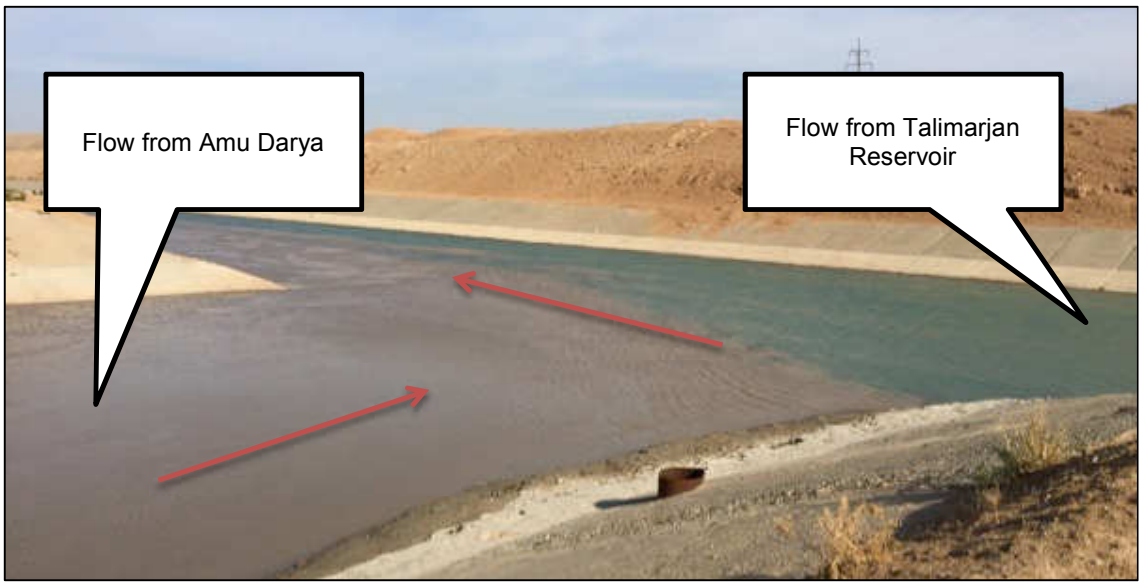
373. **Talimarjan Reservoir.** The reservoir was constructed to act as a water reserve that could be used to make up flows in the KMK in times of shortage. It is located approximately 8km south of the TPC (see **Figure E-11**). Its maximum storage capacity is 1,525 million m^3 and it has a dead storage capacity of 600 million m^3. The reservoir is filled from a pumping station located close to the discharge point for the KMK. Filling of the reservoir occurs intermittently depending on water usage and demand, the highest rates of filling occur from January to June, from July to December the rate decreases by 25-50%.

374. The reservoir also acts as a large sedimentation basin with the high levels of suspended solids in the pumped water from the Amu Darya river settling out in the reservoir.

Typical levels of suspended solids for water in the KMK are 200-800 milligrams per liter (mg/l). Water abstracted from the reservoir has suspended solids levels of < 5mg/l. **Figure E-12** illustrates the levels of silt in the KMK compared with the water from Talimarjan Reservoir at the point where the KMK waters meets the water discharge from the Talimarjan reservoir.

375. Other parameters measured by TPP0 show that the water quality in the reservoir is generally good, although sulfate levels are high (see **Figures E-13** to **E-17)**. These high levels of sulfate are a natural occurrence due to the gypsum derived soils in the area which contain high levels of calcium sulfate. The better water quality of the reservoir means it is used to supply make up water to the power station. The reservoir also provides potable water via pumphouse sited just downstream of the Talimarjan Reservoir to the TPC, Nuriston, Nishon and SGCC.

Figure E-12: Mixing Point of KMK Water and Talimarjan Reservoir Discharge



376. **Water Cooling.** TPP0 requires water for a number of processes at the site. The largest requirement is for cooling water to cool the turbine. TPP0 was constructed to operate two systems as follows:

1. Summer system (cropping season). In this period (March to November) when there is sufficient water flowing in the KMK, TPP0 operates a once through cycle (OTC). Water is abstracted from the KMK via a pump station on the northern-eastern side of the site at a rate of 25 m^3/s. Once it has passed through the plant the water is returned to the KMK some 600m downstream through an outfall channel. The following provides statements made in the TPP1 EIA regarding the OTC along with our comments on these statements:

- "*The temperature of the water at the intake typically averages 16°C, while at the outflow from the turbine condenser it rises to 26°C*". Other information sources suggest a higher average ambient temperature, as much as 21°C.
- "*The heat dissipates from the cooling water as it returns to the KMK down the outfall channel and at the point it discharges back into the KMK it is typically 3-4°C higher in temperature than water in the KMK*". This suggests a cooling of 6-7°C in the outfall channel which maybe considered optimistic in reality, but is probably in line with the calculations made in the TPP1 EIA based on the overestimated flows.
- "*The returning water is only 16% of the total flow in the KMK, the plume of warmer water*

quickly dissipates and mixes with the main flow and the temperature returns to normal within 500m of leaving the outfall channel". There is no model or calculation to prove this statement.

- "*The losses of water during the once-through cooling process are typically 2–3% of the inflow*". A water balance model prepared for TPP2 by MMCS suggests that the losses are more likely to be around 0.45% of the inflow, or less than 1% of the flow in the KMK.

2. Winter system. In winter, there is no demand for irrigation water and flow in the KMK drops, with its minimum flow being approximately 10 m^3/s. As there is not enough flow to operate an OTC, TPP0 switches to a re-circulating spray system for cooling. The system consists of a number of lagoons (or spray basins), which are fitted with pipes and spray nozzles, and the warm water is collected and sprayed into the air by a series of pumps. It is then collected in the lagoons from where it is re-circulated back to the turbine condensers. According to the TPP1 EIA this system reduces the temperature of the cooling water typically by about 4-6°C and some further heat loss occurs as the water flows back to the pump station. Water loss is due to evaporation, wind carry of spray and seepage through the base of the lagoons. The lost water is replaced with water from the KMK which is also supplemented with additional water pumped from the Talimarjan reservoir via dedicated raw water pipelines. The spray cooling system has a high energy demand, with 12 MW of power being required to run the pumps.

377. However, during the course of the EIA preparation it has been noted that the spray basin system is not currently being used, probably because of seepage losses in the basin and the high power requirements. Instead, during low flow periods in the winter months (around 10 m^3/s) the low flow KMK is being used as an extended cooling basin instead of the spray basins. Spot measurements of water temperature were undertaken on the 12th January, 2017 at the mixing point of the KMK and the TPP0 discharge channel and in an irrigation channel approximately 7km downstream north west of the TPC. The results showed an ambient temperature of 17°C in the irrigation channel and 21°C in the KMK. It was also noted that flow in the KMK was low, possibly as low as 10m/s. Water in the KMK was clear, indicating that it was sourced from the Talimarjan reservoir. Obviously this is not a preferred solution and TPP0 should be using the spray basin re-circulating system.

378. TPP1 will operate with different re-circulating system. During the summer months TPP1 will operate in OTC mode requiring approximately 16 m^3/s of water. That would increase the total extraction rates from the KMK to around 41 m^3/s during the summer months. During the original planning phase for the TPC it was estimated that the total power output from the project would be 3,200 MW and as such it was envisaged that eventually more than 120 m^3/s would be extracted from the KMK.[18]

379. During the winter months TPP1 will operate a re-circulating system via a newly constructed water cooling tower. Losses from the new system will be less that TPP0 however, there will still be seepage losses from the spray basins.

380. At the present time the approval for water consumption was issued only for the operation of one generating unit of the thermal power plant with the capacity of 800MW (TPP0) with water intake (for strait-through arrangement) in summer period up to 31.4m^3/s, and in winter period (circulating arrangement) – up to 10 m^3/s. This license will need to be updated for TPP2. If the license cannot be obtained, TPP2 will be required to operate in re-circulation

[18] Requirements of Talimarjanskaya thermal power plant with the capacity of 3200MW in cooling water (up to 120m^3/s in summer period) were approved by Ministry of melioration and water economy by the letter "About selection of the site for thermal power plant" No 8-418 dated 15.11.76 and by "Glavsredazirsovhozstroi" by the letter about approval for the site and water consumption as per KMK No 11-29-347 dated 12.04.79 and No 022-1992 dated 27.03.79.

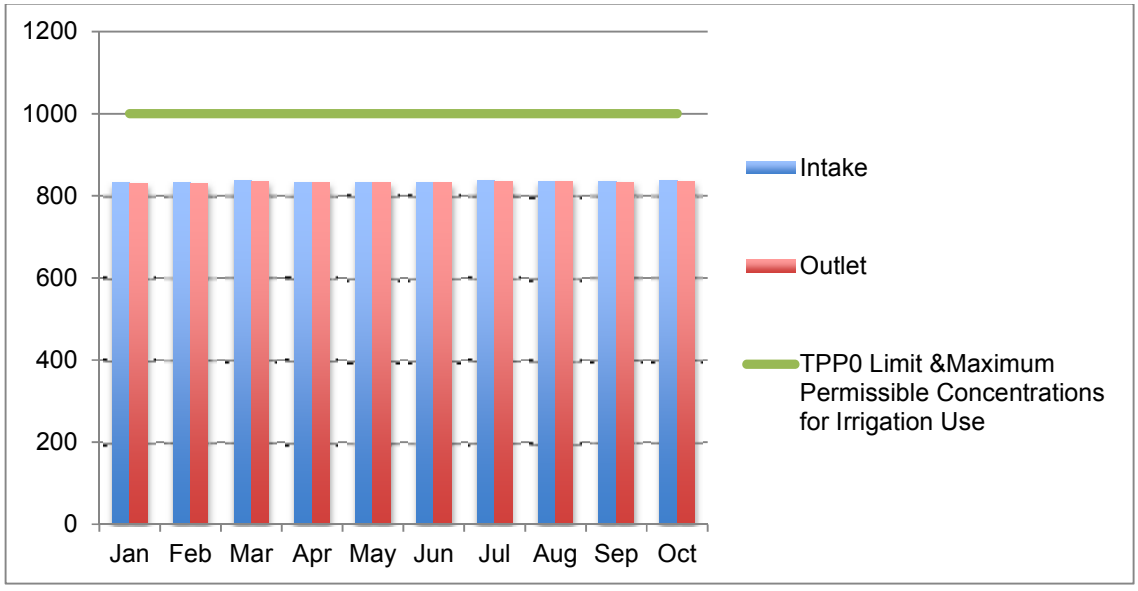
mode.

381. The main water intake for the TPC from the KMK was constructed prior to commencement of TPP0 operations in 2004. It is assumed that the main intake does not comply with IFC thermal power plant guidelines for intakes, e.g. intake velocity 0.15 m/s. However, the intakes for the pumps in the main pump-house designed and constructed for TPP2 will meet the IFC guidelines, including recommended intake velocity of 0.15 m/s and a mesh size of 9.5mm.

382. **Other Water Uses.** TPP0 and TPP1 also need a supply of water to feed the boilers and to supply the site with drinking water. The high levels of suspended solids in the KMK make water from this source unsuitable for these uses and so the cleaner water from the Talimarjan reservoir is used. A pumping station has been installed on the banks of the Talimarjan reservoir's outlet canal. According to the TPP1 EIA approximately 11,000m^3/day is abstracted from the canal, of this 5,600m^3/day is treated for drinking water which supplies both the plant and the residences in Nuriston. The remainder is used as feed water to the desalination plant and for cooling the desalination evaporators.

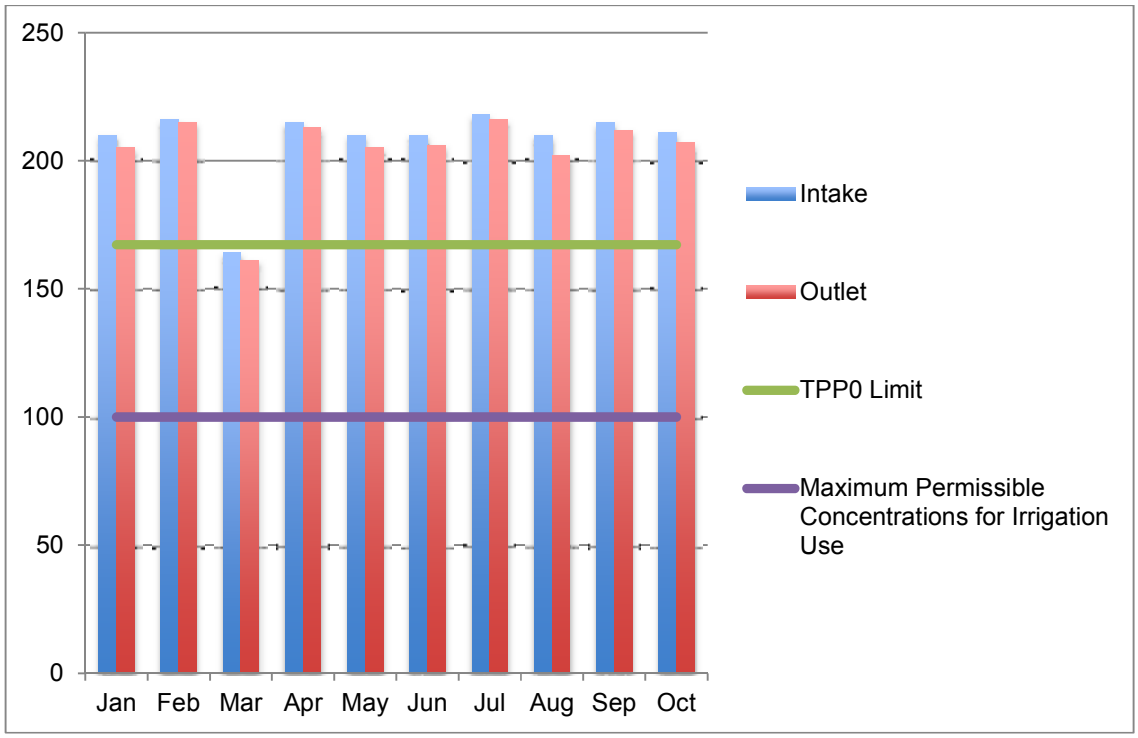
383. **Water Quality**. Water quality of the KMK at the intake and outlet of the TPP0 is measured regularly by TPP0. The results show that levels of sulfate and BOD are elevated above the accepted standards set by Kashkadarya Goskompriroda and the national standards for irrigation water (**Figure E-14** and **Figure E-15**). However, both BOD and sulfate levels are elevated above the standards at both the intake and discharge points indicating that these elevated levels are naturally occurring (as is the case of sulfate) or a result of some other activity downstream, or within the Amu Darya river. Levels of Ammonium are also elevated above the standard for irrigation water at both intake and discharge points, again pointing to a source upstream of the TPC.

Figure E-13: Salinity (mg/l), 2016



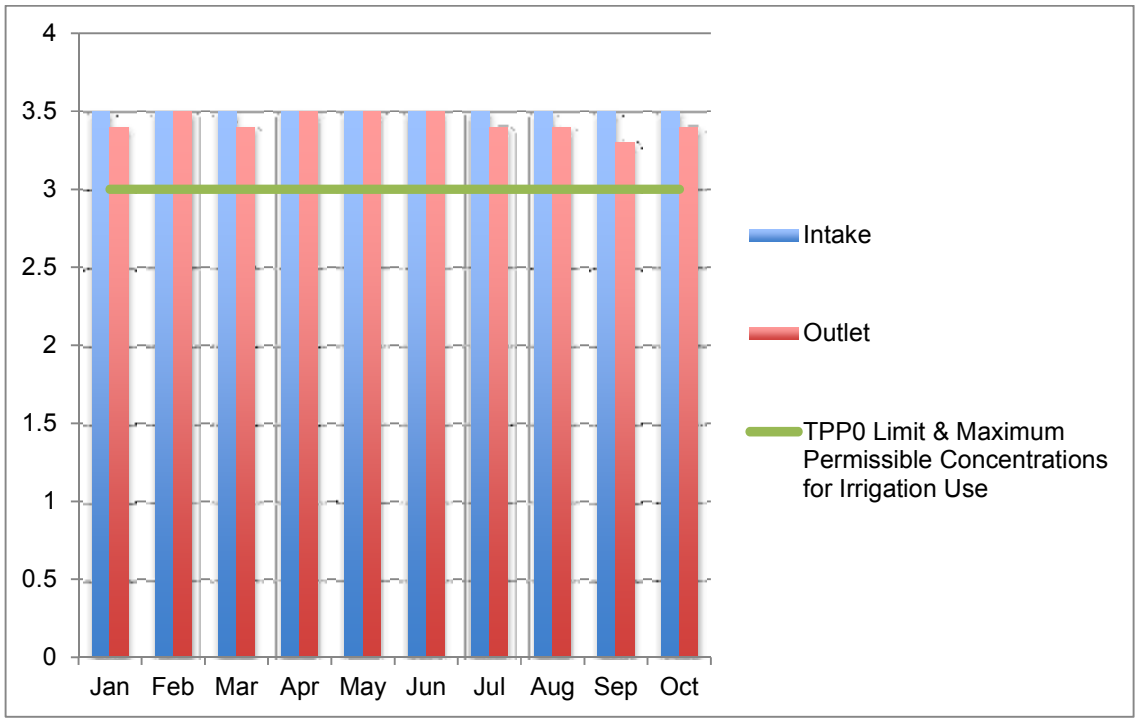
* TPP0 Limit Set by Goskompriroda

Figure E-14: Sulfate (mg/l), 2016



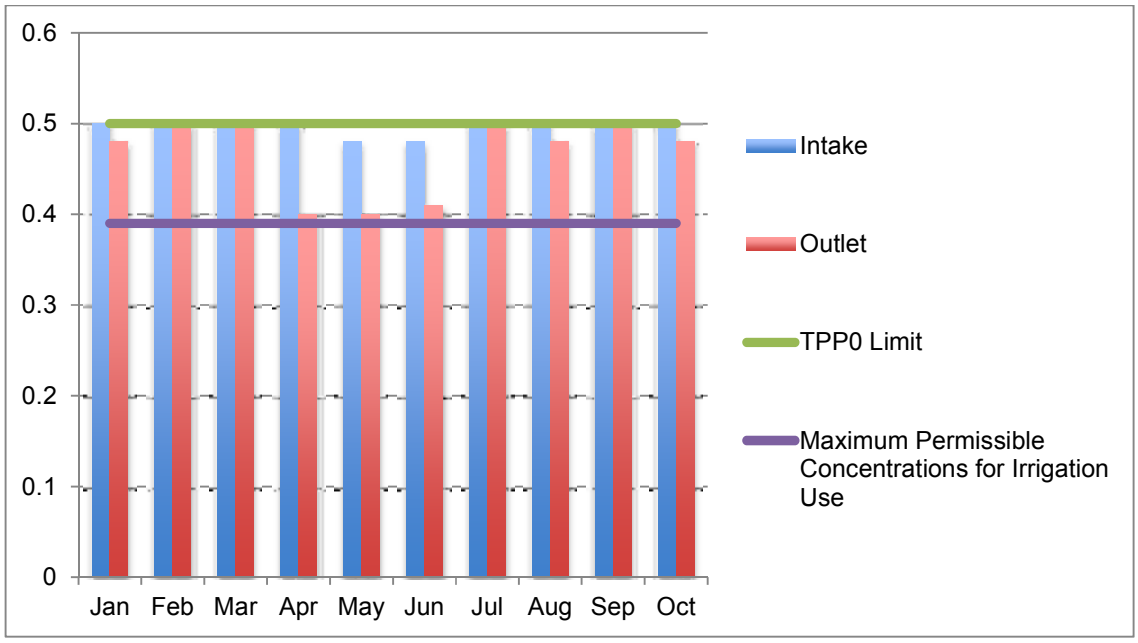
* TPP0 Limit Set by Goskompriroda

Figure E-15: BOD (mg/l), 2016



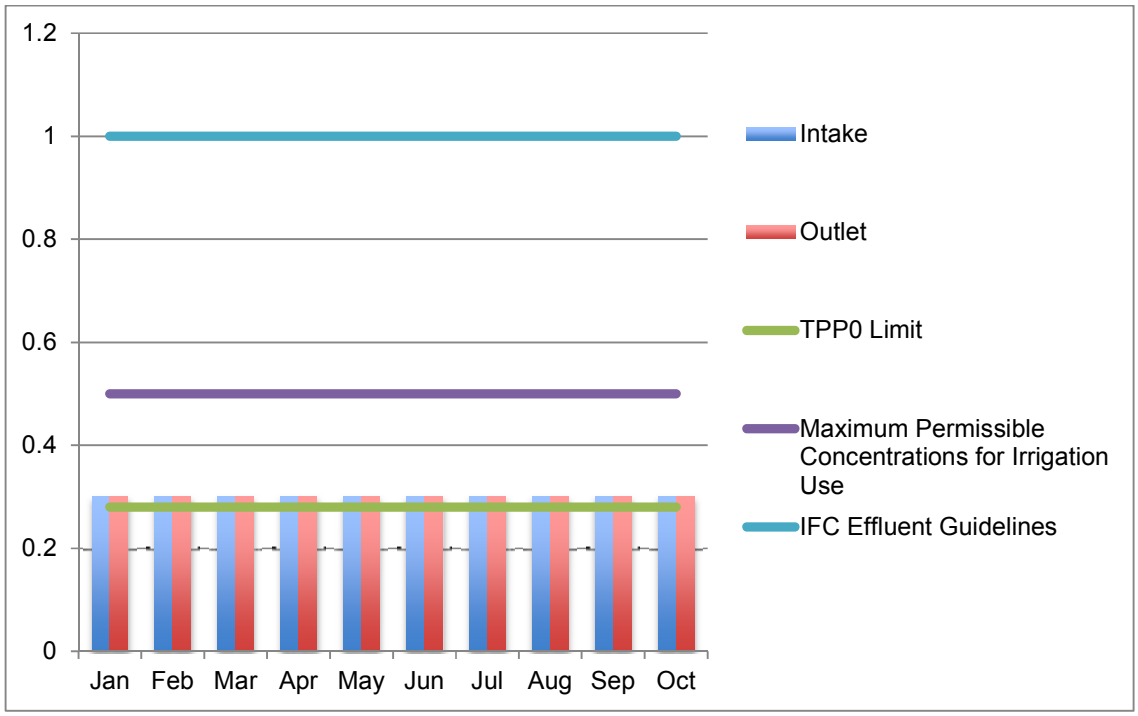
* TPP0 Limit Set by Goskompriroda

Figure E-16: Ammonium (mg/l), 2016



* TPP0 Limit Set by Goskompriroda

Figure E-17: Iron (mg/l)



384. **Waste Water**. There are a number of processes at TPP0 and TPP1 that produce wastewater requiring treatment before discharge. The following section describes these processes.

1. Desalinization Plant Waste Water - The desalinization plant that produces de-mineralized water also produces a wastewater stream that is very saline along with regeneration and cleaning water. This is discharged to concrete lined sludge drying pits where the water evaporates. Excess water from the drying pits is discharged to drain K-3-2 which runs for 14km before discharging into the Kyzyl-Kum desert. The most recent water quality tests from drain K-3-2 indicate that all parameters (with the exception of slightly elevated levels of mixed substances and dissolved minerals) are within the approved maximum allowable concentrations (see **Table E-6**).
2. Chemical treatment Plant Discharge - The Boilers require routine cleaning which is done by washing through with sulfuric acid. The cleaning process produces wastewater that contains acid, suspended particulates and other components. This waste stream is treated in a neutralization plant before it discharges to the afore mentioned concrete lined sludge drying pits. Water quality monitoring at the sludge drying pit was undertaken in October, 2017. **Table E-6** presents the results of the monitoring that was completed by TPP0 staff monitoring water quality according to national requirements. The results show that the only parameter elevated above the national limits is iron. This is a result of the old pipes that transmit the water to the sludge drying pits.

Table E-6: Sludge Drying Pit Water Quality

#	Parameter	Unit	Value	National Limit
1	Disolved minerals	Mg/l	391	1348
2	Mixed substances	Mg/l	30	30.0
3	Sulfate	Mg/l	350	500
4	Chloride	Mg/l	45	350
5	BOD-5	Mg/l	3.6	3.0-6.0
6	Ammonium	Mg/l	0.18	2.0
7	Nitrite ions	Mg/l	1.3	25.0
8	Nitrate ions	Mg/l	0.04	0.5
9	Iron	Mg/l	4.5	0.5
10	Oil Products	Mg/l	0.2	0.3
11	Copper	Mg/l	0.3	1.0
12	pH	-	6.5	6.5 – 8.5

3. Waste Water – Site drainage, including rainwater run-off, is channeled into a holding tank (KH1) before being transferred to an oil water separator tank within the TPP0 grounds. The oily sludge is collected and removed from site on a regular basis by a licensed waste management company. The clean water is re-circulated back into the TPP0 system for re-use.
4. Sewage Water – Sewage is generated from both the TPC and the residential areas of Nuriston. A sewage treatment plant was constructed as part of the original TPC design to treat all the sewage from TPP0, Nuriston and any future plant additions to the TPC (up to 3,200MW). The sewage treatment plant is designed to treat 10,000m^3/day of sewage but only 3.5-4,000m^3/day is currently generated and treated by TPP0. Approximately 160 additional employees will be required to operate TPP1 and TPP2 which will not generate significant quantities of sewage waste and therefore the sewage treatment plant will continue to operate well within its designed capacity (assuming 150 liters per day per capita, this would mean around 24 m^3/day of additional sewage per day). The sewage treatment plant operates a three stage process. The first stage of the process is mechanical screening and primary settlement. The effluent is then treated in an activated sludge process before the final disinfection stage.

Sludge from the sewage treatment plant is pumped to a tank where it is dried before disposal. The outflow from the sewage treatment plant also discharges into drain K-3-2.

Table E-6: Waste Water Quality – Drain K-3-2 (March, 2017)

#	Parameter	Drain K-3-2	National Limit	IFC Guidline (Thermal Power Plants)
1	Disolved Mineral	1118	1348	N/A
2	Mixed substances	32.5	30.0	N/A
3	Sulfate	223	500	N/A
4	Chloride	185	350	N/A
5	Biological oxygen demand (BOD-5)	4.0	3.0 - 6.0	N/A
6	Ammonium	0.6	2.0	N/A
7	Nitrite ions	0.8	25.0	N/A
8	Nitrate ions	0.07	0.5	N/A
9	Iron	0.2	0.5	1.0
10	Petroleum products	0.02	0.3	N/A
11	Copper	0.02	1.0	0.5
12	pH Indicator	7.5	6.5 – 8.5	6-9

1.4.2 Groundwater Water

385. The estimated regional groundwater reserves in Uzbekistan make up 18,455 million m^3/year. The total actual extraction is 7,749 million m^3/year, which is about 42% of the estimated reserves. Fresh groundwater is concentrated mainly in the Fergana Valley (34.5%) and the regions of Tashkent (25.7%), Samarkand (18%), Surkhandarya (9%) and Kashkadarya (5.5%), with the rest being brackish or saline and having limited potential for use. Groundwater supplies are mainly used for domestic and drinking water supplies (173.5 m^3/s), irrigation and stock water development needs (70.5 m^3/s) and industrial and process water supplies (29.6 m^3/s).

386. The groundwater chemical composition is concrete corrosive – however, they are too deep to affect the project. In addition, high sulphate and chloride levels in the groundwater lead to salinization in this region of Uzbekistan.

1.4.3 SGCC

387. The SGCC complex is supplied with water from Pump Station A and Pump Station B which abstract water from the KMK. Pump Station A is located along the canal length behind a discharge outlet of the Talimarjan Reservoir at a distance of approximately 1.5 km. Pump Station B is located further downstream on the canal. The 11.5 million m^3 capacity Himki reservoir has been constructed at SGCC as buffer storage. Annual water supplied to the SGCC complex from the KMK on 2007, 2008 and 2009 are listed in **Table E-7**. According to the Oltin Yol EIA the impact on downstream water users (local and trans boundary) from an abstraction point of view is negligibly small.

Table E-7: Annual water supplied to the SGCC

#	Year	Volume of Water in thousand m^3
1	2007	10,707

2	2008	15,520
3	2009	15,565
4	Average	13,931

E.1.5 Geology & Soils

E.1.5.1 Geology

388. The Project area falls within Alay-Kokshalsky folded system (Southern–Gissarsky zone). This folded system, being a member of the Southern Tian Shan has a complex blocked structure. The general orogenic events, which formed the Tian Shan are of Caledonian and Hercinic age.

389. The folded zones are composed of wide spectrum of rocks ranging from metasedimentary metamorphic rocks (e.g. crystalline schists, quartzites, marbles), volcanic and paravolcanic metamorphic rocks, which were intruded with magmatic rocks ranging from syenites to gabbro. During Mesozoic period the Hercinic Mountains were eroded and massive sedimentation took place in several depression zones and synclines.

390. Amudarya basin was probably the biggest (up to 30 km wide and ~ 800 km long) and most long-living sedimentation zone. The project area is located close to the northern flank of this basin.

391. During the construction phase borrow material will be required. A closed borrow pit is located approximately 500 meters south of Nuriston and was previously used during the TPP1 construction phase. This pit is now closed and will not be used for TPP2. The closed borrow pit will be re-opened as a licensed landfill for inert waste after it has been re-instated by the TPP1 Contractor. The landfill will be operated by a private company. It is not known when the landfill will become operational. No TPP2 waste will be disposed of in this location until all necessary licenses have been obtained by the operator and have been reviewed by the Engineer.

E.1.5.2 Soils

392. Soils at the TPC are mainly represented by alluvial, pro-alluvial and de-alluvial formations. From the surface to 5.0-8.0 m below ground level (bgl) soils are dusty sandy loams characterized as micro porous, light brown, weak, with a high concentration of sand in some places.

393. The topsoil and surface soil layer is generally fertile. Sub-soils of medium density extend to between 2.0-3.5 m bgl. This soil horizon is not homogenous: there are more sandy than clayey particles. In the sandy loam stratum there are lenses of loamy clay. The density of the soil increases with depth, and moisture levels vary widely between 1.2%-15.3%. Soil moisture is very variable because of the different history of agriculture and irrigation across the region as well as the differences in the water-absorbing capacity of the various soil types.

394. Chemically, the soil is composed of saline lenses comprising up to 80% of the total, interspersed with non-saline layers. Water-soluble saline compounds are distributed evenly throughout the entire sandy loam layer, with only isolated cases where salt has accumulated in small pockets and thin layers, appearing as a film of white powder. Clay content varies widely from 0.235 up to 10-15%, and in isolated cases of thin layers of clay compounds its content is even higher, from 24-29%. The permeability of the sandy loam is 0.8 m/day.

395. Under the sandy loam stratum lie clayey loams. The transitional area between these strata is characterized by the presence of heavy sandy loams and light clayey loams between 0.5-1.0 m thick. The clayey loams are predominantly yellow with infrequent layers, pockets or irregular formations of brown clayey loam, sandy loam and separate thin layers of different grains of sand, as well as separate inclusions of coarse fragments of crushed stone, gravel and small pebbles. Sandy loams closer to the surface generally have low moisture content; however, the moisture content in some areas is higher, mainly because of the infiltration of irrigation water (and rarely precipitation). The minimum moisture level is reached at a depth of 9-11 m bgl. Soils In the upper part of this layer soil are of medium density, increasing with depth.

396. The salinity of the underlying loamy soil stratum is uneven across the area and with depth. Easily soluble compounds are generally incorporated with soil particles and are generally not visible as separate minerals. The main source of loam salinity is sulfates associated with clays, and the highest salinity levels are found as individual layers at about 7.6 m bgl. The salt content increases the cementing properties of the soil by more than 15-20%. Soil becomes denser with depth. In the upper layers the salinity does not exceed 5-10%. Loamy soil permeability is 0.25 m/day.

397. There may be some clay sub-soils in the area allocated for TPP2 including clay and sandy loams, which are reactive (swell with changes in moisture), prone to subsidence, and have high salt content that may be aggressive to concrete structures including foundations.

398. Consultations with TPP0 staff have indicated that the TPP2 site has not previously been used for the storage of any hazardous liquids or materials that may have led to soil contamination. The TPC site layout was prepared with the anticipation of a power plant of 3.2 GW, and as such the site of TPP2, like TPP1 before it, has been left unoccupied within the boundary of the TPC site with the exception of portions of the TPP2 site that were used as a lay down area for construction materials during the construction phase of TPP1 (see **Figure E-18**). Although environmental management during the construction phase of TPP1 adjacent to the TPP2 site was far from ideal, no pollution events were noted in the area of TPP2, or adjacent to TPP2 site during the routine environmental monitoring of TPP1 construction activities by the TPP1 Engineer. Accordingly, no significant levels of soil contamination are assumed to be present within the TPP2 site.

Figure E-18: TPP2 site used as lay down area during construction of TPP1, September, 2016.

E.2 Ecological Resources

399. Uzbekistan is located at the crossroads of several bio-geographical regions. It contains a variety of landscapes, including high mountain ranges, wetlands, and the infamous Aral Sea. Almost 85% of Uzbekistan's territory is occupied by desert or semi desert, including the largest arid zones in Central Asia: the Kyzyl-Kum, and the Ustyrt Plateau. About 10% of Uzbekistan's land, most of it in the Fergana Valley, is classified as arable, and 0.8% is planted to permanent agricultural crops. About 0.4% is forested. Most of the rest is desert.

400. The Project area is located on the 'Karshi Steppe', where the natural environment consists of semi-desert scrublands largely the result of the low rainfall in the region. The biodiversity composition of the region and the TPP2 site is described in terms of Avifauna, Flora, Fauna and protected areas.

E.2.1 Avifauna

401. Due to its size and its central location between Europe and Asia, Uzbekistan is host to a diverse avifauna (birds) with an estimated total of about 500 species, which is the same number of species that occur in Europe. [20] Uzbekistan, Kazakhstan and Turkmenistan are areas of several migration routes, including the Black Sea- Mediterranean, West Asian-East African, and Central Asian-South Asian flyways. Thus, large numbers of birds, particularly wildfowl, raptors and cranes, visit this area as part of their stop-over during their annual migrations.

[20] Kh.S. Salikhbaev, M.M Ostapenko. Birds // Ecology, measures on protection and rational use of vertebrates of the Karshi steppe. Tashkent, 1967.

402. Within Uzbekistan there are 47 Important Bird Areas (IBAs) including the Talimarjan reservoir. Studies undertaken in the vicinity of the reservoir the last few years have confirmed that the area is important for migratory bird species in both spring and winter migration periods.

403. However, observations carried out in the vicinity of the reservoir in the last few years have indicated that the breeding bird community of the reservoir being poor in species diversity. Apart from Passeriformes, the only recorded breeding species in the area are a few raptors (*Falco naumanni*, *Circaetus gallicus*, *Aquila chrysaetos*, *and Buteo rufinus*). Griffon Vultures are resident while Cinereous Vultures are present in the area during winter months.[21] There will be no construction activities at the reservoir. The only impact to the reservoir will be a slight increase in the water required during re-circulation mode, 0.09 m^3.

404. Within the Karshi Steppe environment there are 268 species among 18 orders that are expected to occur which represents 60.8% of the 441 species recorded in Uzbekistan. Of the 268 bird species expected to occur on the Karshi Steppe:

- 3 are listed nationally as Critically Endangered (CR);
- 3 are listed nationally as Endangered (EN);
- 10 are listed nationally as Vulnerable (VU) and Declining (D);
- 10 are listed nationally as VU and Rare (VU: R);
- 11 are listed nationally as Near Threatened (NT).

E.2.2 Flora

405. The flora of Uzbekistan is represented by at least 4,800 species of vascular plants which belong to 650 genera and 115 families. Endemism rate is rather low and equals 8 % (or 400 species) of the total number of species.[22]

406. Uncultivated and natural vegetation around the TPC consists of rather poor ephemeral communities, primarily including perennial sedge meadow and bluegrass, as well as annual plants such as fenugreek, malcolmia, borage, afanopleura, etc. and semi-arid saltworts. Irrigation water helps yantak and tamarisk to grow along highways. These plant species are predominant in the TPC area and in the small depressions along the KMK.

407. The lands to the north and west of the TPP2 are intensively cultivated, mainly with cotton. The fields are also sown with corn, and wheat. Vegetable crops such as tomatoes, potatoes, carrots, turnips, and radish are grown on household plots. However, there are few cultivated areas within the TPC SPZ.

408. Artificial tree plantings are established along roads, inside the residential area of Nuriston village and in some places between Nuriston and the TPC. Trees in Nuriston are mainly traditional elms and mulberry trees, and also some poplars, sycamores, and oak trees. The status of this vegetation is generally satisfactory as a result of current irrigation and agricultural practices.

409. As noted previously, the TPP2 site has always been set aside for its planned extension all within the boundary of the TPC that has been in place since 2004. Within this area there is almost no vegetation. Most recently it was partially used as a lay down area for TPP1 construction materials as exhibited by **Figure E-17** above. Accordingly there was no requirement to undertake any detailed assessment of flora within the TPP2 site as part of this EIA.

[21] Oltin Yol ESIA – Avifauna Specialist Study, 2011. Golder Associates
[22] http://enrin.grida.no/htmls/uzbek/report/english/animal.htm

E.2.3 Fauna

410. According to the IUCN's 2008 Red List of Threatened Species, there are 52 critically endangered / endangered / vulnerable species in Uzbekistan. A further 415 species have a lower risk, and the data for five species are insufficient. Uzbekistan produced their national Red Book in 2006, which has a partial overlap with the 2008 International Red List, being more stringent in some instances. No IUCN Red List Species have been identified within the Project area.

411. The native fauna of the Kashkadarya region is represented by species normally inhabiting foothills and semi-deserts. There is very limited biodiversity in and around the TPC, given that the proposed construction area is within a large power generating facility located close to the residential settlement of Nuriston. It is also surrounded for some distance in most directions by intensively cultivated land and other farming activities. Land to the south and further to the east of the TPC is the only possible source of less highly modified habitat

412. The native and introduced fauna of the immediate project area is therefore represented mainly by rodents (field mouse, common mouse, grey rat), birds (rook, jackdaw, grey crow, starling, different species of sparrows, pigeons, etc.), and domestic animals (cattle, small ruminants, and poultry).

413. Reportedly, twenty eight species of fish live in the KMK. The sturgeon family: barbell sturgeon, Amy Darya ich; the carps family: Aral roach, Chinese carp, Capricorn, Aral asp, Turkestan gudgeon, Samarkand khramulya, Aral barbell, Turkestan barbell, Aral shemaya (royal fish), stripped bystranka, carpbream, white-eye, sabrefish, common sawbelly, Korean sawbelly, shrimp, wild carp, silver carp, bighead; loach family: Tibetan char, Amy Darya char; Eurasian freshwater catfishes: catfish.[23] None of these species are found listed in the IUCN Red List. A commercial fishery for catching silver carp, grass carp, carp, and pike perch operates in the Talimarjan Reservoir. There are no commercial fishing activities within the KMK itself.

414. There are two rodent species that have large populations in the region, the greater sand-eel or Great Gerbil (*Rhombomys opimus*) and the red-tailed sand-eel or Libyan Jird (*Meriones libycus*), both of which can reach high population densities in their areas of habitat. However, the population numbers vary widely with weather conditions and food supply over 10-15 year cycles. The populations of most other rodent species in the natural environment are generally small. Unlike in natural landscapes, populations of common mice in all residential areas are generally high, and can grow rapidly in the absence of control measures.

E.2.4 Protected Areas

415. Uzbekistan's current protected natural areas fall into five categories: nature reserves/national reserves (zapovedniks); national parks; one ecological centre; wildlife areas (zakazniks); and national nature memorials.[24] There are no protected areas within 100 kilometers of the TPC.

[23] Draft Feasibility Study. Construction of 500 kV HV Line Sogdiana SS – Talimarjan TPP with 500 kV OSG at Talimarjan TPP. Environment Impact Assessment of Construction of 500 kV HV Line Sogdiana SS – Talimarjan TPP (EIA). TEPLOELEKTROPROEKT OPEN JOINT STOCK COMPANY. 2009

[24] Environmental Performance Review – Uzbekistan. Second Review. UN, 2010

E.3 Economic Development

E.3.1 Industries & Agriculture

E.3.1.1 National Aspects

416. The Uzbek national gas company, Uzbekneftegas, ranks 11th in the world in natural gas production with an annual output of 60 to 70 billion cubic metres (2.1–2.5 trillion cubic feet). The country has significant untapped reserves of oil and gas: there are 194 deposits of hydrocarbons in Uzbekistan, including 98 condensate and natural gas deposits and 96 gas condensate deposits. Uzbekistan also has the fourth largest gold deposits in the world. The country mines 80 tons of gold annually, seventh in the world. Uzbekistan's copper deposits rank tenth in the world and its uranium deposits twelfth. The country's uranium production ranks seventh globally.

417. Along with many Commonwealth of Independent States or CIS economies, Uzbekistan's economy declined during the first years of transition and then recovered after 1995, as the cumulative effect of policy reforms began to be felt. However, since the mid-2000s, Uzbekistan has enjoyed robust Gross Domestic Product (GDP) growth, thanks to favourable trade terms for its key export commodities like copper, gold, natural gas, cotton, the government's macro-economic management, and limited exposure to international financial markets that protected it from the economic downturn. Overall GDP growth for Uzbekistan has continued at around 8% annually during 2011-15, supported by net exports and a large capital investment program.

418. Agriculture employs 26% of Uzbekistan's labour force and contributes 18% of its GDP (2012 data). Cultivable land is 4.4 million hectares, or about 10% of Uzbekistan's total area.

E.3.1.2 Regional and Local Aspects

419. The economy of the Kashkadarya Region and the Project area itself is focused on agriculture and gas production. The share of agricultural production in Kashkadarya in the gross regional product is more than 40%. The gross agricultural output of the region is 796.1 billion soms. Kashkadarya is one of the main sources of grain, cotton and other agricultural products in Uzbekistan producing 10.2% of all agricultural products (10% of cotton, 11% of grain). 98% of gas and more than 80% of oil extracted in Uzbekistan comes from Kashkadarya.[25] Official statistics at the Province level put current unemployment rates at 4.9%, which is considered better than other Provinces. However, despite the presence of some of the largest industrial facilities, Kashkadarya does not compare well with other regions when assessing poverty.[26]

420. TPP2 is located in a sparsely populated rural area of Nishon district, in Kashkadarya province. A significant economic activity of the province is agriculture, with cotton being the dominant crop. Grains and livestock rearing also make contributions to the agricultural economy. The majority of the agriculture is irrigated agriculture supported by an extensive system of canals and pump stations.

421. TPP0 is one of two major industrial sites in the area, the other being the SGCC. TPP0 has a workforce of about 1,300 workers, the majority of which live in nearby Nuriston. The community has a recreation center, a medical center, restaurants, shops, and sports fields. Nearby farms supply meat, fruit and vegetables to the community. The full time employment

[25] http://www.uzbekembassy.org/e/investment_guide_by_kashkadarya/
[26] Socio-economic Specialist Study. Oltin Yol GTL ESHSIA. Golder Associates, 2014

and job security offered by the TPC means that the community is more characteristic of a higher income urban community than the surrounding rural low income communities. In the surrounding rural areas, the communities have an average household size of 6.7 persons, with 2.1 persons in each household in permanent or temporary employment (including children under 15 years old). The employment rate of the employable-age population is about 70% in the province, which is above the national average.

E.3.2 Infrastructure and Transportation facilities

E.3.2.1 Road, Rail and Air

422. Roads – The TPC is linked by an asphalt two-lane road to the Karshi-Amu Darya road located 7 km west of the TPC. The condition of the road is poor due in part to the degradation of the road by heavy vehicles transporting equipment to the TPP1 construction site. However, no condition survey of the roads was undertaken prior to the start of TPP1 construction and there were no contractual obligations for the TPP1 contractor to rehabilitate any roads damaged during TPP1 construction phase. The Karshi-Amu Darya road is in slightly better condition although driving at night can be rather tricky due to the lack of street lighting and the number of potholes in the road. From Karshi there are options to travel north to Kazakhstan along the A380, or east to Tashkent. The regional roads connecting Karshi to the north of Uzbekistan and Tashkent are in the process of being upgraded, but in many locations the road conditions are poor and this has led to significant delays transporting goods for TPP1.

423. Rail – The main Tashkent-Termez railway line is located 1 km east from the TPC and there are five rail spurs that allow direct delivery to the Project site. In addition, Karshi is linked to Tashkent by a high speed train.

424. Air – Karshi is served by an international airport with regular flights between Tashkent and Moscow.

E.3.2.2 Electricity and Gas Supply

425. The major settlements in the Project area are served my mains gas and electricity. Notwithstanding the fact that Nuriston is located almost adjacent to the TPC, the town still suffers from periodic power outages.

E.3.2.3 Water Supply and Water Treatment

426. The water treatment facility at TPC provides drinking water for the Nuriston community, producing around 5,600m^3/day. These conditions are considerably better than those in the region, where only 31% of rural households in Kashkadarya have access to piped drinking water, mostly through a street standpipe. During the public consultation phase one of the key comments from the villagers of Mekhnatabad was that they were not connected to a water supply system and that they had to source their drinking water themselves directly from the KMK, but upstream of the TPC. Additional consultations held to discuss the health impact assessment report revealed that potable water is, and has been available from water tanker trucks in Mekhnatabad. However, many locals do not utilize this source as they would have to pay for it rather than using the free water available in the KMK.

E.4 Social and Cultural Resources

E.4.1 Socio-economic conditions

E.4.1.2 Politics and Governance

427. The Project is located in the Kashkadarya Province, one of 12 Province (or Oblasts in

Russian) in Uzbekistan. The executive branch of the Province is the Khokimyat, which is headed by a governor or Hakim. Each region is further divided into Regional Khokimyat, which also have regional Hakims.

428. Kashkadarya is divided into 14 rayons and the project is physically located in Nishon rayon. The administrative center of Kashkadarya is Karshi, some 40km to the north of TPP2. Each rayon is further divided into areas that are overseen by Village Councils or Mahallah. Nuriston, located in Nishon rayon, is the closest settlement (approximately one kilometer) from TPC and is a Mahallah itself.

E.4.1.2 Population

429. The population of Kashkadarya Oblast is estimated to be around 2,067,000 (2007), with some 73% living in rural areas. The capital of Kashkadarya is Karshi (197,600 people (1999 census estimate)). TPP2 is located in Nishon district which has an estimated population of 106,400.

E.4.1.3 Ethnic Groups

430. Despite of the permanent emigration of ethnic minorities from Uzbekistan since the collapse of the Soviet Union, more than 130 nationalities still live in the country. The main ethnic groups are Uzbeks (79.2 %), Russian (4.1 %), Kazakhs (3.8 %), and Karakalpaks (2.2 %). **Table E-8** indicates the ethnic composition of Kashkadarya and its districts.

Table E-8: Ethnic Composition of Kashkadarya and its Districts[27]

Region / District	Uzbek	Tajik	Kazakh	Karakalpak	Other
Kashkadarya Region	97.7	2.2	0	0	0.1
Kasan District	100	0	0	0	0
Kamashi District	100	0	0	0	0
Yakkabog District	99.4	0	0	0	0.6
Chirokchi District	100	0	0	0	0
Shahrizabz District	97	3	0	0	0
Kitab District	89.7	10.3	0	0	0

E.4.1.2 Languages

431. By law, Uzbek is Uzbekistan's exclusive nation-wide state language. Government policy requires the use of Uzbek in all dealings with officials, in street signage, and in business and education. Russian is still spoken widely, however, and enjoys ambiguous legal status as "the language of interethnic communication." In the autonomous Karakalpakstan region, Karakalpak is a state language alongside Uzbek. In Samarkand, many people speak Tajik as their mother tongue. Within the Project area the main language is Uzbek.

E.4.1.3 Religion

432. Islam is by far the dominant religion in Uzbekistan, as Muslims constitute 90% of the population while 5% of the population follow Russian Orthodox Christianity, and 5% of the population follow other religions. 54% of Muslims are non-denominational Muslims, 18% are Sunnis and 1% are Shias.

[27] Ethnic minorities development framework. Kashkadarya and Navoi rural water supply and sanitation sector project. ADB, 2005.

E.4.2 Community Health & Education

E.4.2.1 Health

433. According to the TPP1 EIA results show that most the prevalent health conditions amongst the TPP0 workers are sore throats and chronic heart disease such as angina. Respiratory diseases are also quite common as a result of the high dust levels and winds in the area.

434. Discussions between MMCS and the medical center staff at the TPP0 indicated that around 20 members of staff per day visit the TPP0 medical center. The main issues are high blood pressure and headaches.

435. Consultations held in Nursiton and Mekhnatabad revealed that locals are concerned about emissions releases from SGCC (see **Section I - Public Consultation, Information Disclosure & Grievance Mechanism**). Several people believed that SGCC had an un-official procedure to release emissions to air during the night time which was leading to health issues including problems with kidneys, hair loss and headaches. They did not believe that any of these issues were related to the operation of the TPC itself.

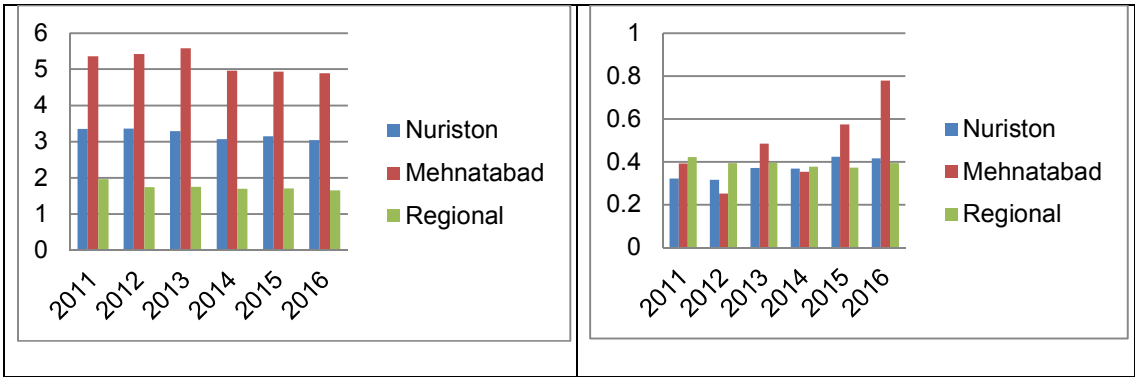
436. Given the above concerns, the MMCS team undertook further consultations with doctors at the health facility in Nuriston. None of the doctors at the facility in Nuriston believed that SGCC had any un-official releases of air emissions at night and they could not provide any medical evidence to show that air emissions from SGCC were impacting upon Nuriston. However, they did note that there had been cases of workers from SGCC who lived in Nuriston having medical issues, such as problems with their liver, skin rashes and respiratory problems.

437. The MMCS team was then requested by ADB to undertake a Heath Impact Assessment (HIA) of the Project to "assess the health and safety impacts/risks of the project, especially from air quality emissions of the project but also in terms of water quality and other impacts/risks, to the existing communities within the project area of influence, notably the communities at Nuriston and Mekhnatabad." [28] The following section summarizes the findings of the HIA.

438. Air Quality - The indicators choose and analyzed according the air pollution pathway, including circulatory diseases; low birth weight; stroke and myocardial infarction and respiratory diseases. The prevalence rates of Nuristan and Mekhnatabad are compared with regional Nishon data.

Figure E-19: Number of CRD per 1000 population	**Figure E-20:** Number of Asthma patients per 1000 population

[28] Terms of Reference for Health Impact Assessment. UZB: Power Generation Efficiency Improvement Project (TPP2). ADB, 2017.



439. The prevalence' tendency of Chronic Respiratory Diseases ((CRD)- **Figure E-19**) stays stable during examined period. The CRD and asthma cases among Mekhnatabad community were more than two times higher comparing to Regional and 1,5 times comparing to Nuriston. Asthma rates have slowly but increasing tendency in both communities except of Regional (since 2015 the asthma rate start to increase among Mekhnatabad population and was nearly two times higher comparing regional and 1,86 times higher comparing Nuriston in 2016). Taking into consideration that Mekhnatabad community have difficulties to access for General Practice services in terms of physical access (Mekhnatabad population cannot take service from Nuriston policlinic due to governmental planning, and inhabitants should take health service from "Samarkand" General practice far away from community location), medicine (no drug store within community), and Nuriston' policlinic is poorly equipped and has shortages in medical doctors we can assume that population cannot take continuous standardize approach to diagnosis and management of respiratory or other diseases. The prevalence of diseases depends on incidence and on the mean duration of the diseases. Mekhnatabad also have limited in gas and energy supply and have more chance to indoor pollution. The raise in the prevalence of asthma in the Mekhnatabad community can therefore be attributed to poor control of indoor pollution and low standardized management. [15]

440. Stable tendency on disease prevalence could be attributed to impact which started many years ago, as SGCC start to operate since 2000 and TPP0 2004 (SGCC impact needs to be confirmed by data for 1995-2016, which not available yet) or natural dust environment. To give exact confirmation there is need to make full research for all operation periods of SGCC, TPP0; technology they used and full access to accurate community health data of Nishon region for 20 years (the data is not accurate). But we can assume minimal or not impact of TPP1 operation on community health based on usage of cleanest technology. Consultations held in Nursiton and Mekhnatabad revealed that locals are concerned about emissions releases from SGCC. Interview results also support the more harm impact comes from SGCC as they have an un-official procedure to release emissions during the night or early 5 a.m. which was leading to different health issues including problems with kidneys, hair loss and headaches. They did not believe that any of these issues were related to the operation of the TPC itself.

Figure E-21: Number of oncology patients per 1000 populations

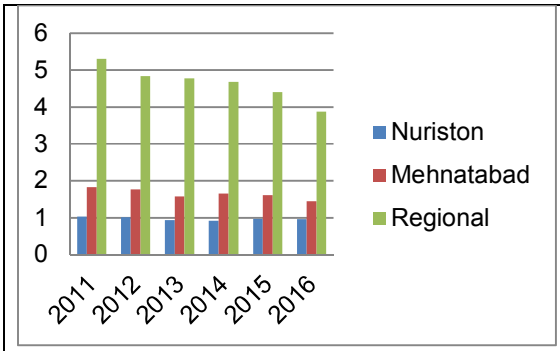
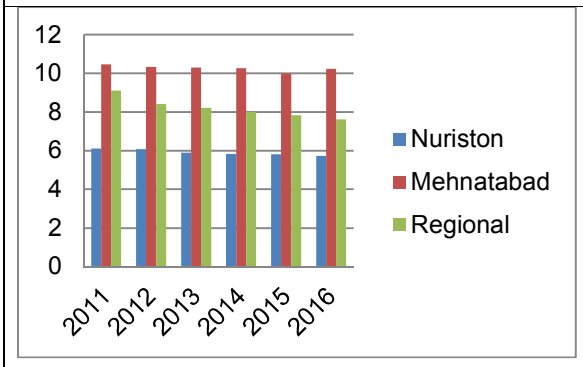
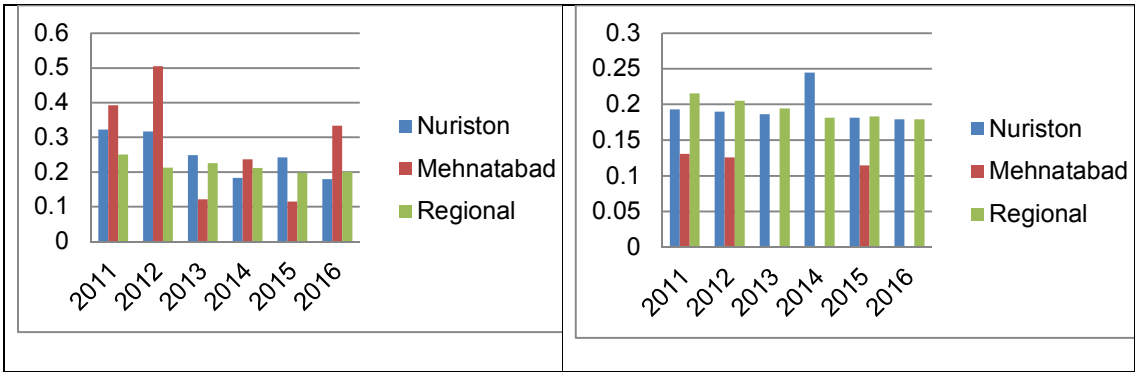
	Oncology situation is worse for whole region (regional prevalence rate of Nishon are 2,6 times higher than in Mekhnatabad and 4 times higher comparing Nuriston). The tendency of oncology prevalence rate for three regions doesn't change and even a bit decreased for Nishon region during 2014-2016. No one Lung cancer registered within examined population during 20011-2016 period.

Figure E-22: Arterial Hypertension per 1000 population



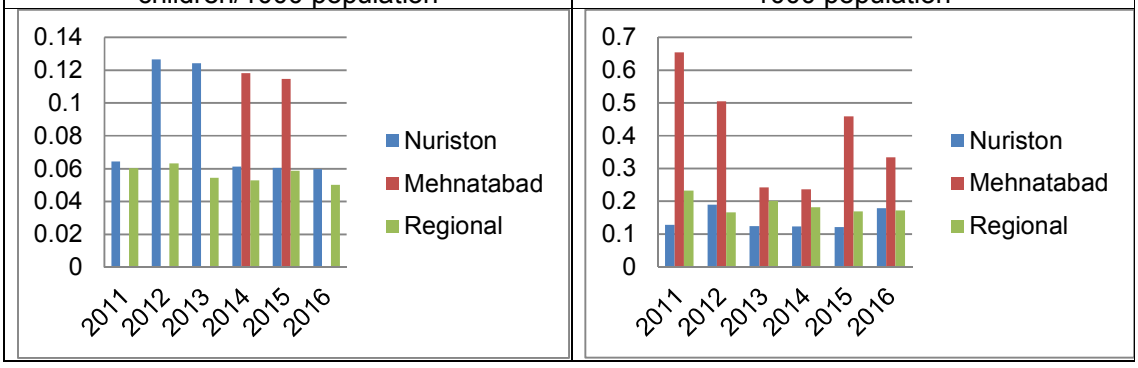
The tendency of Arterial Hypertension (AH) prevalence doesn't change during last 6 years. Presented data clearly underestimate the prevalence of AH in region. As evidence based globally AH distribution in low- and middle developing countries are 31,5% (*review of 90 countries studies; Katherine T, Mills; Joshua D. Bundy et all)*, but the presented regional data for Nishon was 0,76%; Nuriston 0,57% and Mekhnatabad 1,02%. The data show that the prevalence of hypertension is underestimated. There is a high risk of possible increasing of cardiac attack or stroke due to undetected cases. Timely identification and treatment of AH significantly reduce cardiovascular risk and in this situation the undetected patients miss treatment and possible high risk of circulatory diseases cannot be attributed to TPP operation. But still the Cardiac prevalence rate stay stable within examined locations, and no cardiac attack cases for 2013 and 2016 years in Mekhnatabad. The Stroke prevalence tendency has similar pattern, either it worsen in 2011-2012. Low access to drinking water can also attribute to this situation as well, see **Figure E-23** and **Figure E-24** below.

Figure E-23: Number of Stroke patients per 1000 population	**Figure E-24**: MI patients per 1000 population



441. The asthma (**Figure E-25**) and low birth weight among Mekhnatabad children were 2.23 times higher than in Region and 1.92 times higher than Nuriston during 2014-2015 and no cases in 2016. Unstable Asthma rates among children are difficult to explain, absence of cases could be attributed due to moving to other living place or under diagnosed cases. The low birth weight (**Figure E-26**) has similar tendency and the rates of babies born with low birth weight in Mekhnatabad increased by 1-2 times during 2011-2012 and 2015-2016 (in 2016 this indicator were even less).

Figure E-25: Number of Asthma among children/1000 population	**Figure E-26:** Low birth weight children per 1000 population



442. Water - Water quality measurement results show that most parameters are within national standards with the exception of sulfate and BOD which are both slightly elevated above the standards at both the intake and discharge points indicating that these higher levels are naturally occurring.

443. The number of dysentery cases among Mekhnatabad inhabitants was nearly two times higher comparing to regional and 1,5 times higher comparing to Nuriston (**Figure E-27**). From other side increased Hepatitis and Acute gastroenteritis cases in whole region comparing to target two communities indicate on existence of regional water and hygiene issues. (**Figure E-28** and **Figure E-29**).

Figure E-27: Dysentery cases per 1000 population	**Figure E-28:** Hepatitis cases per 1000 population

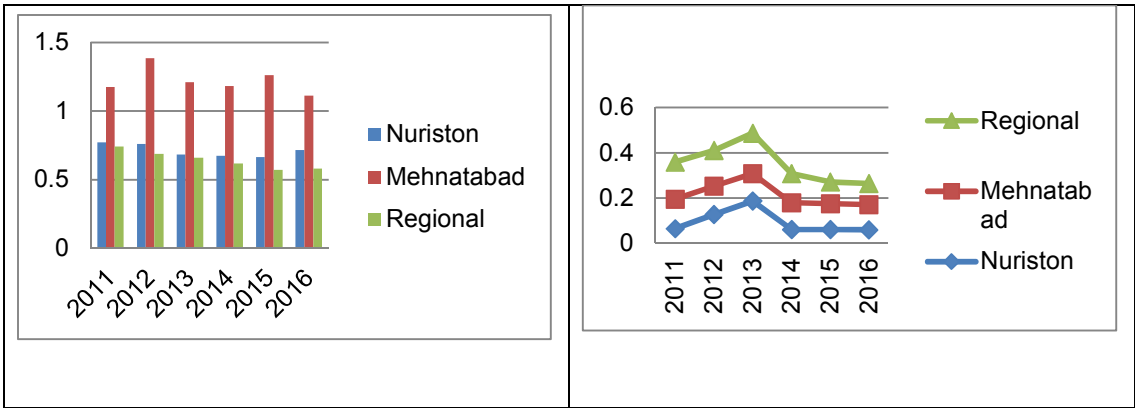
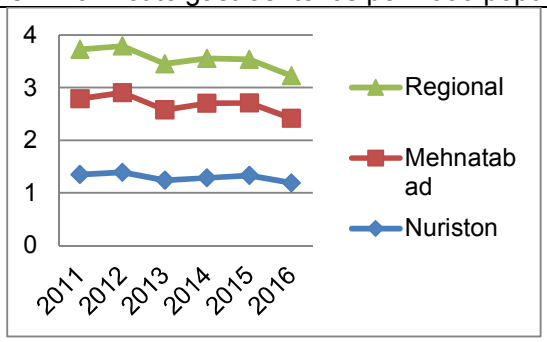


Figure E-29: Acute gastroenteritis per 1000 population



444. A review of medical facilities in the area was also undertaken. In general, the quality of medical facilities and care was considered low, which contributes significantly to health issues in the Project area. Specifically Mekhnatabad do not have any adequate medical facilities and have to travel to distant health facilities for treatment. There is also a lack of health education and awareness in the area, which leads to people drinking water from non-potable sources, such as the KMK.

445. Consultations undertaken with people living in Nuriston and Mekhnatabad on an informal basis, the following summarizes the key findings:

- Community are concerned most about: Infection - 81%; Respiratory issues – 72% and chronic diseases 51%.
- More than half interviewed did not mention about water problems in KMK. Problems with drinking water are suffering more the Mekhnatabad community members.
- SGCC impact is more significant and increases respiratory and cardiac diseases.

446. Summary – the HIA concludes that:

- The evidence base for various impacts, including the sources or studies this information comes from, vary in quality. Sometimes information is just not available. This often means making a judgments have been made on incomplete information.
- Mekhnatabad inhabitants examined health indicators were worse comparing to Nuriston. Respiratory issues may be a result of naturally occurring dust in this area and also to indoor pollution as housing condition which are worse comparing to Nuriston community. However, data supplied only dates to 2011, as such no comparison with pre-TPC periods has been available. In addition, no disaggregation of impacts from TPC and SGCC has been completed due to a lack of data from 1995 onwards.
- Mekhnatabad community have difficulties to access for General Practice services. Nuriston medical facility is poorly equipped and has shortages in medical doctors.

- Mekhnatabad population has ever less access to gas, power; not connected to a water supply system and had to source their drinking water themselves directly from the KMK (upstream of TPC).

447. Based on the findings of the HIA the following Public Health Monitoring Plan has been prepared to be followed during the operational phase of TPP1 and TPP2.

Table E-9: Public Health Monitoring Plan

Disease	Issue	Recommendation	Monitoring
General	Inaccurate statistics	Negotiate with health departments on gathering and registration statistics at least to air and water pollution related diseases	Mortality rate among >30 aged populations: 1) Mortality from cardiovascular diseases among adults over 30 years (myocardial infarction, stroke, ischemic heart disease) 2) Mortality from lung diseases among people over 30 years of age 3) Mortality from lung cancer 4) Mortality among children 0-1 year: 5) Mortality from Infection diseases (intestinal, hepatitis,) Incidence rate for: 1) Bronchitis among people under 18 years of age 2) Chronic bronchitis among people over 30 years of age 3) Asthma attacks among all ages (number of emergency calls for emergency visits due to asthma attacks) 4) Hospitalizations among all ages for cardiovascular disease 5) Hospitalizations among all ages for respiratory diseases

			The prevalence rate for: 6) Bronchitis among people under 18 years of age 7) Chronic bronchitis among people over 30 years of age 8) Asthma attacks among all ages (registered asthmatic patients, (number of emergency calls for emergency visits due to asthma attacks) 9) Hospitalizations among all ages for cardiovascular disease 10) Hospitalizations among all ages for respiratory diseases 11) Prevalence of underweight newborns
Respiratory and circulatory diseases	Preventive and management issues	Train nurses on usage preventive measures regarding indoor and outdoor pollution. Outreach and communication activities	Number of medical staff trained on respiratory diseases management and preventive measures Number of outreach activities and number of educated community members
Infection diseases	Prevention from water born and other infection diseases	Outreach and communication activities on infection prevention	Number of outreach activities and number of educated community members
ACCESS TO GENERAL PRACTICE in Nuriston:			
Equipment shortages:	2 child and 1 adult weight machine; otoscope; ophtalmoscope; ECG; surgical instruments and gynecologist instrument for daily practice	Support procurement	If get agreement- the number of procured equipment
Medical workers shortage		Possibility to help with scholarship for medical	

		students from local community???	
ACCESS TO GENERAL PRACTICE in Mehnatabad:			
Difficulties to access for General Practice services; kindergartens and schools.	Policy	Recommend/advice to revise Primary health care serving strategy to Mehnatabad in terms of geographical location	Letter to MOH and local health authority prepared and submitted
ENVIRONMENT AND HOUSING in Mehnatabad:			
Infrastructure	less access to gas, power; not connected to a water supply system and had to source their drinking water themselves directly from the KMK	Policy of infrastructure development	Prepare the letter to related authority to know health issues connected to poor housing environment and have possible support for water, gas and power supply in community
Less green environment	Drying trees and less greens	Outreach Campaign to train on developing and preserving gardens and parks in this area. Volunteering activity among youths to put and take garden within community	Number of trained community members Number of volunteering campaign
Workers			
Education; checkup	limited preventive education; follow up; checkup;;	**Noise:** Regular checkup of workers from areas with noise levels >85dBA and education to use personal safety equipment. **Electrical hazards:** Provide periodic retraining proper safe work procedures including first aid CPR and proper rescue procedures. **Fire and explosion hazards:** First aid during fire and proper procedures and provisions. **Chemical hazards:** First aid and proper procedures and provisions should be	Number of educated staff

		made for periodic retraining as necessary.	
	accidents' registration	Register and analyzed the accident's	Availability of registered report on incidence and lessons learned.

E.4.2.1 Education

448. Several schools are located within the Project area. These schools are considered sensitive receptors. In Nuriston the nearest schools are located between 1,100 and 2,500 meters from the TPP0 turbine hall. **Figure E-30** illustrates their location.

Figure E-30: Location of Schools and Clinic in Nuriston

E.4.3 Physical and Cultural Resources

449. No physical and cultural resources (PCR) are present within the boundaries of the TPC.

E.4.4 Noise & Vibration

E.4.4.1 General

450. Noise is often explained as sound that is unwanted by the listener. Sound is a wave motion carried by air particles between the source and the receiver, usually the ear. Sound, pressure and noise are measured in units of decibel (dB) using a logarithmic scale. If a sound is increased by 10 dB, it is perceived as a doubling in loudness. Changes in a sound by 3

dB(A) is barely perceptible to the human ear. Noise standards in Uzbekistan and IFC noise standards are described in **Section B.3.3** above.

E.4.4.2 Existing Noise Levels

451. Noise monitoring is currently undertaken by both TPP0 and the TPP1 EPC Contractor. The results of the most recent noise monitoring by TPP0 indicate that the TPP0 meets the required national standards (and international standards) for noise in the workplace except for the control room where IFC guidelines specify 60 dB(A). **Table E-9** provides the results from June, 2016.

Table E-9: TPP0 Noise Levels, June, 2016

#	Location	Noise Level (dB(A))	Uzbek Workplace Standard (dB(A))
1	Main Building	52-56	60
2	Electrical Department	48-52	60
3	Chemical Treatment Area	48-56	60
4	Maintenance area	48-56	60
5	Control room	76-78	80
6	Waste water treatment area	75-76	80
7	Warehouse	74-75	80
8	Welding shop	72-74	80
9	laboratory	72-74	80

452. As part of the performance tests for TPP1 noise monitoring was also undertaken by the TPP1 EPC Contractor at five locations in Nuriston on the 14th December, 2016 between 10.00 and 11.00. TPP0 was also operating during this period.

453. **Table E-10** indicates that the noise levels in Nuriston were below IFC and Uzbek standards for daytime noise during the performance tests.

Table E-10: Performance Test Daytime Noise Monitoring, Nuriston

Location	Noise Level (dB(A))
1	41.9
2	52.8
3	48.7
4	47.1
5	48.4

D.4.4.3 Independent Noise Monitoring Results

454. Additional independent noise monitoring has been undertaken for this EIA. TPP0 and TPP1 were operating during this period. **Figure E-31** indicates the locations of the noise monitoring (NQ) and **Table E-11** provides the results of the monitoring.

Table E-11: Independent Noise Monitoring Results (05/05/2017)

NQ	Location	dB(A) - Daytime	Daytime Compliance (55 dB(A))	dB(A) - Nighttime	Nighttime Compliance (45 dB(A))
1	Nuriston – close to sewage treatment plant	45	Yes	37	Yes

Table E-11: Independent Noise Monitoring Results (05/05/2017)					
2	Nuriston – bypass road to TPP1	43	Yes	39	Yes
3	Nuriston – close to health facility	56	No	36	Yes
4	Mekhnatabad	44	Yes	37	Yes
5	Western boundary of TPC	46	Yes	37	Yes
6	TPP0 front gate	44	N/A	58	N/A
7	TPP1 EPC Contractors Office	45	N/A	60	N/A
8	Central Nuriston	45	Yes	37	Yes
9	Southern boundary of TPC	72	N/A	38	N/A
10	TPP1 / TPP0 boundary (middle of TPC site, see Figure E-18)	75	N/A	58	N/A

Figure E-31: Noise Monitoring Locations

455. The results of the independent noise monitoring indicate that daytime and nighttime noise levels in Nuriston meet the IFC and Uzbek daytime and nighttime standards in all cases except two, and in those instances it was exceeded by only 1 and 2 dB. The results are also broadly consistent with the EPC Contractors performance test noise results.

456. 72 dB(A) was recorded at location 9 on the southern boundary of the TPC. The nearest residential properties to this location are more than 800 meters away, within the SPZ which prohibits residential properties. According to TPC staff these properties have been constructed in the SPZ after construction of TPP0. Attenuation as a function of distance alone will be sufficient to limit the noise exposure of residents in the SPZ to less than 45 dB(A) from location 9.

F. Environmental Audit

F.1 Objectives

457. As part of Talimarjan 2 Power Generation Efficiency Improvement Project the ADB have requested that the Consultants conduct an environmental audit of the existing Talimarjan Power Plant Unit 1 (TPP0) and Talimarjan Power Plant Phase 1 project (TPP1) to determine any areas where TPP0 and TPP1 may cause environmental risks.

458. The main objectives of the audit are:

- Provide an overview of TPP0 environmental aspects and potential impacts and make recommendations for corrective actions to TPP0;
- Review the TPP1 EIA to identify any potential mitigation measures that need to be strengthened to ensure compliance with ADB SPS (2009);
- Review the Contractors performance on TPP1 and identify the areas of regulatory and contractual non-compliance;
- Considering any regulatory and contractual non-compliance identified during the construction phase of TPP1, make recommendations to ensure the same issues do not arise during the construction phase of TPP2.

459. The audit can be found in its entirety as **Appendix E**.

F.2 Audit Procedure

460. An on-site audit of TPP0 and TPP1 was undertaken between the 28th and 30th of September, 2016 and follow-up visits were made on the 14th – 16th November, 2016. The initial on-site audit included inspections of portions of TPP0 and the TPP1 construction site. In addition, meetings were held with TPP0 Environmental Manager (TPP0 EM) and the TPP1 Contractors environmental, health and safety team. Meetings were also held in Tashkent with the head of Uzbekenergo Environmental Protection Department (UE EPD) between 26th and 27th of September, 2016. A number of documents were requested for review by the MMCS team, most of which have now been provided for review. Pre-audit activities were also undertaken, including review of available documentation, such as the TPP1 EIA and environmental monitoring reports.

F.3 Main Findings

461. A range of exiting and potential environmental, social and health and safety issues have been identified by the audit relating to TPP0 and TPP1. Most of the issues relating to TPP0 and TPP1 operational phase relate to a lack of, or uncoordinated management of environmental, health and safety issues. This can be remedied with the development of an overarching environmental and social management system, which is described in more detail below. In addition, TPP0 and TPP1 require strengthening of the environmental management capacity on-site, with the addition of one, or perhaps two, additional environmental staff to work with the TPP0 Environmental Manager.

462. The audit has also identified numerous shortcomings during the construction phase of TPP1. These were primarily associated with the poor performance of the Contractor and a lack of capacity within the PMU to adequately manage the Contractors attitude towards environmental, health and safety issues. The Engineer undertook routine monitoring of the

Contractors performance and provided monitoring reports to the ADB indicating the outstanding environmental issues.

F.4 Corrective Actions

463. Most of the environmental, social and health and safety issues that have been identified by the audit can be mitigated through the adoption of the three corrective action plans (CAP) provided as part of the audit. The first two CAPs for the operational phases of TPP0 (**Table F-1**) and TPP1 (**Table F-2**) must be considered as a set of recommendations to improve the environmental performance of the TPP1 and TPP2 in order to achieve compliance required by international institutions, good practices and national legislation. It should be pointed out that both CAPs should be agreed and budgeted by all Project stakeholders (JSC Uzbekenergo; Unity Enterprise Talimarjan TPP0; TPP1 Uzbekenergo Project Management Unit (PMU) TPP0 senior management) in order to be implemented by UE. Those corrective actions that only imply a management improvement could be implemented as soon as possible, taking advantage of the willingness of the UE EPD and TPP0 senior management. Other actions may take longer and involve more cost and assistance from external consultants.

464. One of the key recommendations of the CAPs is the preparation of an Environmental and Social Management System (ESMS) for the Talimarjan Power Complex (TPP0, TPP1 and TPP2) as a whole. The ESMS would encompass TPP, TPP1 and eventually TPP2 activities and would allow for greater coordination and control of environmental and social management aspects and impacts, not only on-site, but also within the local community.

465. An effective ESMS is a dynamic and continuous process initiated and supported by management, and involves engagement between TPP0, its workers and local communities directly affected by the project. Drawing on the elements of the established business management process of “plan, do, check, and act,” the ESMS entails a methodological approach to managing environmental and social risks and impacts in a structured way on an on-going basis. A good ESMS, appropriate to the nature and scale of the project promotes sound and sustainable environmental and social performance, and can lead to improved financial, social, and environmental outcomes.

466. The third CAP (**Table F-3**) puts forward recommendations to ensure that TPP2 does not repeat the same mistakes as TPP1 during the Construction phase. The recommendations provided within the CAP will then be used as part of the TPP2 EIA.

Table F-1: Corrective Actions for TPP0 – Operational Phase							
#	**Remark**	**Risk**	**Significance**	**Corrective Action**	**Target Date**	**Responsible Party**	**Estimated Cost**
1	TPP0 using KMK as a storage basin for cooling water instead of spray basins	Thermal pollution of KMK	High	TPP0 to use spray basins.	Before commencement of TPP2 project	TPP0 Operational Department	None
2	Bunding is not adequate in the hazardous liquid storage area behind the chemical treatment plant.	Potential leaks of hazardous liquids leading to ground contamination	Medium	The bunding in this area of the site needs to be improved so that it is impermeable and capable of holding at least 110% of the volume of the largest storage tank within the bund.	15 December, 2017.	TPP0 Maintenance Department.	$2,000.
3	Water quality from the sludge drying pits is not monitored at the immediate discharge point from the pit.	Potential contamination of soils and groundwater.	Medium	Water quality from the sludge drying pits need to be tested on a regular basis at the immediate discharge point from the pits to drain K-3-2. Parameters shall include all required by IFC EHS Guidelines for Thermal Power Plants (2017) Table 5 – Effluent Guidelines.	1 November, 2017	TPP0 EM	None, part of general TPP0 responsibilities.
4	The sludge pit needs to be rehabilitated to ensure that there are no leaks from the pits that could contaminate the soils around the pits.	Potential contamination of soils and groundwater.	Medium	The sludge from the existing pit should be replaced in the adjacent empty sludge drying pit while repairs area made to the existing pit. The	15 December, 2017	TPP0 EM	None, part of general TPP0 responsibilities.

Table F-1: Corrective Actions for TPP0 – Operational Phase							
#	**Remark**	**Risk**	**Significance**	**Corrective Action**	**Target Date**	**Responsible Party**	**Estimated Cost**
				pipeline to the pit also needs to be replaced so that it no longer leaks and to reduce elevated levels of iron in discharge water.			
5	The correct PPE needs to be worn at all times by staff.	Injuries to staff.	Low / Medium	Ensure that appropriate PPE is worn by all staff through regular (daily) inspections.	With immediate effect.	TPP0 Health and safety Department.	None, part of general TPP0 responsibilities.
6	According to TPP0 Environmental Manager and the Environmental Protection Department of UE in Tashkent, there is no asbestos containing materials in TPP0.	Despite the comments of TPP0 staff and UE, it is possible that asbestos containing materials could be present at TPP0. This may represent a risk to human health when any portion of TPP0 is decommissioned or refurbished.	Low / Medium	Prior to any decommissioning or major refurbishment works in any part of TPP0 an asbestos survey should be undertaken. If the survey identifies any asbestos it should be removed by a company licensed to handle and dispose such materials.	Prior to any decommissioning or major refurbishment works	TPP0 Health and safety Department. Licensed asbestos disposal contractors	TBD.
7	No on-site ambulance.	Workers not getting adequate treatment in time.	Low / medium	TPC shall have an on-site ambulance for emergencies, staffed 24 hours a day.	By end of 2017.	UE	$25,000
8	No dedicated waste management plan.	Soil contamination.	Low	A waste management plan should be established as part of an overarching Environmental Management System.	By end of 2017.	UE EPD & External environmental consultants.	$50,000 for ESMS for TPC

Table F-1: Corrective Actions for TPP0 – Operational Phase							
#	**Remark**	**Risk**	**Significance**	**Corrective Action**	**Target Date**	**Responsible Party**	**Estimated Cost**
8	Water quality from the sewage treatment plant	Elevated levels of effluent in K-3-2 drain	Low	Ensure all IFC water quality parameters are monitored at the sewage treatment plant discharge	By end of 2017.	TPP0 EM	None, part of TPP0 EMs responsibilities.
9	Elevated noise at the boundary of TPC	No receptors have been identified that will be affected by thus issue, however it is a compliance risk.	Low	To ensure that TPP0 meets noise limits of 70 dBA at the boundary of the TPC, including the southern boundary TPP0 shall undertake a comprehensive noise survey around TPP0 to identify the sources of noise that result in noise levels at the boundary of the site exceeding 70dBA. TPP0 will then prepare mitigation measures to reduce to the noise levels to acceptable standards.	1st January, 2017	TPP0 EM	$10,000 for noise survey. Unknown costs for noise mitigation.
10	There are no calculations of CO_2 emissions from TPP.	None.	Negligible	Calculate annual CO_2 emissions and report as part of an ESMS.	By end of 2017.	TPP0 EM	None, part of TPP0 EMs responsibilities.
11	Air quality monitoring is only undertaken, or the results reported, three times per month.	None.	Negligible	Report, or record, daily maximum NOx levels as part of an ESMS. This is not a regulatory requirement, but is considered best practice.	By end of 2017.	TPP0 EM	None, part of TPP0 EMs responsibilities.

Table F-2: Corrective Actions for TPP1 - Operational Phase							
#	**Remark**	**Risk**	**Significance**	**Corrective Action**	**Target Date**	**Responsible Party**	**Estimated Cost**
1	TPP1 EIA does not comply with IFC guidelines for thermal discharge	IFC thermal pollution limits breached.	Medium to High	Ensure that TPP1 thermal discharge meets IFC standards.	December, 2017	UE EPD	The same costs as the thermal discharge monitoring equipment recommended for TPP2. If TPP2 moves ahead no further equipment purchase will be required as TPC will share the data.
2	Potential lack of capacity to manage the additional environmental workload (e.g. monitoring) at the site.	Potential accidents, pollution incidents and regulatory non-compliance	Medium to High	Ensure UE has adequate staff in place to manage environmental aspects of TPP1 during its operation phase.	December, 2017.	UE EPD	1 Deputy EM / $2,000 per month.
3	No procedures for the safe management of hazardous materials have been recommended for the operational phase.	Potential contamination of soils and water. Impacts to health of workers.	Medium	Prepare a hazardous materials management plan as part of an overarching ESMS for TPP1 and TPP0.	December, 2017	UE EPD & External environmental consultants.	Included in the EMS costs for TPP0 operational phase corrective actions above.
4	There are no specific requirements or recommendations for waste management in the operational phase.	Potential regulatory non-compliance and general pollution of the surrounding area.	Medium	Prepare a waste management plan as part of an overarching ESMS for TPP1 and TPP0.	December, 2017	UE EPD & External environmental consultants.	Included in the EMS costs for TPP0 operational phase corrective actions above.

Table F-2: Corrective Actions for TPP1 - Operational Phase							
#	**Remark**	**Risk**	**Significance**	**Corrective Action**	**Target Date**	**Responsible Party**	**Estimated Cost**
5	Inadequate instrumental monitoring recommended for the operational phase.	Potential regulatory non-compliance, water and air pollution.	Medium	Ambient Air Quality Monitoring in Nuriston and Mekhnatabad on a monthly basis. Parameters include: SO_2, NOx, NO_2, CO and Benzene. Noise monitoring (LAeq) at the six locations specified in Appendix G of the TPP2 EIA on a monthly basis (daytime and nighttime). Water Temperature measured daily at 1) discharge point to KMK feeder channel, 2) the immediate mixing point with the KMK and 3) 100 meters downstream of the immediate mixing point. Effluent Discharge at 1) discharge point to KMK feeder channel, 2) 100 meters downstream of the immediate mixing point, 3) Immediate discharge point of the sludge drying pit, 4) Drain K-3-2 and 5)	1 November, 2017	UE EPD.	None.

Table F-2: Corrective Actions for TPP1 - Operational Phase							
#	**Remark**	**Risk**	**Significance**	**Corrective Action**	**Target Date**	**Responsible Party**	**Estimated Cost**
				Discharge from sewage treatment plant. Parameters to be measured include • Suspended Solids • COD • BOD • pH • Dissolved solids • Appearance • Other parameters specified by Oblkompriroda • All parameters specified by IFC Thermal Power Plant EHS Guidelines (2017) – Table 5 Effluent Guidelines.			
6	No requirements are made for an environmental and social management system.	Inability to monitor and control environmental aspects and impacts.	Low to Medium	Prepare an ESMS for the operational phase of TPP1 and TPP0	December, 2017	UE EPD & External environmental consultants.	Included in the EMS costs for TPP0 operational phase corrective actions above.
7	Noise levels are measured against the wrong standards.	Regulatory non-compliance. Elevated noise levels in Nuriston.	Low	Ensure operational noise levels are measures against the correct standards.	June, 2017	UE EPD	None.
8	The assessment of the impact of climate change on the Talimarjan Power Project is insufficient.		Low	As part of TPP2 EIA undertake a more detailed assessment of	Submission date for the TPP2 EIA.	TPP2 EIA Consultant.	None, part of the TPP2 EIA costs.

Table F-2: Corrective Actions for TPP1 - Operational Phase							
#	**Remark**	**Risk**	**Significance**	**Corrective Action**	**Target Date**	**Responsible Party**	**Estimated Cost**
				climate change impacts on the project.			

Table F-3: Corrective Actions Considered for TPP2 as Lesson Learned from TPP1					
#	**Issue Identified During TPP1 Construction Phase**	**Risk to TPP2**	**Risk Significance**	**Corrective Action**	**TPP2 EIA Section**
1	Inadequate environmental reporting by the Contractor.	Regulatory and contractual non-compliance.	Medium to High	1. Improve capacity of PMU to monitor Contractors performance. 2. Engineer to review Contractors initial environmental reports to ensure that all issues are reported correctly. 3. Continuous review of environmental reports by Engineer and PMU to ensure they are adequate.	1. H.2.7 – TPP2 PMU Requirements. 2. H.2.6 – Engineer Requirements. 3. H.2.6 – Engineer Requirements.
2	Outstanding environmental permits.	Regulatory and contractual non-compliance.	Medium to High	1. Engineer and PMU to ensure Contractor has all environmental permits prior to the start of construction works.	1. Table H-1 – Environmental Mitigation and Monitoring Plan / H.2.5 – EPC Contractor Requirements
3	No audits or corrective actions taken by the Contractor relating to environmental matters.	Regulatory and contractual non-compliance.	Medium to High	1. Improve capacity of PMU to monitor Contractors performance. 2. PMU to withhold Contractors payments.	1. H.2.7 – TPP2 PMU Requirements
4	Contractor not providing environmental training.	Impacts to health and safety of workers.	Medium	1. Engineer to review and attend Contractors training program.	1. H.2.6 – Engineer Requirements.
5	Incomplete SSEMP	• Regulatory and contractual non-compliance. • Impacts to health and safety of workers. • Potential pollution incidents.	Medium	1. Engineer and PMU to ensure Contractor has completed his SSEMP prior to the start of construction works.	1. Table H-1 – Environmental Mitigation and Monitoring Plan.

Table F-3: Corrective Actions Considered for TPP2 as Lesson Learned from TPP1					
#	**Issue Identified During TPP1 Construction Phase**	**Risk to TPP2**	**Risk Significance**	**Corrective Action**	**TPP2 EIA Section**
6	No designed waste disposal area meeting the requirements of local environmental regulations and no separate storage for hazardous and non-hazardous waste and no spill kits.	• Regulatory and contractual non-compliance. • Impacts to health and safety of workers. • Potential pollution incidents.	Medium	1. Engineer to ensure Contractor has identified suitable licensed waste disposal sites prior to the start of construction works. 2. Engineer ensure Contractor has constructed suitable hazardous waste storage areas on-site. 3. Spill kits to be provided across the site.	1,2 & 3. Table H-1 – Environmental Mitigation and Monitoring Plan.
7	Water (chemical cleaning water, oily water, etc) discharged to the wrong locations, e.g. sewage network.	• Regulatory non-compliance. • Potential pollution incidents.	Medium	1. Engineer to continuously monitor water quality and inform Contractor of any non-compliance.	1. Table H-2: Construction Phase Instrumental Monitoring / Table H-3: Commissioning Phase Instrumental Monitoring
8	Water and wastewater analysis data not provided in the monthly environmental reports.	• Regulatory non-compliance. • Potential pollution incidents.	Medium	1. Engineer to undertake monitoring of water quality.	1. Table H-2: Construction Phase Instrumental Monitoring / Table H-3: Commissioning Phase Instrumental Monitoring
9	Inadequate vehicle washing area.	• Potential pollution incidents.	Low to Medium	1. Vehicle wash bay built to best practice standards.	1. G.8.4 – Construction Camps and Batching Plants / Appendix F
10	Inadequate concrete batching yard.	• Potential pollution incidents, air and water.	Low to Medium	1. Batching yard built to best practice standards.	1. G.8.4 – Construction Camps and Batching Plants
11	Borrow pits being used as un-official dump sites.	• Potential pollution incidents.	Low to Medium	1. Regular inspection of the borrow pits by the Engineer. 2. Removal of any waste materials by borrow pit operator.	1. G.8.5 – Borrow Pits / Table H-1 – Environmental Mitigation and Monitoring Plan.

Table F-3: Corrective Actions Considered for TPP2 as Lesson Learned from TPP1					
#	**Issue Identified During TPP1 Construction Phase**	**Risk to TPP2**	**Risk Significance**	**Corrective Action**	**TPP2 EIA Section**
12	No MSDS are provided at work sites.	• Impacts to health and safety of workers. • Potential pollution incidents.	Low to Medium	1. Ensure Contractor keeps copies of MSDS with all hazardous materials.	1. G.6.5 – Soils / Table H-1 – Environmental Mitigation and Monitoring Plan.
13	Drinking water for workers not filtered in construction site to provide clean potable water supply to workers.	Impacts to health of workers.	Low to Medium	1. Ensure Contractor provides filtered potable water to workers.	1. Table H-1 – Environmental Mitigation and Monitoring Plan.
14	Air quality monitoring not undertaken.	Impacts to workers and local community.	Low to Medium	1. Implement air quality monitoring program. 2. Withhold payments for any non-compliance.	1. Table H-2: Construction Phase Instrumental Monitoring / Table H-3: Commissioning Phase Instrumental Monitoring
15	No inventory for wastes generated, and their disposal methods.	Potential pollution incidents.	Low to Medium	1. Contractor to provide an inventory of wastes generated and disposal methods in his monthly reports.	1. Table H-1 – Environmental Mitigation and Monitoring Plan.
16	The standards used for noise monitoring and the certification of equipment not provided.	Regulatory and contractual non-compliance.	Low	1. Contractor to provide information on standards and calibration of equipment in his monthly reports.	1. H.4 – Instrumental Monitoring Plan
18	Not monitoring all waste streams and neglecting to report on the volumes of other waste produced, e.g. hazardous waste.	Regulatory non-compliance	Low	1. Contractor to monitor all waste streams throughout construction, including volumes of different waste types. 2. Results to be provided in monthly reports.	1. Table H-1 – Environmental Mitigation and Monitoring Plan.
19	Borrow Pit restoration	None	Low	1. Contractor to re-instate the borrow pit according to the terms of his contract.	N/A

G. Potential Environmental Impacts and Mitigation Measures

G.1 Introduction

467. This section of the EIA details the Projects potential impacts and proposes mitigation measures to limit any negative impacts identified. The first items discuss the types and phases of the impacts. The report then presents the impacts and mitigation in detail for the Project in the subsections as follows:

- Physical Resources
  - Air quality
  - Air Dispersion Model
  - Climate Change
  - Topography
  - Soils
  - Surface Water Hydrology
  - Groundwater Hydrology
  - Geology & Sesmicity
- Ecological Resources
  - Flora
  - Avifauna
  - Fauna
  - Protected areas
- Economic Development
  - Infrastructure & Transportation Facilities
  - Land Use
  - Waste Management
  - Construction Camps and Batching Plants
  - Borrow Pits
- Social and Cultural Resources
  - Employment Creation, Skills Enhancement and Local Business Opportunities
  - Workers Rights and OHS
  - Community Health and Safety
  - Emergency Response Planning
  - Physical and Cultural Resources
  - Noise
- Compliance Impacts

G.2 Impact Phases

468. This impact assessment and mitigating measures cover the entire cycle of the project activities, from pre-construction to construction and operation and maintenance. The coverage of each of this sub-project phases is defined as follows:

- Pre-construction Phase
- Construction Phase
- Commissioning Phase
- Operation Phase

469. 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 with the exception of a greater emphasis on waste disposal. This is a logical statement since construction and decommissioning include analogous activities and it is just the sequence of them that is inverse. Therefore, only construction phase impacts are assessed at this stage.

G.3 Types of Impacts

470. The types of impacts that may arise during Project works can be classified as follows:

- Direct Impacts - i.e., those directly due to the Project itself such as the impacts to air quality resulting from construction activities, equipment and vehicles and plant operation. Direct impacts also include the impact of construction expenditures in the local economy.
- Indirect Impacts - i.e., those resulting from activities prompted by the Project, but not directly attributable to it. The use of rock and other construction materials, for example, has an indirect impact of increasing the demand for these materials.
- Cumulative Impacts - i.e., impacts in conjunction with other activities. A single power plant may not exert a significant impact to air emissions, but if several power plants are developed in the same area the cumulative or additive effect of air emissions could be more significant.
- Compliance Impacts – i.e. impacts that would occur if correct compliance mechanisms are not enforced.

471. Impacts in all of these categories may be either:

- Short-term – i.e., impacts which occur during construction and affect land use, air quality and other factors. Many of these impacts, however, will be short-lived and without long-lasting effects. Even the effects of some relatively significant impacts such as borrow pits, for example, may be eventually erased if appropriate mitigation actions are taken. Many potential short-term negative impacts can be avoided or otherwise mitigated through proper engineering designs and by requiring Contractors to apply environmentally appropriate construction methods. Or;
- Long-term – i.e., construction impacts that could, for example, affect regional air quality if poor design practices are used.

472. Both short-term and long-term impacts may be either beneficial or adverse. Short-term positive impacts will include, for example, the generation of employment opportunities during construction period. Long-term benefits will include enhanced development opportunities, improved air quality, improved reliability of electricity supply, etc.

G.4 Mitigation Aspects

473. Mitigation is recommended through strategic avoidance combined with construction monitoring. Bid and contract documents are recommended to specify that a Site Specific EMP (SSEMP) shall be required for the Project. The EPC Contractor shall ensure that the SSEMP is submitted to the Engineer for review at least 10 days before taking possession of any work site. No access to the site will be allowed until the SSEMP is reviewed and approved by the Engineer and EA.

G.5 Summary of Impacts

474. **Table G.1** provides a summary of the potential Project impacts that are discussed in detail under **Sections G.6** to **G.8**.

Table G-1: Summary Potential Impact Table

	Physical Characteristic						**Biological Characteristic**			**Socio-economic Characteristic**						
	Geology & Seismicity	Topography	Soils	Climate	Air Quality	Hydrology	Flora	Fauna	Avifauna	Infrastructure & Transport	Industry and Agriculture	Waste Management	Socio-economic	Community Health & Safety	Occupational Health and Safety	Noise Level
Construction Phase																
Borrow Pits			S/D		S/D					S/D				S/D	S/D	S/D
Batching Plants					S/D	S/D				S/D		S/D		S/D	S/D	S/D
Construction Camp					S/D	S/D				S/D		S/D		S/D	S/D	S/D
Storage Areas					S/D	S/D				S/D					S/D	
Haul Routes					S/D					S/D				S/D		S/D
Site Clearance & Earthworks					S/D					S/D		S/D			S/D	S/D
General Site Construction												S/D			S/D	S/D
Commissioning Phase																
Noise														S/D	S/D	S/D
Air emissions					S/D									S/D	S/D	
Operational Phase																
Noise														L/D	L/D	L/D
Water Use						L/D		L/D								
Air emissions					L/D									L/D	L/D	
Solid Waste												L/D				
Hazardous Materials			S/D			S/D								L/D	L/D	
Liquid Waste			S/D			S/D		L/D				L/D				

D = Direct Impact	S = Short-term Impact	L= Long term Impact		Potential Positive Impact		Potential Low/Medium Impact		Potential High Impact

G.6 Physical Resources

G.6.1 Air quality

Potential Air Quality Impacts

475. The potential impacts of the Project to air quality are described as follows:

Construction Phase

476. During construction of TPP2, air quality is likely to be degraded by a range of activities including:

- Exhaust emissions from the operation of construction machinery and construction and transportation vehicles (e.g. NO_X, SO_X and CO);
- Open burning of waste materials; and
- Dust (Particulate Matter (PM)) generated from excavation works, quarries, borrow pits, concrete batching plants, haul roads, unpaved roads, exposed soils and material stock-piles. It should be noted that naturally dusty conditions do occur in the Project area, especially during the summer months.

Commissioning Phase

477. During the commissioning phase of the Project air quality can be degraded by elevated levels of NO_X during the testing of the gas turbines. This was noted as a concern of locals during the construction phase of TPP1.

Operational Phase

478. Ambient air quality monitoring undertaken for this EIA (**Table E-2**) show that the levels of NO_X and CO in Nuriston and Mekhnatabad are currently within the national limits for ambient air quality. In addition, emissions from TPP0 are well within the standards set by Goskompriroda. Air dispersion modeling prepared as part of TPP1 EIA for also indicates that operational phase emissions to air will not lead to elevated concentrations above the national standards beyond the boundary of the TPC. The operational phase cumulative impacts of the Project are discussed below under Item **G.6.2 – Air Dispersion Model.** The model concludes that the cumulative air quality impacts of the Project will not exceed any national or EU standards. Accordingly, the Project is not anticipated to result in health impacts to the residents of Nuriston or Mekhnatabad.

Mitigation Actions

Pre-construction Phase

479. To adequately manage air quality impacts during the construction phase, the EPC Contractor shall be responsible for the preparation of an Air Quality Plan. The plan will detail the actions to be taken to minimize dust generation and emissions from vehicles and equipment (e.g. spraying un-surfaced roads with water, covering stock-piles, etc.) and will identify the type, age and standard of equipment to be used and will also provide details of the air quality monitoring program for baseline and routine monitoring. The Plan shall also include contingencies for the accidental release of toxic air pollutants (or shall make reference to the Projects Emergency Response Plan).

Construction Phase

480. To limit air pollution during the construction phase the EPC Contractor will be required to take measures to ensure the following conditions are met:

- *Exhaust emissions* - No furnaces, boilers or other similar plant or equipment using any fuel that may produce air pollutants will be installed without prior written consent of the Engineer. Construction equipment shall be maintained to a good standard and fitted with pollution control devices regularly monitored by the EPC Contractor and Engineer.
- All construction emissions will comply with measures and standards in the general and thermal power EHS guidelines in addition to relevant national guidance.
- *Open burning of waste materials* - No burning of debris or other materials will occur on the Site.
- *Dust generated from haul roads, unpaved roads, material stock piles, etc.* - The EPC Contractor shall ensure that material stockpiles shall be located in sheltered areas and be covered with tarpaulins or other such suitable covering to prevent material becoming airborne. All trucks used for transporting materials to and from the site will be covered with canvas tarpaulins, or other acceptable type cover (which shall be properly secured) to prevent debris and/or materials from falling from or being blown off the vehicle(s). Hard surfaces will be required in construction areas with regular movements of vehicles. Effective use of water sprays will be implemented (e.g., all roads within the construction areas of the Site shall be sprayed at least twice each day, and more if necessary to control dust to the satisfaction of the Engineer).

481. Locations for borrow pits shall require approval from the Engineer and the PMU during the Construction phase. Efforts should be made to ensure that these facilities are as close to the TPC as practical to avoid unnecessary journeys and potential dust issues from vehicle movements during construction works.

482. The concrete batching plant used by TPP1 will be used for TPP2 construction. The batching plant is not located close to any sensitive receptor (more than 700 m from the nearest residential properties within the SPZ and more than 1 kilometer from Nuriston and Mekhnatabad) as such impacts to air quality from the batching plant will be minor.

483. In the unlikely event that a new concrete batching plant is to be opened it shall not be located within one kilometer of any urban area or sensitive receptor.

484. Emissions from on-road and off-road vehicles should comply with national or regional programs. In the absence of these, the following should be considered:

- Regardless of the size or type of vehicle, owners / operators should implement the manufacturer recommended engine maintenance programmes
- Drivers should be instructed on the benefits of driving practices that reduced both the risk of accidents and fuel consumption, including measured acceleration and driving within safe speed limits
- Implement a regular vehicle maintenance and repair program.

Commissioning Phase

485. The EPC Contractor shall be responsible for monitoring the NO_X stack emissions of TPP2 on a daily basis to ensure that elevated levels of NO_X are not degrading the airshed.

Operational Phase

486. Mitigation measures for the operational phase discussed below under Item **G.6.2 – Air Dispersion Model.**

G.6.2 Air Dispersion Model

G.6.2.1 Introduction

487. **Overview** - This report provides an assessment of the potential effects of the TPP2 on local air quality. This assessment has been carried out in accordance with national requirements and international guidelines and addresses the operational impacts resulting from emissions to air.

488. This assessment has been undertaken assuming the Project will consist of two gas turbines with associated heat recovery steam generators and two steam turbines. It has been assumed the project will operate on natural gas and the Project will have an electrical output of 900MW (2x450MW) when operating at full load. The Project will be located on the TPC site.

G.6.2.2 Key Pollutants

489. **Overview** - The combustion of fossil fuel gives rise to a number of pollutants with the potential to negatively affect local air quality. With respect to natural gas (the proposed fuel for the Project), the primary pollutants of concern are:

- Oxides of nitrogen (NO_x)
- Carbon monoxide (CO)

490. The project will not lead to emissions of sulfur dioxide (SO_2). The specification of the natural gas provided in the EPC contract, which the plant has been designed for contains no hydrogen sulfide or sulfur. In addition, fuel samples undertaken during the commissioning phase confirmed that there was no monitored concentrations H_2S or Sulfur in the gas supply Therefore, at worst it is antiquated that there would only be trace levels in the fuel supplied.

491. The project will also not lead to emissions of particulate matter. This is confirmed by the European Commission's Best Available Technique Reference (BREF) document for large combustion plants which states "The efficient combustion of gaseous fuels does not generate particulates".

492. **Oxides of Nitrogen** - Oxides of nitrogen is a term commonly used to describe a mixture of nitric oxide (NO) and nitrogen dioxide (NO_2), referred to collectively as NO_x. These are primarily formed from atmospheric and fuel nitrogen as a result of high temperature combustion. The major sources in most countries are road traffic and power generation.

493. During the process of combustion, atmospheric and fuel nitrogen is partially oxidized via a series of complex reactions to NO. The process is dependent on the

temperature, pressure, oxygen concentration and residence time of the combustion gases in the combustion zone.

494. Most NO_x exhausting from a combustion process is in the form of NO, which is a colorless and tasteless gas. It is readily oxidized to NO_2, a more harmful form of NO_x, by chemical reaction with ozone and other chemicals in the atmosphere.

495. **Carbon Monoxide** - Oxides of nitrogen is a term commonly used to describe a mixture of nitric oxide (NO) and nitrogen dioxide (NO_2), referred to collectively as NO_x. These are primarily formed from atmospheric and fuel nitrogen as a result of high temperature combustion. The major sources in most countries are road traffic and power generation. During the process of combustion, atmospheric and fuel nitrogen is partially oxidized via a series of complex reactions to NO. The process is dependent on the temperature, pressure, oxygen concentration and residence time of the combustion gases in the combustion zone. Most NO_x exhausting from a combustion process is in the form of NO, which is a colorless and tasteless gas. It is readily oxidized to NO_2, a more harmful form of NO_x, by chemical reaction with ozone and other chemicals in the atmosphere.

G.6.2.3 Applicable Legislation

496. **Overview -** International financing is being sought for the Project, therefore, demonstration of compliance with the following international requirements has also been considered:

- The Asian Development Banks (ADB) Safeguard Policy Statement (SPS) (2009).
- International Finance Corporation (IFC) Performance Standards (PS) (2012).
- World Bank Group (WBG) Sector Specific Environmental Health and Safety (EHS) Guidelines.
  - WBG EHS Guidelines for Thermal Power Plants.
  - WBG General EHS Guidelines.

497. **Uzbekistan's Emission Limits** - Within Uzbek legislation, emissions released to the atmosphere are controlled via 'Maximum Permissible Emission's (MPEs) which are defined on a project specific basis. Currently there are no specified standards set for emissions from the Project therefore only emission limits specified within IFC guidance and EU legislation have been presented in **Table D-3** below and applied where appropriate.

498. **The ADB SPS** - The ADB environmental safeguard policy has the principle to *"apply pollution prevention and control technologies consistent with international good practices as reflected in internationally recognized standards such as the WBG's EHS Guidelines".* The policy statement requires that if host countries standards differ from values set out within such documents a project is expected to achieve the most stringent. The policy statement requires that *"when the project has the potential to constitute a significant source of emissions in an already degraded airshed, strategies that help improve ambient conditions, such as evaluating alternative project locations and considering emissions offsets, will be introduced".*

499. **IFC PSs** - The IFC provides a portfolio of Standards and Guidelines that should be adhered to for any project seeking IFC finance. The IFC PS3: Resource Efficiency

and Pollution Prevention aims: *"to avoid or minimize adverse impacts on human health and the environment by avoiding or minimizing pollution from project activities".* To achieve this, the IFC provides both industry-specific and general guidance on Good International Industry Practice with respect to emissions to air.

500. Relevant IFC standards for emissions to air applicable for the project are presented in the WBG Guidelines for Thermal Power Plants. These Guidelines advise that, with respect to emission limits, when host country regulations differ from the levels presented in the Guidelines, projects are expected to achieve whichever is more stringent. **Table G-2** provides a summary of the relevant international emission limits applicable to the Project.

Table G-2: Summary of Applicable Emission Limit Values (mg/Nm³)

Fuel	**Pollutant**	**IFC Guidelines[a]**	
		Non-degraded airshed (NDA)	**Degraded airshed (DA)[b]**
Natural Gas	NO_x	51 (25ppm)	51 (25 ppm)

Notes: [a] WBG EHS Guidelines for Thermal Power Plants. Nm³ is at 0ºC, dry, 15% O2, 1 atmospheric pressure

[b] An airshed is considered to be degraded if nationally legislated air quality standards are exceeded significantly.

501. **Uzbekistan Ambient Air Quality Standards** - Uzbekistan has developed a unified system of ambient air quality standards applicable to all regions across the country and are referred to as the 'Maximum Allowable Concentrations' (MACs). The MACs define the amount of the pollutant in ambient air which will prevent an impact on human health or the environment as a results of direct contact or exposure.

502. MACs have been developed by the Ministry of Health and are summarized in SanPiN RUz No.0179-04 – *'Hygienic norms: List Maximum Allowable Concentrations (MACs) of pollutants in ambient air of communities in the Republic of Uzbekistan'*. Relevant MACs are presented in **Table G-3**.

503. **International Standards** - The WBG 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 such as the EU which have been used to supplement national standards in this assessment.

504. Where a host country's legislated standards are less stringent than 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. Uzbekistan's ambient air quality standards are in some cases more stringent than the WHO guidelines and other internationally recognized sources.

505. The WBG General EHS Guidelines suggest that, as a general rule, emissions should not contribute more than 25 percent of the relevant air quality standards to allow additional, future sustainable development in the same airshed. It also states that projects located within poor quality airsheds (if the nationally legislated standards are exceeded significantly), should ensure that any increase in pollution is as small as

feasible, and amounts to a fraction of the applicable short term and annual average air quality guidelines established in the project-specific environmental assessment.

506. The impacts of the Project have been discussed in the context of this approach.

507. **Summary** - **Table G-3** provides a summary of the ambient air quality standards that have been applied to the proposed Project. Model results have been presented against the Uzbek and EU ambient air quality standards as the EU standards also provide a one hour standard which is absent in the national standards and impacts averaged over a one hour time period is considered a key period for determining project impacts.

Table G-3: Summary of Relevant Air Quality Standards

Pollutant	Averaging Period	Uzbek Standard[(a)]	EU Standard[(b)]
Nitrogen Dioxide (NO_2)	30 minutes	**85**	-
	1 hour	-	**200**[(d)]
	24 hours	**60**	-
	1 month	**50**	-
	Annual	**40**	**40**
Oxides of Nitrogen (NO_x)[(c)]	30 minutes	600	-
	24 hours	250	-
	1 month	120	-
	Annual	60	30[(e)]

Notes: Bold text indicates the primary standards that the Project has been assessed against
[(a)] SanPiN RUz No.0179-04
[(b)] EU Directive 2008/50/EC on ambient air quality and cleaner air for Europe.
[(c)] NOx is interpreted as NO within Uzbekistan. Modeling results have been compared to NO_2 standards only as these are more stringent.
[(d)] To be achieved 99.79% of the year.
[(e)] For the protection of vegetation and not for human health.

G.6.2.4 Assessment Methodology

508. **Overview** - This section provides an overview of the assessment approach taken and the inputs used within the dispersion modeling.

509. **Dispersion Model** - A number of commercially available dispersion models are able to predict ground level concentrations arising from emissions to atmosphere from elevated point sources such as a power plant. A new generation dispersion model - AERMOD (executable version 15181) was used to inform the basis of the air quality assessment. A model description is included below.

510. A committee, AERMIC (the American Meteorological Society / Environmental Protection Agency Regulatory Model Improvement Committee), was formed to introduce state-of-the-art modeling concepts into the US Environmental Protection Agency's local-scale air quality models. AERMIC's focus was on a new platform for regulatory steady-state plume modeling. AERMOD was designed to treat both surface and elevated sources in simple and complex terrain.

511. Special features of AERMOD include its ability to treat the vertical heterogeneity nature of the planetary boundary layer, special treatment of surface releases, irregularly-shaped area sources and limitation of vertical mixing in the stable boundary layer.

512. AERMOD is a modeling system with three separate components and these are as follows:

- AERMOD (AERMIC Dispersion Model)
- AERMAP (AERMOD Terrain Pre-processor)
- AERMET (AERMOD Meteorological Pre-processor).

513. AERMET is the meteorological pre-processor for AERMOD. Input data can come from hourly cloud cover observations, surface meteorological observations and twice-a-day upper air soundings. Output includes surface meteorological observations and parameters and vertical profiles of several atmospheric parameters.

514. AERMAP is a terrain pre-processor designed to simplify and standardize the input of terrain data for AERMOD. Input data include receptor terrain elevation data. For each receptor, the output includes a location and height scale, which is an elevation used for the computation of air-flow around hills.

515. **Stack Height Determination** - The purpose of a stack height determination is to calculate the height necessary to ensure that emissions from a stack do not result in excessive ground level concentrations of air pollutants as a result of atmospheric downwash, eddies or wakes which may be created by nearby structures or terrain.

516. Nearby structures are normally the dominant cause of any atmospheric downwash, eddies or wake effects. For proper dispersion to occur it is necessary for the emissions to be released well above the top of nearby structures. Dispersion of emissions from a stack is also determined by the emission characteristics of the source, particularly their temperature and speed when they exit the stack.

517. A number of methods are available to determine an appropriate stack height, including simple equations and dispersion modeling. In this case the stack height has been determined by dispersion modeling as detailed below.

518. The results of the stack height determination are presented in **Appendix K** and concluded that a stack height of 85 meters is appropriate. Modeling has been undertaken assuming this stack height for the future operating situations. It should be noted that the bypass stacks are also designed to be 85 meters. Flue gas parameters such as temperature and exit velocity are much greater in open cycle mode compared to combined cycle mode, therefore air quality impacts are reduced and these stacks have not been considered further within the assessment of stack height or impacts.

519. **Current and Future Operating Situations** - To account for the future operation of TPP1, ambient concentrations for a 'future baseline' have been assessed. In addition, the impacts of the Project in isolation and the cumulative impacts have also been considered. The following situations have been assessed:

- Operating situation 1 – The future baseline based on the operation of TPP and TPP1 firing on natural gas continuously all year.

- Operating situation 2 – The Project in isolation firing on natural gas continuously all year.
- Operating situation 3 – The cumulative impacts from the operation of the Project, TPP and TPP1.

520. In all operating situations it has been conservatively assumed that all plant will operate at 100% plant load for the whole year to account for the worst case short term impacts. However, it is likely that, at various intervals, individual units or whole plants will not operate due to periods of shut down (planned or unplanned). Therefore, predicted annual mean impacts presented in this assessment are likely to be higher than will be experienced during the operation phase.

521. Considering the location of TPP, TPP1 and TPP2 in relation to the SGCC there will be no significant cumulative effects. This is because they are approximately 15 km apart and, as the modeling presented below shows the Project's impacts are located within approximately 2km, will not interact with emissions from the SGCC due to the distances involved and the prevailing wind direction in the region.

522. **Emissions Data** - Emissions data for TPP have been based on emissions monitoring data collected for TPP and Mott MacDonald assumptions where specific parameters were not available. Emissions for TPP1 have been assumed to be the same as those derived for TPP2. TPP2 emissions data have been calculated based on data provided by GT Pro computer simulations for the likely plant design. The emissions data used within the assessment are presented in **Table G-4**.

523. Emissions of CO have not been assessed further as they are related to poor combustion and therefore will be mitigated through the efficient operation of the Project. Additionally, the relevant ambient standards for CO are significantly higher than those for NO_2 and therefore project impacts are not considered to have the potential for a significant impact.

524. As stated above the project will not lead to emissions of SO_2 or particulates and therefore these have not been modeled as the Project will not affect existing conditions.

525. **Table G-3** presents emission data for TPP, TPP1 and TPP2. It should be noted that the stack height determination for TPP2, presented in **Appendix K** has been carried out for one unit only. The NOx emissions limits for the Project are 50mg/Nm^3 (25ppm) these are consistent with international best practice and the standard guarantees provided by turbine manufactures.

526. As noted above modeling in open cycle mode is not required as impacts will be lower than in combined cycle mode due to the changes in emissions parameters. Therefore, no emissions data for open cycle mode is presented below.

Table G-4: Emissions Data

Parameter	TPP2 (per unit)	TPP1 (per unit)	TPP (multiflue)
Actual Volumetric Flow (Am^3/s)	754.0	754.0	369.5

Normalised Volumetric Flow (Nm^3/s)[(a)]	633.4	633.4	-[(d)]
Efflux Temperature (°C)	91.3	91.3	120
Efflux Velocity (m/s)	15.0	15.0	15.0
Stack Height (m)	85[(c)]	85	270
Stack Diameter (m)	8.0	8.0	24.6
Stack coordinates (m)[b)]	Stack 1: 729179,4262367 Stack 2: 729089,4262348	Stack 1: 729354,4262390 Stack 2: 729273,4262373	729402,4292321
NO_x (mg/Nm^3)	50	50	-[(d)]
NO_x (g/s)	31.7	31.7	71.3[(d)]

Notes: [(a)] Reference conditions: 15 °C, 1atm, Dry.
[(b)] Projection is Universal Transverse Mercator (UTM) Zone 41 North (WGS1984)
[(c)] See Appendix K. Stack Height Determination
[(d)] NO_x mass emissions for TPP have been calculated using TPP monitoring data. Therefore, normalized data is not required.

527. **Meteorological Data** - The most important meteorological parameters governing atmospheric dispersion of pollutants are wind direction, wind speed and atmospheric stability, as described below:

- Wind direction determines the sector of the compass into which the plume is dispersed
- Wind speed affects the distance which the plume travels over time and can affect plume dispersion by increasing initial dilution of pollutants and inhibiting plume rise
- Atmospheric stability is a measure of the turbulence of the air, and particularly of its vertical motion. It therefore affects the spread of the plume as it travels away from the source. New generation dispersion models use a parameter known as the Monin-Obukhov length that, together with wind speed, describes the stability of the atmosphere

528. For meteorological data to be suitable for dispersion modeling purposes, a number of meteorological parameters are measured on an hourly basis. These parameters include wind speed, wind direction, cloud cover and temperature.

529. A review of meteorological data from meteorological stations at Karshi Kanabad airport and Karshi, which are approximately 47km and 36km to the north east of the Project site, showed that the data from these sites is not suitable for use in the dispersion model, primarily due to poor data capture. Other potential meteorological sites with suitable data capture rate are located considerable distance from the project site with large topographical features in between and therefore were not considered appropriate. As no suitable and representative monitored meteorological data is not available for the project site, meteorological data from the prognostic gridded meteorological model 'MM5' was used to generate a pseudo-station in the study area. The generated MM5 data provides 100% data capture for all five modelled years

(2011-2015) and is considered to suitably represent meteorological conditions at the Project site and is considered robust. It should be noted that other prognostic meteorological models are available but any differences in modelling approach would not affect the conclusions of this assessment.

530. **Figure G-1** presents wind roses of the MM5 meteorological data used within the main assessment. The wind roses illustrate that the dominant wind direction is from the north and indicates that the Project emissions will be dispersed to the south and therefore will have a minimal impact on populated areas.

531. **Modeled grids** - This assessment has included modeling of pollutant concentrations across two Cartesian grids. The first grid has a receptor spacing of 100 meters and has been used for the first five kilometers from the Project site. The second grid has a spacing of 300 meters and covers the area that is between five and 15 kilometers from the Project. These grids have been assumed to represent sensitive receptors which are likely to receive the largest change in concentrations of NO_2 associated with the Project.

532. **Surface Roughness and Terrain** - Roughness of the terrain over which a plume passes can have a significant effect on dispersion by altering the velocity profile with height, and the degree of atmospheric turbulence. This is accounted for in the meteorological data processing by a parameter called the 'surface roughness length'.

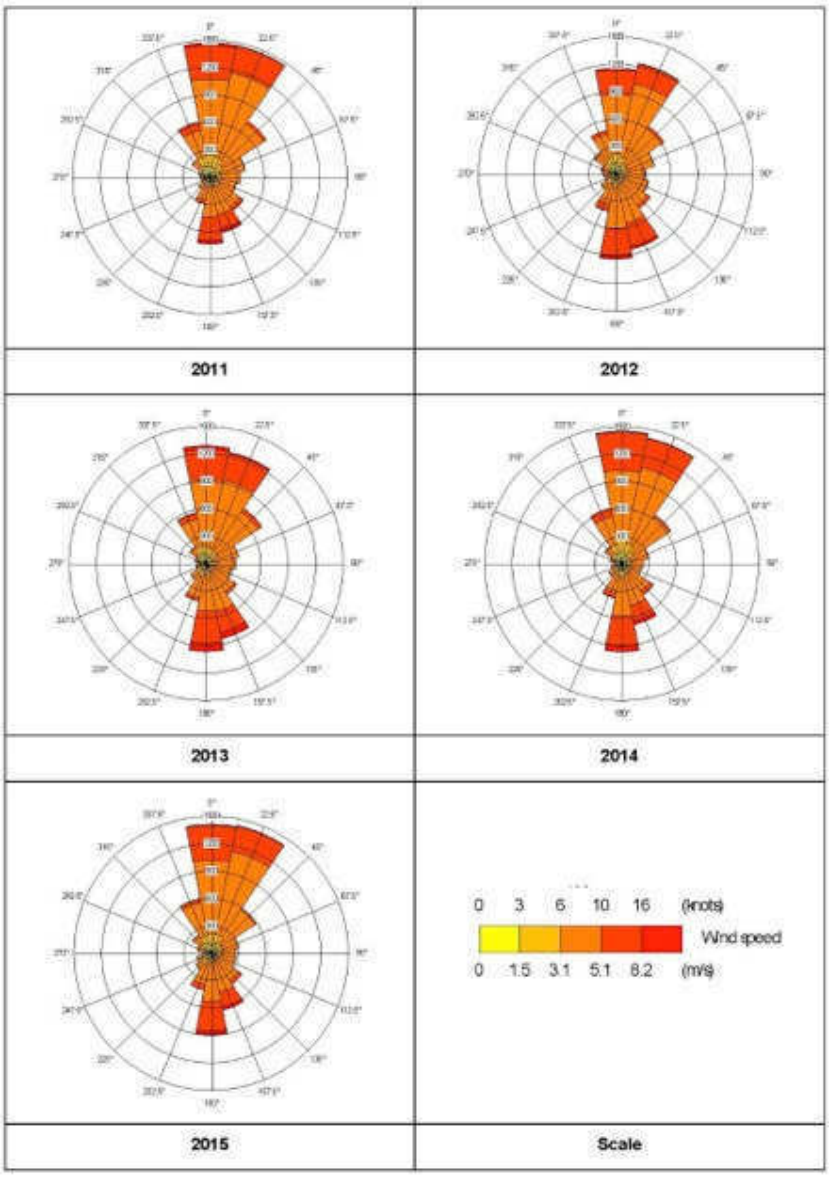
533. The surface roughness length within the study area has been calculated based on the land uses around the meteorological station and calculated within the AERMET meteorological processor.

534. The presence of elevated terrain can significantly affect (usually increase) ground level concentrations of pollutants emitted from elevated sources such as stacks, by reducing the distance between the plume center line and ground level and increasing turbulence and, hence, plume mixing. Terrain has been incorporated into the model with a horizontal spatial resolution of 1 arc second (approximately 25m by 25m).

535. **NO_x to NO_2 relationship** - NO_x emissions associated with combustion sources such as gas turbines will typically comprise of approximately 90-95% NO and 5-10% NO_2 at source. The NO oxidizes in the atmosphere in the presence of sunlight, ozone and volatile organic compounds to form NO_2, which is the principal pollutant of concern with respect to environmental health effects.

536. There are various techniques available for estimating the proportion of the NO_x that is converted to NO_2. A 50% conversion of NO_x to NO_2 has been assumed for short term averaging periods (30 minute, 1 hour and 24 hour), and 70% conversion for long term averages (annual). This approach is considered appropriate based on guidance from the United Kingdom's Environment Agency (EA) and United States Environmental Protection Agency (USEPA).

Figure G-1: Wind roses



Note: Derived from MM5 Data

537. **Buildings and plant layout** - The movement of air over and around buildings generates areas of flow circulation, which can lead to increased ground level concentrations in the building wakes. The buildings likely to have the dominant effect (i.e. with the greatest dimensions likely to promote turbulence) are the heat recovery steam generators and the TPP boiler room which are listed in **Table G-5** and illustrated in **Figure G-2**.

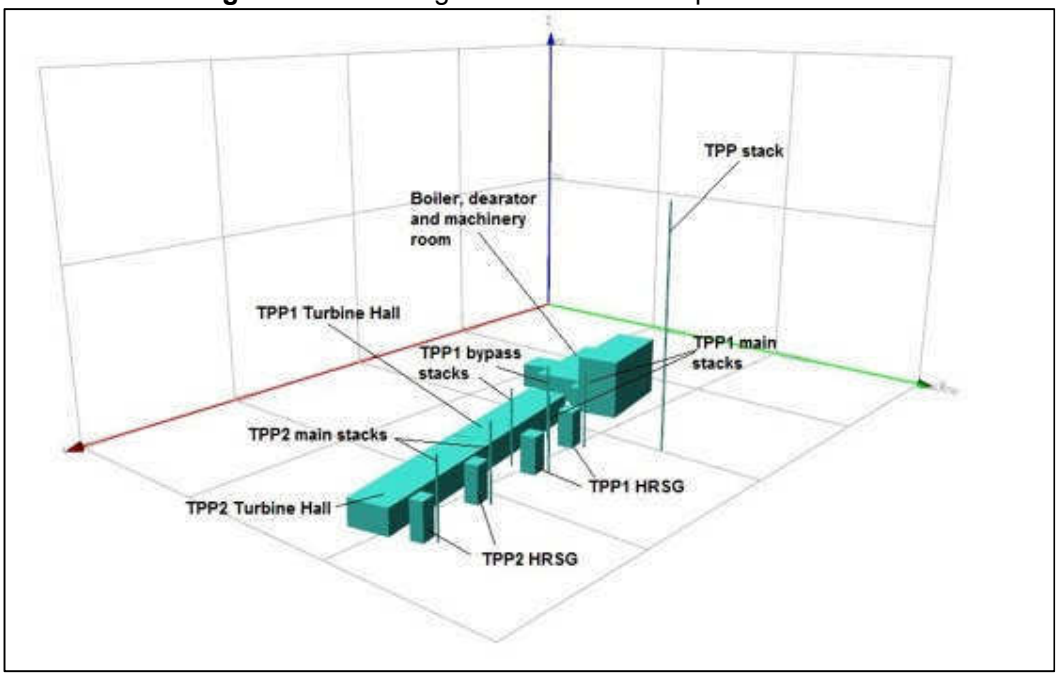
Table G-5: Buildings included within dispersion model

Power Plant	Building	X	Y	Height (m)	Length (m)	Width (m)
TPP2	Turbine Hall	729150	4262434	29	182	46

TPP2	HRSG1	729177	4262383	41	18	17
TPP2	HRSG2	729085	4262364	41	18	17
TPP1	Turbine Hall	729325	4262465	29	168	46
TPP1	HRSG1	729351	4262406	41	18	17
TPP1	HRSG2	729268	4262389	41	18	17
TPP	Boiler Room	729499	4262449	67	106	45
TPP	Deaerator	729515	4262481	28	162	12
TPP	Machinery Room	729521	4262517	29	130	54

Note: Projection is Universal Transverse Mercator (UTM) Zone 41 North (WGS1984)

Figure G-2: Buildings included within dispersion model



538. **Impact assessment criteria** - Guidance has been issued in the UK to assist in determining the significance of operational phase impacts in air quality assessments. This guidance recommends that significance should be determined by a combination of two aspects:

- Change in concentrations (Process Contribution (PC)) caused by the Project at sensitive receptors; and
- Resulting total concentrations (Predicted Environmental Concentrations (PEC)) at sensitive receptors as a percentage of the relevant ambient air quality standard(s).

539. This approach is considered to represent best practice for assessments of this kind and has therefore been adapted in determining the significance of impacts on local air quality from the proposed Project.

540. Changes in ambient concentrations over 25 % of the relevant standards are considered to represent an impact of 'Major' magnitude as the WBG General EHS Guidelines note that Projects should:
"…prevent or minimize impacts by ensuring that …emissions do not contribute a significant portion to the attainment of relevant ambient air quality guidelines or standards. As a general rule, this guideline suggests 25 % of the applicable air quality standards to allow additional future sustainable development in the same airshed." (WBG General EHS Guidelines).

541. The WBG General EHS Guidelines classify 'poor quality airsheds' as those where relevant standards are exceeded significantly. Therefore, receptors experiencing existing ambient pollutant concentrations above the relevant standards are concluded to be of 'High' sensitivity.

542. For each of the key pollutants and averaging periods assessed, a number of ambient air quality standards are applicable.

543. Impact magnitude and receptor sensitivity criteria are presented in **Table G-6** and **Table G-7.**

Table G-6: Determination of impact magnitude – operational phase	
Change in Concentrations as % of Standard	Magnitude
Increase >25%	Major
Increase 15-25%	Moderate
Increase 5-15%	Minor
Increase <5%	Negligible

Table G-7: Determination of receptor sensitivity – operational phase	
Ground Level Pollutant Concentrations in Relation to Standard	Receptor Sensitivity
Above Standard	High
75 to 100% of the Standard	Medium
50 to 75% of the Standard	Low
Below 50% of the Standard	Negligible

544. **Significance** - Based on the methods defined above for determining the magnitude of impact and sensitivity of receptors, the significance matrix presented in **Table G-8** has been applied to determine overall significance.

545. All impact descriptors described as 'moderate' or 'major' are considered to be significant. Notwithstanding the above, any non-negligible increases causing a new exceedance of the relevant standards are considered to represent a significant impact irrespective of their impact magnitude.

Table G-8: Significance Matrix

Sensitivity	Magnitude							
		Adverse				*Beneficial*		
		Major	Moderate	Minor	Negligible	Minor	Moderate	Major
	High	Major	Major	Moderate	Negligible	Moderate	Major	Major
	Medium	Major	Moderate	Minor	Negligible	Minor	Moderate	Major
	Low	Moderate	Minor	Negligible	Negligible	Negligible	Minor	Moderate
	Negligible	Minor	Negligible	Negligible	Negligible	Negligible	Negligible	Minor

G.6.2.5 Baseline Description

546. Overview - This section establishes the ambient baseline pollutant concentrations within the airshed. As described above, the only pollutant of concern for the project during operation is NO_x as other pollutants such as SO_2 and particulates will not be emitted. Therefore, this baseline section has focused on NO_2 only.

547. Existing Baseline Conditions - No ambient monitoring for NO_2 is currently undertaken as part of the TPP or TPP1 projects. To inform the existing baseline conditions a specific monitoring survey was undertaken and the baseline survey undertaken for the proposed gas to liquids gas plant adjacent to the SGCC was reviewed. Although the SGCC is outside of the Project's affected airshed baseline concentrations of NO_2 are likely to be similar between the two areas given the number of emission sources in the region.

548. Ambient air quality monitoring data has been collected by the Uzbekistan Public Health Laboratory from ten locations in the vicinity of the Project, these are shown in **Figure G-3**. Monitoring was undertaken on the 10th January 2017 and therefore the monitored concentrations provide an indicative snapshot of existing ambient concentrations rather than long term averages. During the operational phase of the Project there will be a requirement to undertake monitoring during its lifetime to comply with the requirements of the ADB. The monitored NO_2 concentrations are presented in **Table G-9.**

549. As indicated in **Table G-9** the existing ambient NO_2 concentrations are 0mg/m^3 at all monitored locations considered. Information provided by the Uzbekistan Public Health Laboratory suggested that the weather conditions were windy when the monitoring was undertaken. The Uzbekistan Public Health Laboratory also confirmed that the limit of detection for the monitoring equipment was zero. The results indicate that the existing NO_2 concentrations are likely to be very low in the airshed.

Figure G-3: Ambient Air Quality Monitoring Locations

Table G-9: NO_x Ambient Air Quality Monitoring Results

Site ID	X	Y	Monitored NO_2 Concentration (mg/m^3)
NQ AQ 1	730481	4262384	0.0
NQ AQ 2	730003	4262867	0.0
NQ AQ 3	729833	4263309	0.0
NQ AQ 4	727635	4262971	0.0
NQ AQ 5	727338	4262026	0.0
NQ AQ 6	729790	4262638	0.0
NQ AQ 7	729026	4262267	0.0
NQ AQ 8	730796	4263176	0.0
NQ AQ 9	729599	4261775	0.0
NQ AQ 10	729401	4262409	0.0

Note: Projection is Universal Transverse Mercator (UTM) Zone 41 North (WGS1984)

550. A review of baseline data collected around the SGCC shows that the annual mean NO_2 concentrations were also very low (<1µg/m^3) during the monitoring period. This data is considered to be robust as the data was collected using diffusion tubes for a period of 12 months. This data is consistent with the data collected for the Project.

551. Although it should be noted that long term average NO_2 concentrations are unlikely to be zero in the Project airshed, the results do confirm that the current airshed status can be described as non-degraded. It also confirms that that approach undertaken in this assessment to determine the baseline concentrations through dispersion modeling to account for TPP and the future operation of TPP1 is appropriate to undertake a conservative approach to determine existing baseline conditions.

552. An additional survey was undertaken on 3rd and 4th of November 2017 by the Service monitoring of environmental pollution of Uzhydromet using. The exact methodology and sampling period has not been made avaliable. Spot measurements were undertaken for NO_2 at two locations near to the Project site. The results are presented in **Table E-3**. The concentrations monitored during these spot measurements are low and demonstrate that NO_2 concentrations are well below the short-term air quality standards and demonstrate that it is likely that annual mean concentration of NO_2 are also very low when considering all the data reviewed.

553. **Future Baseline Conditions** - The baseline monitoring undertaken indicates that apart from TPP and TPP1 there are minimal other sources of emissions contributing to ambient NO_2 concentrations.

554. TPP1 is currently under construction and is being commissioned and therefore ambient monitoring undertaken would not fully represent the baseline conditions for when TPP2 becomes operational. In addition, monitoring undertaken to date does not provide long term pollutant concentrations.

555. Therefore, the 'future baseline' conditions have been established through dispersion modeling and the results are described below. The results indicate that the airshed will be non-degraded for NO_2 in the future. This approach is considered appropriate and robust considering the Project location and the likely contribution of pollution from other nearby sources.

556. The specified emission limits that the Project is being designed in accordance with are considered appropriate.

G.6.2.6 Impact Identification

557. **Operating Situation 1: Future Baseline** - This section provides an overview of the likely impacts from the Project. It also presents the future baseline accounting for emissions from TPP and TPP1 and the likely cumulative impacts of all three plants operating simultaneously.

558. This operating situation presents the future baseline of the airshed based on the operation of TPP and TPP1 and assumes continuous full plant load operation and natural gas firing for the whole year.

559. **Table G-10** presents the maximum results from the modeled grids and indicates that the future baseline concentrations will be below the national air quality standards for NO_2. This demonstrates that the airshed will not be non-degraded with the operation of TPP and TPP1. In accordance with the significance criteria assigned to this assessment as the future baseline concentrations are all below 50% of the relevant standards and therefore the sensitivity of the airshed to future change is described as 'negligible'.

Table G-10: Operating Situation 1 – Comparison relevant standards (µg/m^3)

Pollutant	Averaging period	Future modelled baseline	Sensitivity descriptor	National standard	EU standard
NO_2	30 minute[(a)]	22.4	Negligible	85	-
	1 hour 99.79th %ile	14.4	Negligible	-	200
	24 hour	9.7	Negligible	60	-
	Monthly	5.8	Negligible	50	-
	Annual	2.2	Negligible	40	40

Note: All pollutant concentrations and changes rounded to 1 decimal place and presented in micrograms per meter cubed (µg/m^3)
[(a)] Calculated from one hour maximum modeled concentration

560. **Operating Situation 2: The Project** - This operating situation presents the impacts from the Project in isolation and assumes continuous full load operation and natural gas firing.

561. **Table G-11** presents the Projects impacts at the maximum modeled gridded receptor outside the site boundary.

562. The Project's maximum predicted process contributions are below 25% of the national and international standards for all NO_2 averaging periods, with the exception of the 30-minute averaging period, where the maximum process contribution is 26.8%. **Table G-12** presents the modeled top 10 results for the 30-minute averaging periods and shows that there are predicted to be only nine 30-minute periods in the worst meteorological year used in the assessment where the maximum predicted 30-minute average is above 25% of the national standard. The application of the IFC's 25% rule is a suggested approach to allow future sustainable development in an airshed. Therefore, the Project's process contributions are considered to meet the requirements of the IFC EHS guidelines based on:

- the limited number of times that the 30-minute concentrations are above 25% of the standard
- the maximum concentrations are only just above 25% of the standard
- the 30 minute Uzebek standard of 85µg/m^3 is considered extremely stringent when compared to the international standards, such as the EU one hour standard of 200µg/m^3

563. **Table G-11** also presents the Project impacts in accordance with the magnitude descriptors adopted for this assessment.

564. **Figure G-4** to **Figure G-8** present contour plots for the 30 minute, one hour, 24 hour, monthly and annual mean averaging periods and demonstrate that the highest process contributions are at locations close to the proposed Project site and cover a small area. The contour plots show that the process contributions at the nearby residential areas are well below national and international air quality standards.

565. Considering the results of the assessment there is no requirement for further NO_x abatement to be installed as the additional benefits would be disproportionate to

the level of improvement that they would achieve when considering the existing air quality in the airshed and the predicted impacts of TPP2.

Table G-11: Operating Situation 2 – Comparison with legislated Uzbek standard and relevant international standards (µg/m^3)

Pollutant	Averaging period	Process Contribution	% of Standard	Magnitude descriptor	National standard	EU standard
NO_2	30 minute[(a)]	22.8	26.8	Major	85	-
	1 hour 99.79th %ile	13.4	6.7	Minor	-	200
	24 hour	9.1	15.1	Moderate	60	-
	Monthly	4.9	9.9	Minor	50	-
	Annual	1.7	4.4	Negligible	40	40

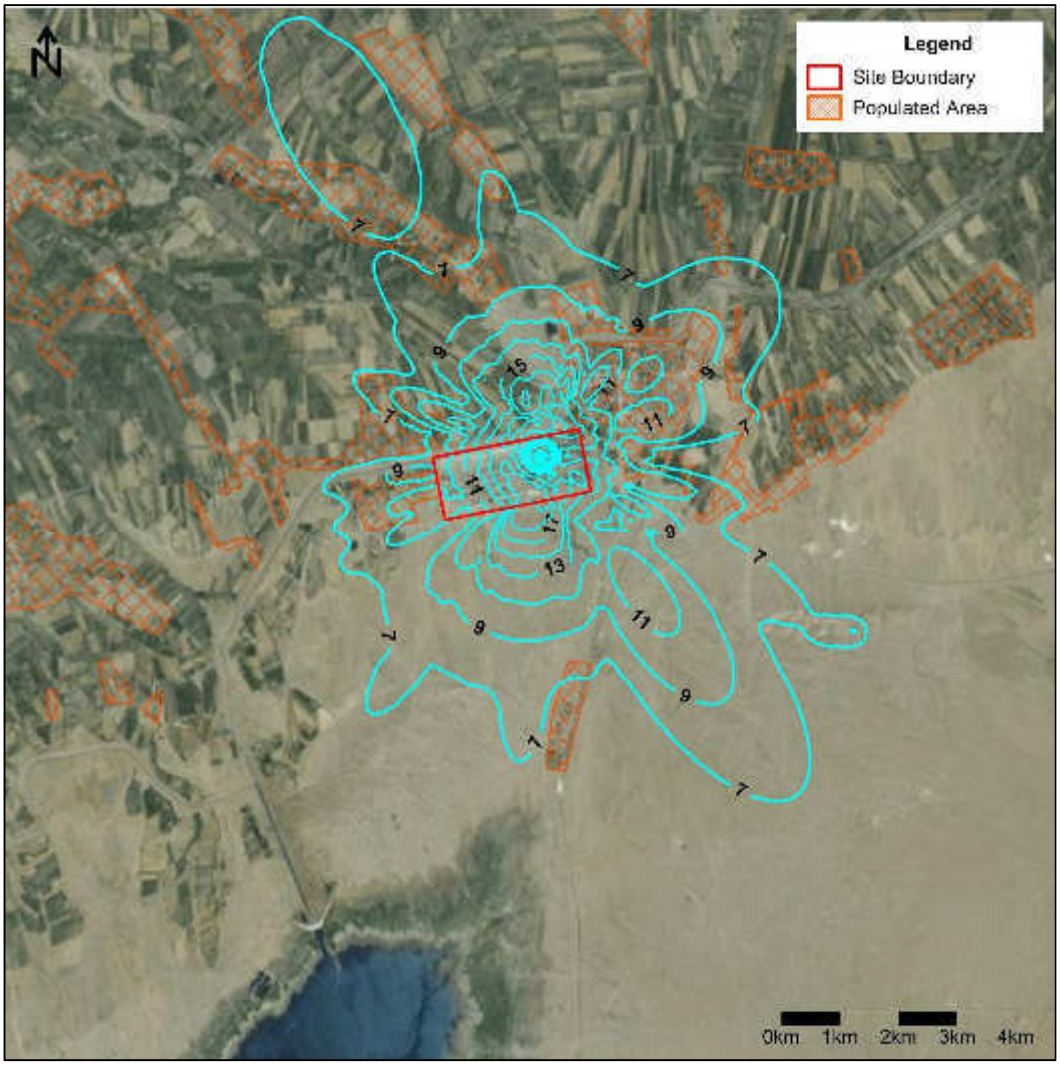
Note: All pollutant concentrations and changes rounded to 1 decimal place and presented in micrograms per meter cubed (µg/m^3)
[(a)] Calculated from one hour maximum modeled concentration

Table G-12: 30 minute NO_2 concentrations – top 10 modeled results (µg/m^3)

Pollutant	Modelled high	Process Contribution	% of Standard
NO_2	1	22.8	26.8
	2	21.5	25.3
	3	21.8	25.6
	4	21.5	25.3
	5	21.8	25.6
	6	21.3	25.1
	7	21.7	25.6
	8	21.3	25.0
	9	21.6	25.4
	10	21.2	24.9

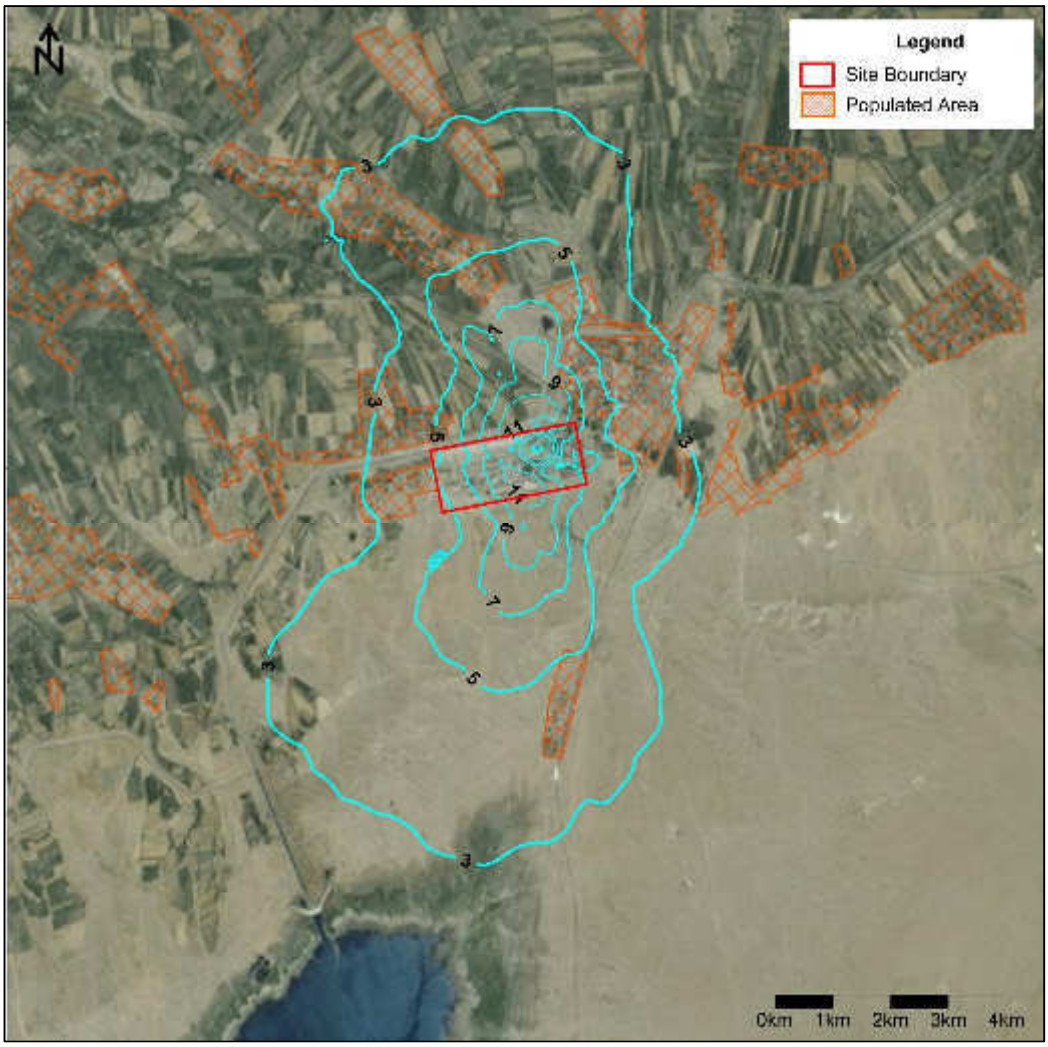
Note: All pollutant concentrations and changes rounded to 1 decimal place and presented in micrograms per metre cubed (µg/m^3)
[(a)] Calculated from one hour maximum modelled concentration

Figure G-4: Operating Situation 2 - 30 minute NO_2 (µg/m^3)



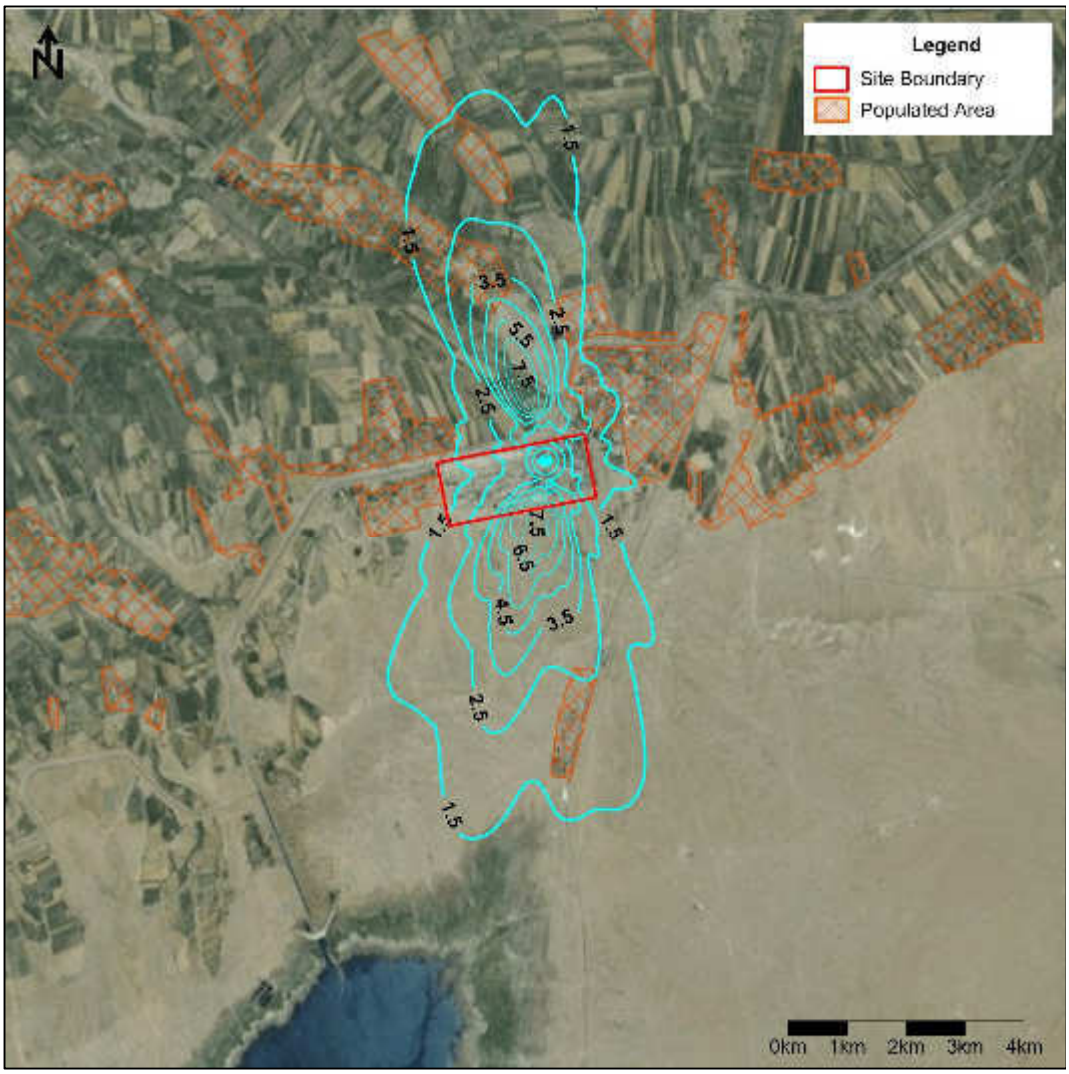
Notes: Contours at 2µg/m^3 intervals, based on 2012 worst case meteorological year

Figure G-5: Operating Situation 2 – one hour 99.79th percentile NO_2 (µg/m^3)



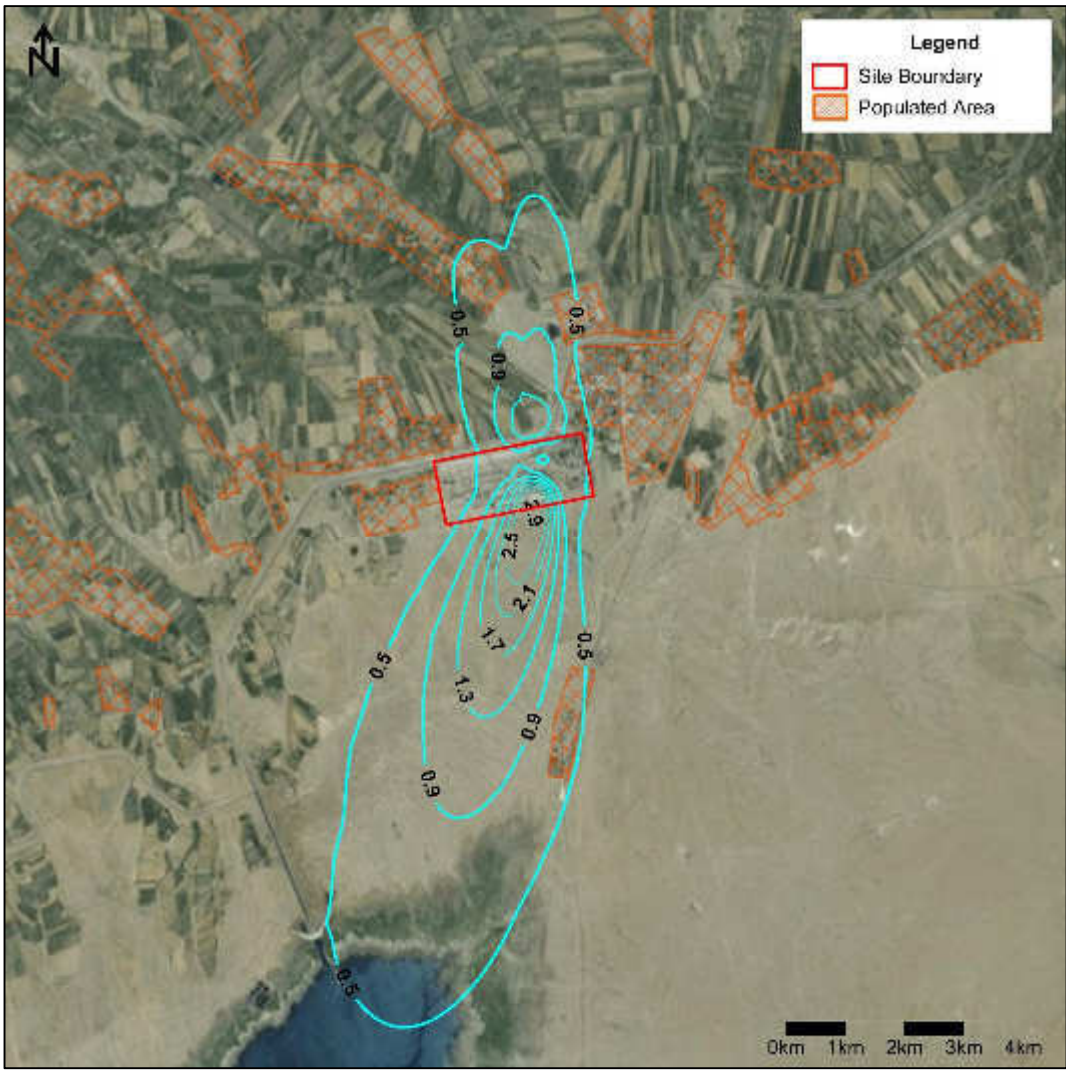
Notes: Contours at 2µg/m^3 intervals, based on 2012 worst case meteorological year

Figure G-6: Operating Situation 2: 24 hour NO_2 (µg/m^3)



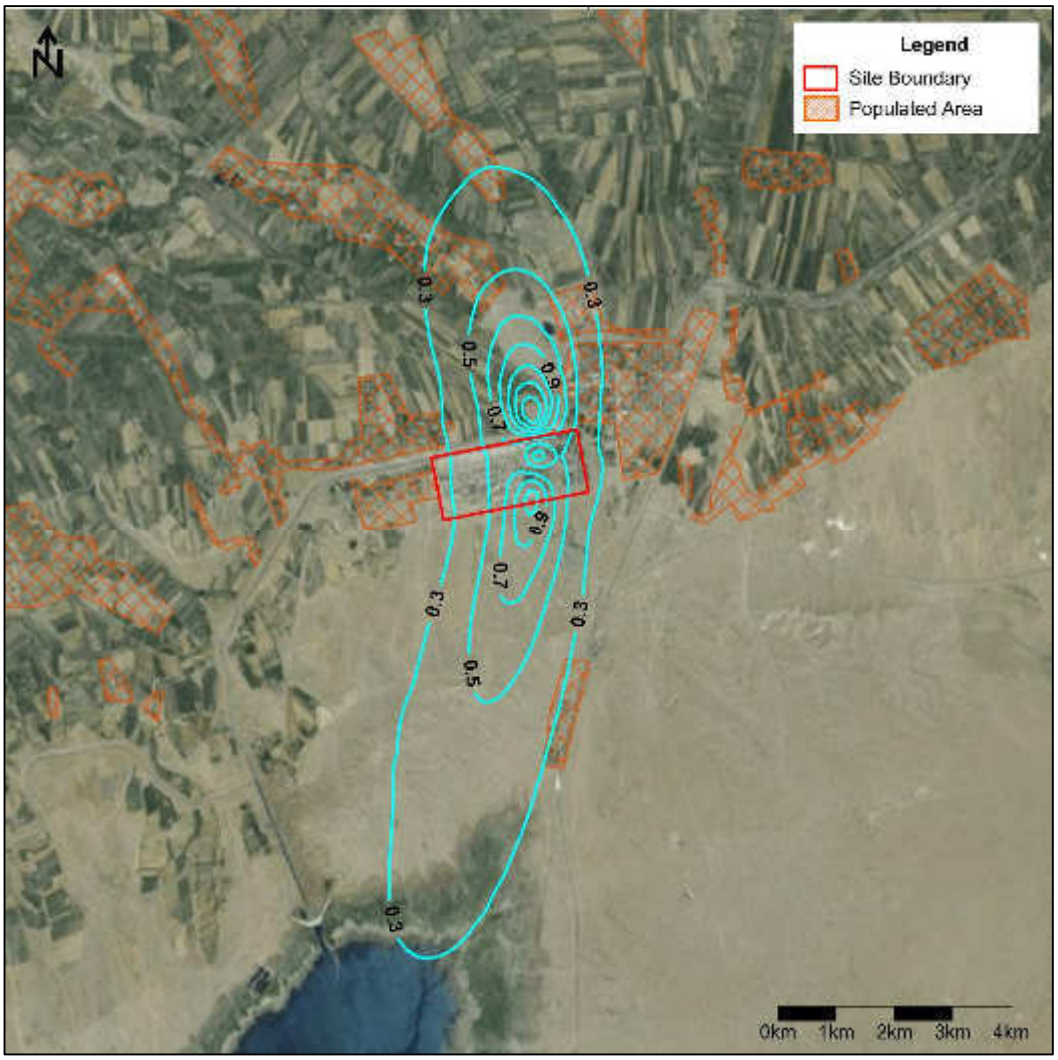
Notes: Contours at 1µg/m^3 intervals, based on 2013 worst case meteorological year

Figure G-7: Operating Situation 2: Monthly NO_2 (µg/m^3)



Notes: Contours at 0.4µg/m^3 intervals, based on 2015 worst case meteorological year

Figure G-8: Operating Situation 2: Annual NO_2 Contour Plot (µg/m^3)



Notes: Contours at 0.2µg/m^3 intervals, based on 2012 worst case meteorological year

566. **Operating Situation 3: Cumulative Impacts** – This operating situation presents the cumulative impacts associated with the operation of TPP, TPP1 and the Project.

567. **Table G-13** presents the Project's impacts at the maximum modeled gridded receptor outside the site boundary. The cumulative maximum concentrations from the Project are well below the national legislated standards at all locations and therefore it can be concluded that the airshed will remain non- degraded.

568. In addition, **Table G-13** also presents the overall significance of the predicted impacts in accordance with the significance criteria adopted for this assessment. This takes account of the sensitivity and magnitude descriptors presented in **Table G-10** and **Table G-11** and the significance matrix presented in **Table G-8**. Overall, the impacts are described as not significant.

569. **Figure G-9** to **Figure G-13** present contour plots for the 30 minute, one hour, 24 hour, monthly and annual mean averaging periods and demonstrate that the

highest process contributions are at locations close to the proposed Project site and cover a small area. The contour plots show that the predicted concentrations at residential areas are well below national and international air quality standards.

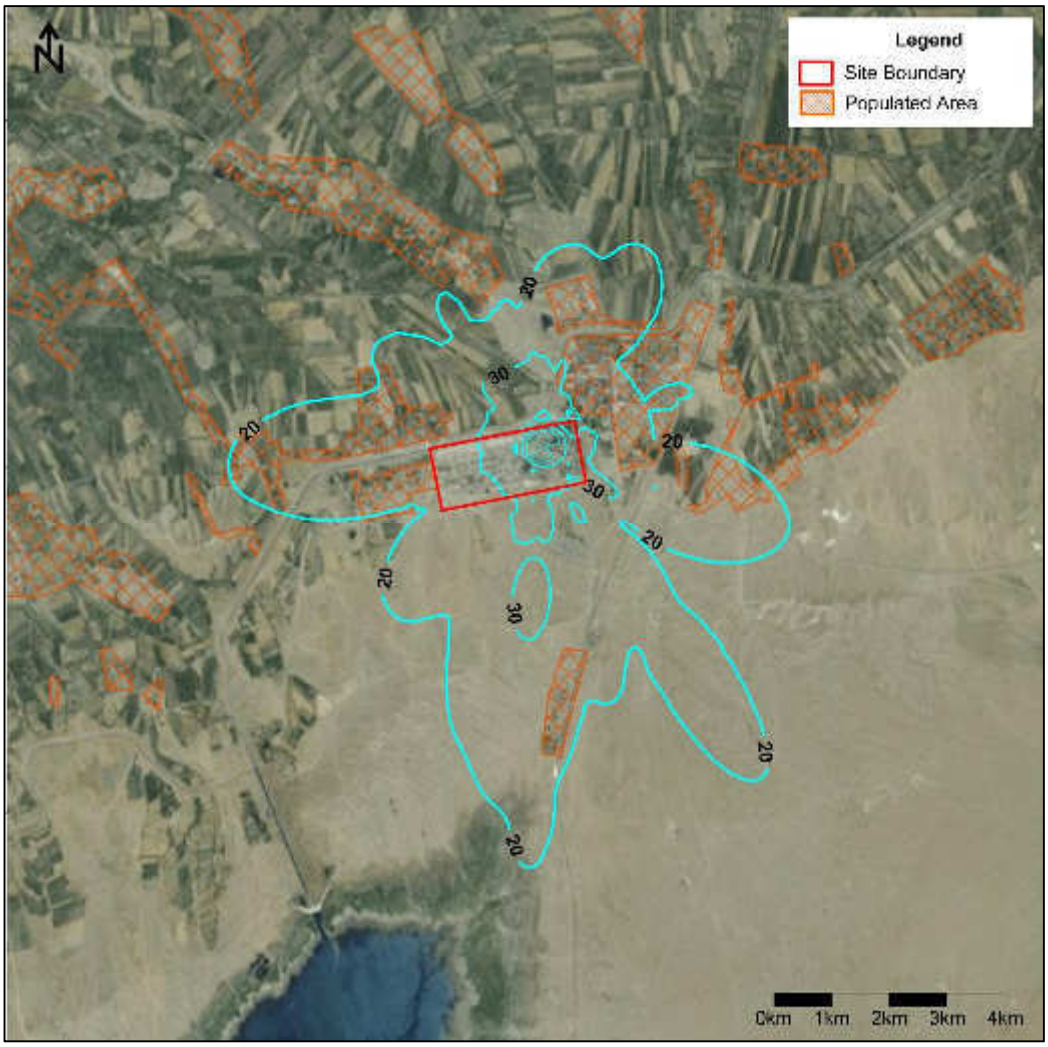
Table G-13: Operating Situation 3 – Comparison with legislated Uzbek standard and relevant international standards (µg/m^3)

Pollutant	Averaging period	Cumulative concentration	Impact magnitude (from scenario 2)	Receptor sensitivity (From scenario 1)	Impact descriptor (Table 3.5)	Significance	National standard	EU standard
NO_2	30 minute[(a)]	41.3	Major	Negligible	Minor	Not significant	85	-
	1 hour 99.79th %ile	25.5	Minor	Negligible	Negligible	Not significant	-	200
	24 hour	17.5	Moderate	Negligible	Negligible	Not significant	60	-
	Monthly	7.6	Minor	Negligible	Negligible	Not significant	50	-
	Annual	3.8	Negligible	Negligible	Negligible	Not significant	40	40

Note: All pollutant concentrations and changes rounded to 1 decimal place and presented in micrograms per meter cubed (µg/m^3)

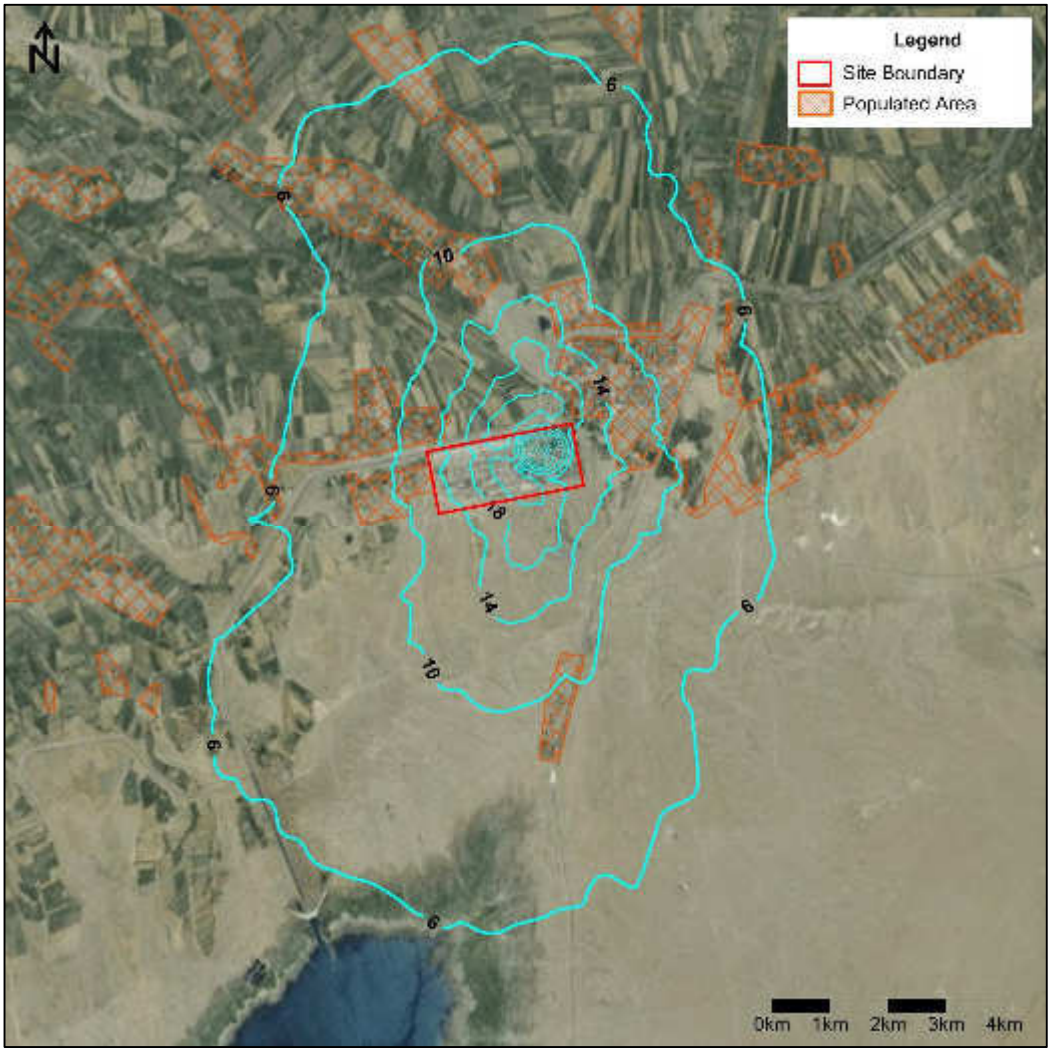
[(a)] Calculated from one hour maximum modeled concentration

Figure G-9: Operating Situation 3 - 30 minute NO_2 (µg/m^3)



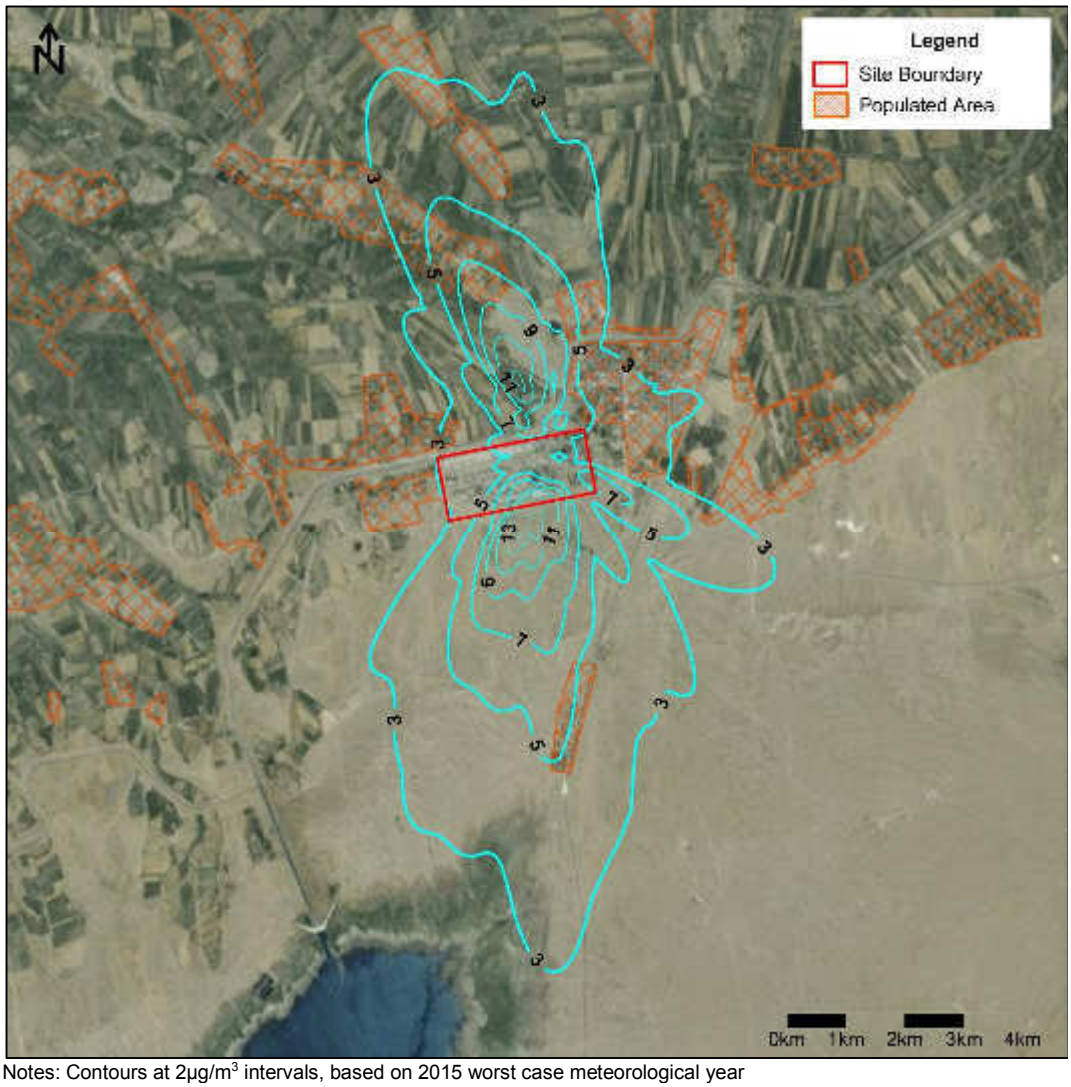
Notes: Contours at 10µg/m^3 intervals, based on 2011 worst case meteorological year

Figure G-10: Operating Situation 3 – one hour 99.79th percentile NO_2 (µg/m^3)



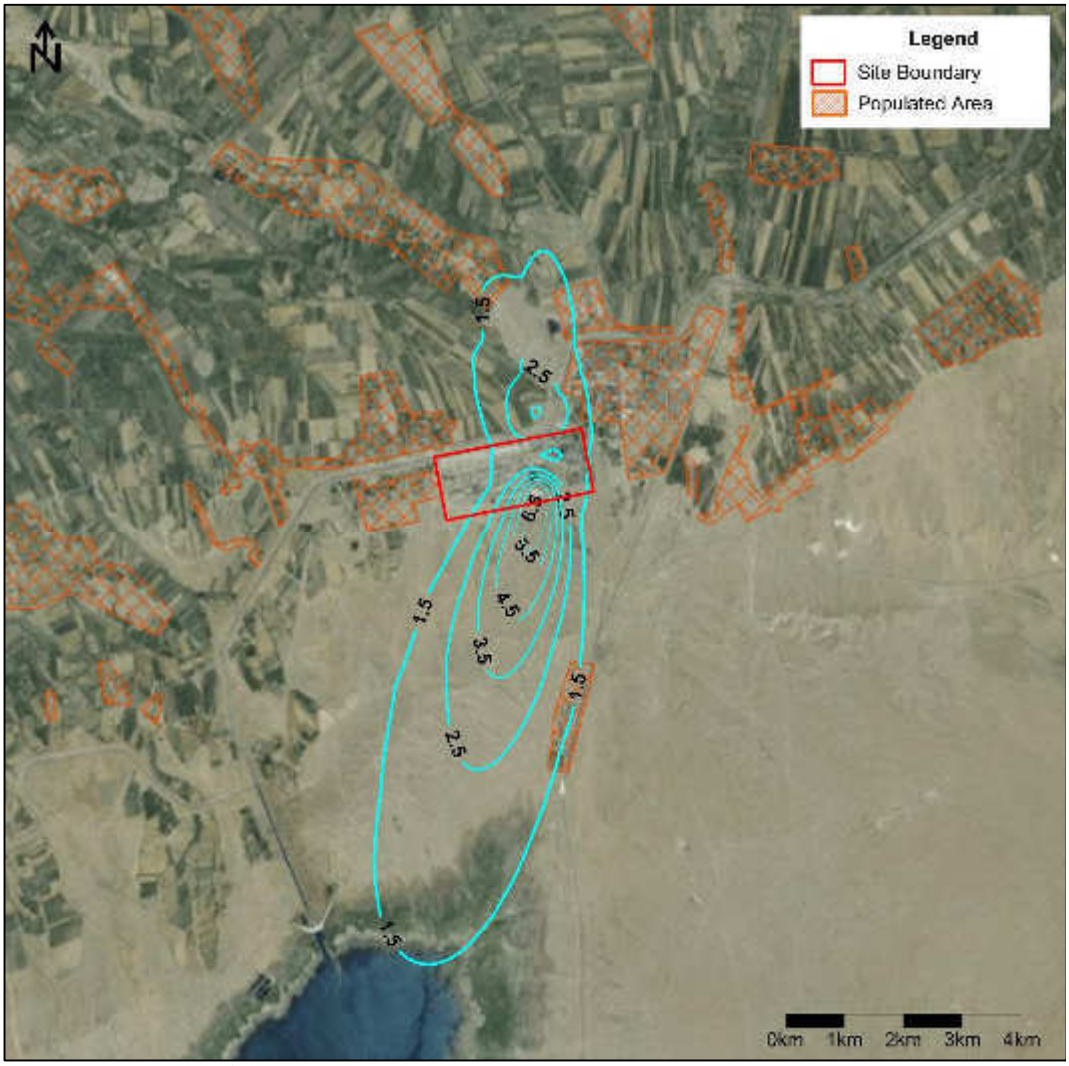
Notes: Contours at 4µg/m^3 intervals, based on 2012 worst case meteorological year

Figure G-11: Operating Situation 3: 24 hour NO_2 (µg/m^3)



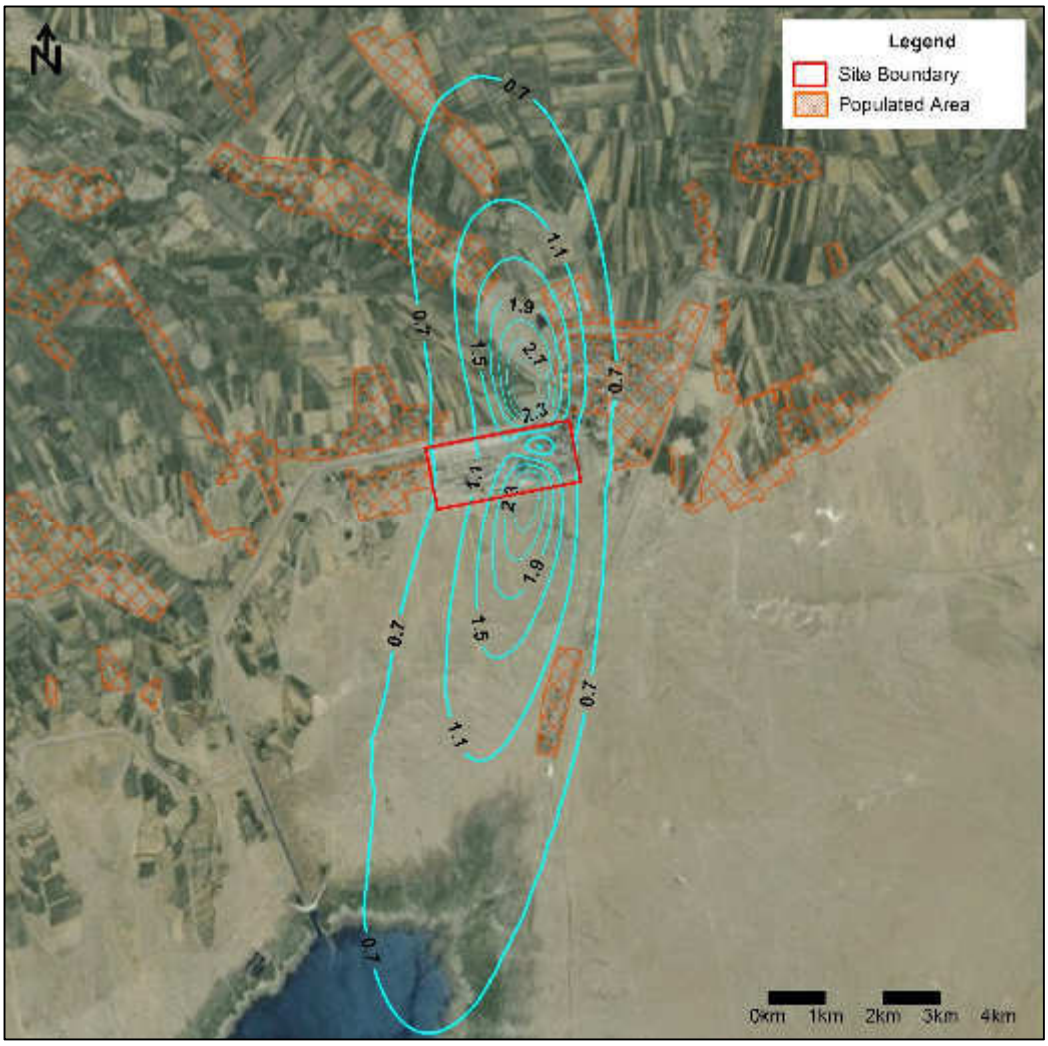
Notes: Contours at 2µg/m^3 intervals, based on 2015 worst case meteorological year

Figure G-12: Operating Situation 3: Monthly NO_2 ($\mu g/m^3$)



Notes: Contours at 1$\mu g/m^3$ intervals, based on 2015 worst case meteorological year

Figure G-13: Operating Situation 3: Annual NO_2 (µg/m^3)



Notes: Contours at 0.4µg/m^3 intervals, based on 2013 worst case meteorological year

G.6.2.7 Mitigation and Monitoring

570. No combustion mitigation measures in addition to those already accounted for within the dispersion modeling are proposed. The following key design features have been accounted for are:

- An exhaust stack height of 85 metres to ensure effective dispersion of emissions.
- Emission limits guaranteed to meet 50 mg/Nm³) for NO_x.

571. During operation emissions of NO_x will be monitored continuously via a continuous emissions monitoring system.

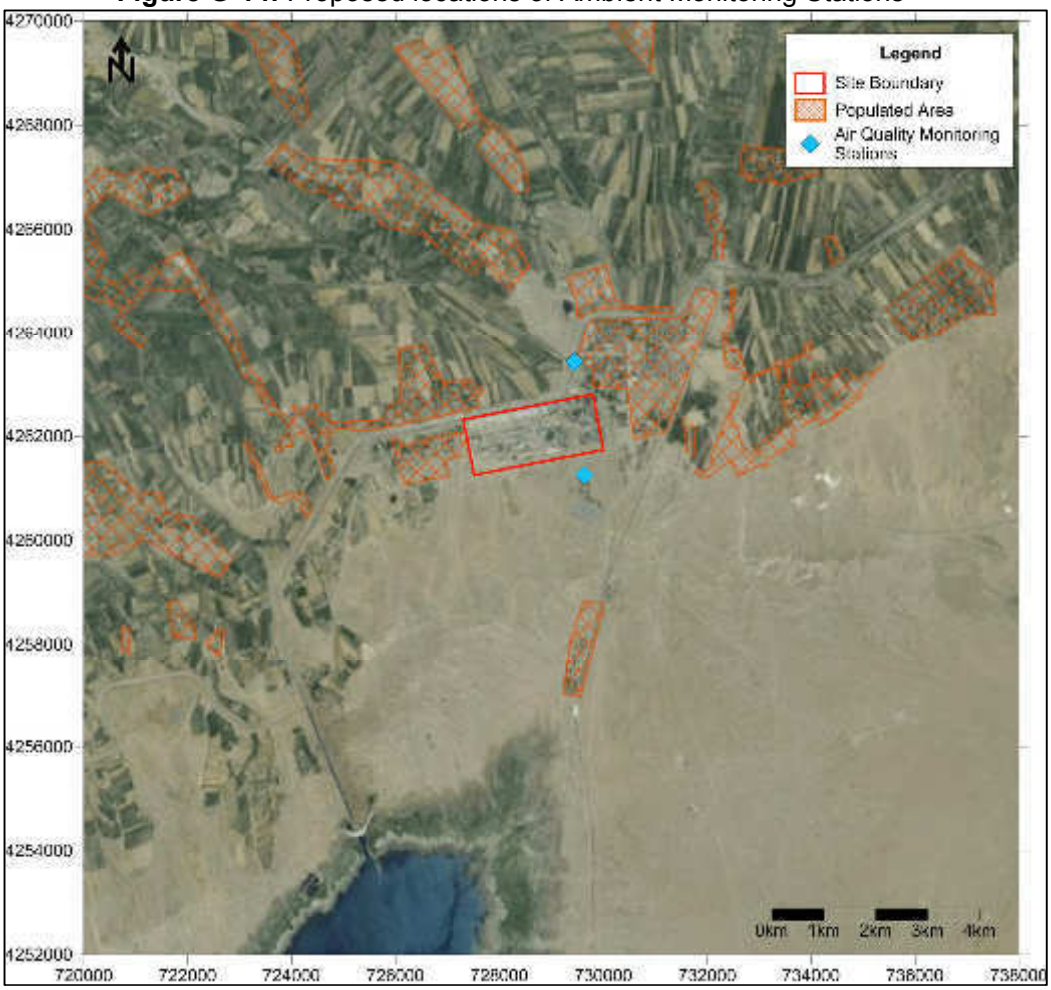
572. Although the modeling has demonstrated that impacts are below 25% of the standards applicable in the assessment with the exception of the 30 minute averaging period, the total thermal input is above 1200MWth. Therefore, ambient air quality

monitoring will be undertaken at two ambient monitoring stations will take account of the following:

- Continuously monitor ambient concentrations of NO_x and NO_2 in accordance with internationally recognised approach
- Include a dispersion model ready meteorological station in accordance with US EPA guidance which can monitor wind speed, direction and temperature
- Be subject to regular calibration procedures and audits to ensure proper function
- One to be located offsite, at the point of maximum impacts predicted by the dispersion modelling
- One to be located offsite in the populated area.

573. In order to establish baseline levels, the monitoring stations should be installed prior to the start of construction of TPP2. The effectiveness and the need for the two monitoring stations will be reviewed annually and if monitored concentrations confirmed to be well below the standards it will be simplified or reduced. **Figure G-14** illustrates their proposed locations.

Figure G-14: Proposed locations of Ambient Monitoring Stations[29]



[29] Exact location to be determines based on electricity supply, security and accessibility.

G.6.3 Climate Change

574. Greenhouse Gas (GHGs) Emissions – One of the key environmental issues associated with a project such as TPP2 are GHG emissions. TPP2 will have a similar layout to TPP1 using two twin-shaft CCGT units, each with a generating capacity of 450 MW. A nominal 7,500 hours per annum of operation at full rated output has been assumed for the units, but plant availability is expected to be up to 90% or 7,900 hours (as per TPP1 specifications). **Table G-14** details the emissions resulting from the operation of TPP2.

Table G-14: Expected Emissions from TPP2 CCGT Units

Parameter	**Value**	**Units**
Operating hours (nominal)	7,500	hours
Generated Energy**	900	MW
	6,750	GWh
Fuel use*	1,278,750,000	Nm^3/a
	42,198,750 ***	GJ/a
The standard emission factor for natural gas (assumed lower heating value basis)****	56	kg CO_2-e/GJ
CO_2 emissions	2,363,130,000	kg CO_2-e/a
	2,363,130	t CO_2-e/a
Emission rate (based on generated power)	0.00003501	t CO_2-e/kWh
	350.9	g CO_2-e/kWh

* fuel use based on 170,500 m3 per hour (assuming 25C, 1.013 bar)
** generated energy for TPP1 and TPP2 based on guaranteed value
*** Nm3 to GJ conversion factor 0.033, LHV value for gas used at TPP (assuming 25C, 1.013 bar
**** Source: TPP1 EIA

575. The TPP2 value of 350 g CO_2-e/kWh, is broadly in line with the IFCs estimated of CO_2 emissions from new gas CCGT power plants [30] (355 g CO_2-e/kWh) and would result in the emission of an estimated 2,363,130 t CO_2-e/a for 7,500 hours of operation.

576. The emission rate for TPP0 has been calculated as 510 g CO_2-e/kWh and TPP1 as 344 g CO_2-e/kWh. This would give an average emission rate for TPC of 401 g CO_2-e/kWh. A review of gas fired power plants over 500 MW in North America [31] indicates that the average emission rate is approximately 508 g CO_2-e/kWh. Given this value as a reference point for gas fired power plants the TPC as a whole produces lower levels of CO_2 emissions than comparable gas fired power plants in North America.

[30] EHS Guidelines for Thermal Power Plants. IFC.
[31] http://www2.cec.org/site/PPE/co2emissions?order=field_plant_country_value&sort=asc

577. According to the World Bank, Uzbekistan's total CO_2 emissions in 2013 were 103,226,000 tons, [32] or 0.34% of global CO_2 emissions. It is assumed that this figure includes emissions from TPP0. Potential emissions from TPP1 and TPP2 would therefore increase the 2013 figure by 4.7m tons, or around 4.5%.

578. Prior to the start of the Project UE shall investigate options to offset Project related GHG emissions. This could involve forestation projects or renewable energy projects. The government Uzbekistan carries out the targeted policy for energy saving in the key economy sectors. *"Decreasing in GDP energy consumption by approximately 2 times as a result of broad introduction of the advanced energy saving technologies* has been identified in Uzbekistan as the one of targeted tasks for period up to 2030. Strengthening the institutional capacity and improving the legal framework are carried out in renewable energy sector and energy efficiency to achieve the long-term sustainable development goals. The draft Long-term Strategy for low carbon development is considered in the country. It identifies target indices to energy efficiency and the "Program of measures for transition to low carbon development" for the key sectors of economy (electric energy, thermal energy, housing and utilities sectors), which are the main contributors to GHGs emission in Uzbekistan. Pursuant to the decision of the 20th session of the Conference of the Parties to the United Nations Framework Convention on Climate Change, 1/CP.20, and in accordance with the national circumstances and sustainable development goals, taking into account transition of the country to a resource-efficient development model, the Republic of Uzbekistan has identified and presents its Intended Nationally Determined Contribution (INDC) for the period up to 2030. The key measures to mitigate the climate changes are as follows:

Measures	Action Plan
Policy measures	There are currently the legally binding programs and acts aimed at ensuring by 2020 the implementation of measures for decrease in energy consumption, introduction of energy saving technologies in various sectors of the economy, social sphere and development of RES: • Decree of the President of the Republic of Uzbekistan No. UP-4512, dated 01 March 2013, "On Measures for Further Development of Alternative Energy Sources"; • Decree of the President of the Republic of Uzbekistan No. UP-4707, dated 04 March 2015, "On Program of Measures for Ensuring Structural Reformation, Modernization and Diversification of Production for 2015-2019"; • Resolution of the President of the Republic of Uzbekistan No. PP-2343, dated 05 May 2015, "On Program of Measures for Reduction in Energy Consumption, Introduction of Energy Saving Technologies in Economy Sectors and Social Sphere for 2015-2019"; • Program of Actions for Environmental Protection of the Republic of Uzbekistan for 2013-2017; • Resolution of the Cabinet of Ministers of the Republic of Uzbekistan No. 255, dated 29 August 2015, "On

[32] http://data.worldbank.org/indicator/EN.ATM.CO2E.KT?end=2013&start=2012

	Integrated Program of Actions for Mitigation of the Aral Sea Disaster Impacts, Rehabilitation and Socio-Economic Development of Priaralie Region for 2015-2018"; • Program for Further Development of Agricultural Production for 2015-2019; • Program for Further Irrigated Lands Improvement and Rational Use of Water Resources for 2013-2017. The elaborated development concepts are reflected in the following papers: • Analytical Report of the Center for Economic Research (CER) "Uzbekistan Towards 2030: Transition to the Resource-efficient Growth Model", prepared within the framework of UNDP/WB Joint Project "National Strategy of Structural Reforms of Uzbekistan for 2030"; • Report "Towards Sustainable Energy: Strategy for Low Carbon Development of the Republic of Uzbekistan", prepared within the framework of UNDP/Ministry of Economy Joint Project "Support to Uzbekistan in Transition to Low Carbon Development of National Economy" and reflecting predictions of development of various economy sectors and social sphere, their structural reformation.
Implementation of measures aimed at improvement of energy efficiency in various sectors of economy and social sphere	• Modernization and technical upgrading of industry; • Creation of new production facilities exclusively on the basis of introducing advanced energy efficient and energy saving technologies. • Decrease in specific fuel consumption for generation and use of electric energy; • Decrease in losses of natural gas with its extraction, processing and transportation; • Development and broad use of alternative energy sources: intensive construction of large solar photovoltaic power plants; creation of biogas plants; scaling up of wind power generation; • Improvement of energy efficiency of buildings on account of decrease in specific energy consumption; • Development of governmental financing schemes and subsidy support to energy saving measures; • Extension of transport and logistics communication systems, ensuring efficient energy resources use (including optimization of transportation routes, improvement of motor roads quality, etc.)' • Expansion of measures on motor vehicles change over to run on alternative fuel.
Development of scientific researches, educational and training activities	• Carrying out of fundamental researches in the area of climate change, development of system for climate change monitoring and prediction, development of methodologies for assessment of climate change impacts, vulnerability and risks;

	• Expansion of applied scientific researches and designs for introduction of energy saving technologies and RES; • Education and advanced training for specialists in the area of energy saving and RES; • Development of information systems for efficient solution of climate change problems; • Intensification of outreach activities on issues associated with climate change, energy efficiency and resources saving.
Development of system for inventory, reporting and control over greenhouse gas (GHGs) emissions	• Improvement of the quality of the greenhouse gases inventory and decrease in the general uncertainty of the GHGs inventory through development and refinement of the national emission factors, approaches and methods for calculation of greenhouse gas emissions. • Development of the system for inventory of greenhouse gas sinks and emissions in the "Land Use Change and Forestry" sector on the basis of advanced GIS technologies.

Potential Impacts Upon the Project

579. The ADBs Climate Change Screening report prepared for the Project by the ADB indicates that the risk of climate change impacting upon the Project is low, and that the risks of precipitation increases or decreases in the Project area are low. However, other ADB reports suggest that water availability in the Amu Darya will decrease. The KMK is fed by water from the Amu Darya which in turn provides cooling water for the TPC. **Table G-15** illustrates flow data for 2016/2017 (provided by UE) and the anticipated 2041 – 2050 flow data based on predicted maximum monthly percentage flow decrease.

Table G-15: Amu Darya Flow (m^3/s), 2016/17 & 2041 – 2050

Month	**Flow 2016 / 2017 (m^3/s)**	**Predicted Maximum Monthly % Flow Decrease by 2041 - 2050**	**Flow 2041 – 2-50 (m^3/s)**
January	300	30	210
February	500	30	350
March	1,000	25	750
April	1,500	15	1,275
May	3,000	20	2,400
June	2,500	30	1,750
July	2,000	40	1,200
August	3,000	45	1,650
September	2,000	45	1,100
October	1,000	45	550
November	1,000	40	600
December	700	35	455

580. To operate all units of the TPC in once through cycle (OTC), 57 m^3/s of water is need needed from the KMK. As noted in **Section G.6.6** below, there is insufficient flow in the KMK during December, January and February to meet this requirement (flow in these months is based on agricultural demand), and as such the TPC operates, and will operate in re-circulation mode. In addition, an assessment of the Projects impacts on thermal pollution indicates that it will be unlikely that the TPC could operate in OTC during the hottest summer months (June, July, August and September) due to the fact that thermal pollution limits will most likely be breached.

581. Accordingly, at full capacity, the TPC may only be able to operate in OTC for a few months per year (March, April, May, October, November). **Table G-16** shows that the percentage of water currently needed for TPC represents between 3% and 6% of total current Amu Darya flow. This would rise to 3% and 10% of total Amu Darya flow by 2041 – 2050 using the predictions provided in recent ADB reports.

Table G-16: Changes in % of Water Abstraction from the Amu Darya River for TPC use (m^3/s): 2016/2017 – 2041-2050

Month	% of flow (2016/2017	% of flow (2041 – 2050)
January	N/A (Insufficient flow in KMK)	N/A
February	N/A (Insufficient flow in KMK)	N/A
March	6	8
April	5	6
May	3	3
June	N/A (KMK thermal pollution limits reached)	N/A
July	N/A (KMK thermal pollution limits reached)	N/A
August	N/A (KMK thermal pollution limits reached)	N/A
September	N/A (KMK thermal pollution limits reached)	N/A
October	6	10
November	6	10
December	N/A (Insufficient flow in KMK)	N/A

582. The percentage changes are minimal for the months March, April and May, however, they are higher for October and November. It is important to remember that the figures in **Table G-16** are based on the worst case scenario, and any potential increase in the percentage of flow could in fact be lower.

583. During TPC re-circulation mode only 2.39 m^3/s of make-up water is required. This water is provided either from the Talimarjan Reservoir which is supplied by water from the KMK, or directly from the KMK itself (for example during the summer months when there is adequate flow in the KMK but thermal pollution limits have been met). During re-circulation mode 1.07 m^3/s is lost (due to losses in the system and evaporation) with the remaining 1.32 m^3/s returned to the KMK. The maximum storage capacity is of the Talimarjan Reservoir is 1,525 million m^3 and it has a dead storage capacity of 600 million m^3. Filling of the reservoir occurs intermittently depending on water usage and demand, the highest rates of filling occur from January to June, from July to December. Water from the Talimarjan reservoir is used predominantly for water supply to the towns of Nuriston, Nishon and the SGCC.

584. **Table G-16** indicates that in a worst case 2041-2050 scenario the minimum water flow in the Amu Darya during the winter period would be 210 m^3/s. 2.39 m^3/s represents around 1% of the future flow of the Amu Darya. The TPC water requirement will not increase in the future and as such 1% is not considered to represent a significant impact to the flow of the Amu Darya. It is possible that the potable water requirements of Nuriston and Nishon may increase with population growth, and potentially the SGCC as well. This would mean that additional water would need to be extracted from the Amu Darya via the KMK to recharge the Talimarjan Reservoir. However it is difficult to predict with any certainty how any population change could impact upon water withdrawals from the reservoir and any impacts this may have on the TPC water requirements in 2050.

Mitigation Measures

585. The figures above suggest that, even in the worst case scenario, there will be enough water in the Amu Darya river by 2041-2050 to continue to supply the TPC comfortably in both OTC, when flow is high, and most importantly in recirculation mode when flow is low or thermal pollution limits are reached.

586. It is important to note that the flow of the KMK is determined by agricultural requirements, the TPC simply uses the water for cooling and discharges it directly back to the KMK with minor losses. If anything, the demand for increased irrigation water in the Karshi region and the KMK may place a stress on the Amu Darya, but the TPC itself will not dictate this demand.

587. Notwithstanding the above, it is recommended that UE continues to assess the potential impacts of climate change on the TPC, including temperature increase in the KMK and its impacts to thermal discharge. Such an assessment should be undertaken every five years and could form part of an overarching assessment of climate change on all of UEs assets including their hydropower facilities.

G.6.4 Topography

Potential Impacts

588. The Project is located adjacent to the existing TPP1 on flat open land. Borrow material will be sourced from borrow pits, the locations of which have yet to be determined. Issues relating to borrow pits are discussed further below under **G.8.5 – Borrow Pits**. No other impacts to topography are anticipated.

Mitigation Actions

589. None warranted.

G.6.5 Soils

Potential Impacts

590. Inadequate storage, handling and transport of fuels, oils and other hazardous liquids could lead to contamination of soils during both the construction and operational phase of the Project.

591. Impacts associated with borrow pits are discussed below under **Section G.8.5 – Borrow Pits**.

Mitigation Actions

Pre-construction phase

592. The EPC Contractor will be responsible for the preparation of a Spill Response Plan. The plan shall specify the procedures for managing spills of hazardous liquids.

Construction Phase

593. The EPC Contractor, with oversight from the Engineer, shall ensure that:

- All fuel and chemical storage (if any) shall be sited on an impervious base within a bund and secured by fencing. The storage area shall be located away from any watercourse. The base and bund walls shall be impermeable and of sufficient capacity to contain 110% of the volume of tank (or one tank if more than one tank is located in the bund).
- Underground emergency oil drain tanks from Gas Turbine and Steam Turbine will be double skinned, comprising cast-in-place, reinforced-concrete structures, manufactured from concrete on the basis of sulfate-resistant portland cement lined with a steel inner tank. The tanks will be routinely monitored to detect leaks.
- All transformers shall be located on an impervious base within a bund and secured by fencing. The base and bund walls shall be impermeable and of sufficient capacity to contain 110% of the volume of tank (or one tank if more than one tank is located in the bund).
- The construction camp maintenance yard shall be constructed on impervious hardstanding with adequate drainage to collect spills, there shall be no vehicle maintenance activities on open ground.
- Filling and refueling shall be strictly controlled and subject to formal procedures. Drip pans shall be placed under all filling and fueling areas. Waste oils shall be stored and disposed of by a licensed contractor.
- All valves and trigger guns shall be resistant to unauthorized interference and vandalism and be turned off and securely locked when not in use.
- The contents of any tank or drum shall be clearly marked. Measures shall be taken to ensure that no contaminated discharges enter any soils.
- No bitumen drums or containers, full or used, shall be stored on open ground. They shall only be stored on impervious hardstanding.
- Areas using bitumen shall be constructed on impervious hardstanding to prevent seepage of oils into the soils.
- All hazardous liquids shall be stored with copies of their Material Safety Data Sheets (MSDS).

Operational Phase

594. UE TPP shall be responsible for the preparation of spill and leak response procedures and part of an ESMS for TPP2.

595. Chemical storage areas will be sized to store at least one months supply of chemicals. Accordingly, the following conditions should be met:

- A list of the chemicals, their quantities, and bulk storage dimensions must be kept by the TPP2 HSE Manager.
- For chemicals that have a base load use of up to 3.0 m^3 per month, the bulk storage

facilities using intermediate bulk storage containers (IBC) of the 1 m^3 size shall be used. The IBCs must be arranged for easy and safe change-over and connection.
- For chemicals that have a base load of greater than 3.0 m^3 per month a bulk tank facility must be supplied including a bulk road-tanker unloading facility, situated such that it does not interfere with daily movement of operational staff or equipment. For the case of liquid deliveries, the unloading and storage facilities must be fully bunded.
- A separate lubrication and oil storage facility compliant with relevant standards is to be provided. The storage facility is to be bunded and fitted with a roof. It must also be provided with a means of lifting the oil drums without manual handling.
- Adequate bundings, transfer pumps and associated safety equipment must ne provided.
- All fuel and chemical storage (if any) shall be sited on an impervious base within a bund and secured by fencing. The base and bund walls shall be impermeable and of sufficient capacity to contain 110% of the volume of tank (or one tank if more than one tank is located in the bund).
- Diesel storage tanks must include drain points for removal of water and breathers fitted with filters.
- All hazardous liquids shall be stored with copies of their MSDS.

G.6.6 Surface Water Hydrology

Potential Impacts

Design Phase

596. The main water intake for the TPC from the KMK was constructed prior to commencement of TPP0 operations in 2004. It is assumed that the main intake does not comply with IFC thermal power plant guidelines for intakes, e.g. intake velocity 0.15 m/s.

Construction Phase

597. The only surface watercourse within the vicinity of TPP2 is the KMK. Due to the distance of the construction activities from the KMK (80 meters) and the fact that construction activities will be confined to a specific footprint within the boundary of TPC it is considered unlikely that spills or leaks of liquids used during the construction phase will impact upon the KMK.

Operational Phase

598. **Thermal Pollution** - Thermal power plants, such as TPP2 that use an OTC system require a significant volume of water to cool and condense steam. This water will be discharged back to the source water (the KMK) with almost no losses but at a higher temperature than the ambient water temperature. Thermal discharge needs to be controlled to ensure that this discharge water temperature does not result in thermal pollution.

599. Thermal pollution is any discharge that will dramatically alter the temperature of a water source. If the temperature of discharge is significantly warmer than the ambient water, it can negatively affect water quality. There are several significant consequences of thermal pollution, including fish kills.

600. Considered alone, water temperature can affect the metabolic rates and biological activity of aquatic organisms. As such, it influences the chosen habitats of a variety of aquatic life. Some organisms, particularly aquatic plants flourish in warmer temperatures, while some fishes such as trout or salmon prefer colder streams.

601. For most fish, a 10°C increase in water temperature will approximately double the rate of physiological function. This increase in metabolic rate can be handled by some species better than others. Increased metabolic function can be noticed in respiration rates and digestive responses in most species. Increased respiration rates at higher temperatures lead to increased oxygen consumption, which can be detrimental if rates remain raised for an extended period of time. Furthermore, temperatures above 35°C can begin to denature, or breakdown, enzymes, reducing metabolic function.

602. In addition to its effects on aquatic organisms, high water temperatures can increase the solubility and thus toxicity of certain compounds. These elements include heavy metals such as cadmium, zinc and lead as well as compounds like ammonia.

603. The solubility of oxygen and other gases will decrease as temperature increases. This means that colder lakes and streams can hold more dissolved oxygen than warmer waters. If water is too warm, it will not hold enough oxygen for aquatic organisms to survive.

604. The issue of thermal pollution was discussed as part of the TPP1 EIA. According to the TPP1 EIA:

"*The increase in cooling water usage (from TPP1) will also see an increase in the temperature of the discharge (to the KMK). Table 6 (**Table G-17**) shows that the temperature increase in the canal resulting from the addition of cooling water from the new turbines will be an increase of 2.7°C which is within acceptable guidelines*."

605. Acceptable guidelines are the requirements of the Sanitary Norms and Regulations (SNiP) № 0319-15 dated February 10, 2015 "Hygienic and antiepidemic requirements for protection of water in water basin in the territory of the Republic of Uzbekistan". The TPC has to ensure that all discharges directed to the KMK shall meet these regulations, in particular "in accordance with the thermal regime the summer water temperature as a result of discharge of sewage waters shall not increase more than 3°C in comparison with the monthly mean temperature of the hottest month of the year in the last ten years". The TPP1 Pre-feasibility Study states that "*Water temperature in the KMK varies from 8 to 26 °C (VII). So the discharge waste water temperature (in summer) shall not exceed 29 °C."*

Table G-17: Discharge Water Temperature [36]

		Existing outflow from TTP0	**Outflow from TPPO and TPP1**
KMK flow	km^3/d	12,960	12,960
	m^3/s	150	150
Cooling water flow	km^3/d	2,160	3,550
	m^3/s	25	41.08796296

[36] Source: TPP1 EIA

$Temp_{in}$	°C	16	16
$Temp_{out}$	°C	26	26
$Temp_{mixed}$	°C	17.7	18.7

606. However, a review of these figures in **Table G-17** indicates that there are some shortcomings in the data:

a) Average flow in the KMK is not 150 m^3/s. 150 m^3/s is the current maximum flow of the KMK. Data supplied by TPP0 indicates that the current average flow of the KMK is closer to 52 m^3/s [37] (see **Table G-18**). TPP0 requires a minimum of 25 m^3/s to operate in a once through cooling mode (OTC) (maximum flow above 25 m^3/s is highlighted in green in **Table G-18)**. During March and November it is assumed that TPP0 operates with reduced take up of water which impacts upon the efficiency of the plant.

Table G-18: KMK Flow Rate Data*

Month	**Flow Rate m^3/s**		
	min	max	Avg
January	6	15	10.5
February	6	15	10.5
March	15	30	22.5
April	15	50	32.5
May	15	70	42.5
June	60	105	82.5
July	70	105	87.5
August	60	90	75
September	0	20	10
October	30	70	50
November	10	35	22.5
December	6	15	10.5
Average (cropping season)			51.87

* Source: TPPO

b) The TPP1 EIA states that the average ambient temperature is 16°C. The EIA does not say if this is for the whole year, or just the summer months when the OTC mode is in use. Summer months are assumed to be (March to November – the cropping seasons). However, a different data set provided by TPP0 gives an average ambient temperature of 20.22°C (minimum average = November @ 12 °C / maximum average – August @ 26 °C). Other monitoring data provided by UE indicated that the average ambient KMK temperature was 21.77 °C.

[37] This figure does not take into account the winter months (December, January and February) as TPP0 operates on recirculation mode during this period. September figure was also discounted as 10 m^3/s is considered to be incorrect for this period of the year.

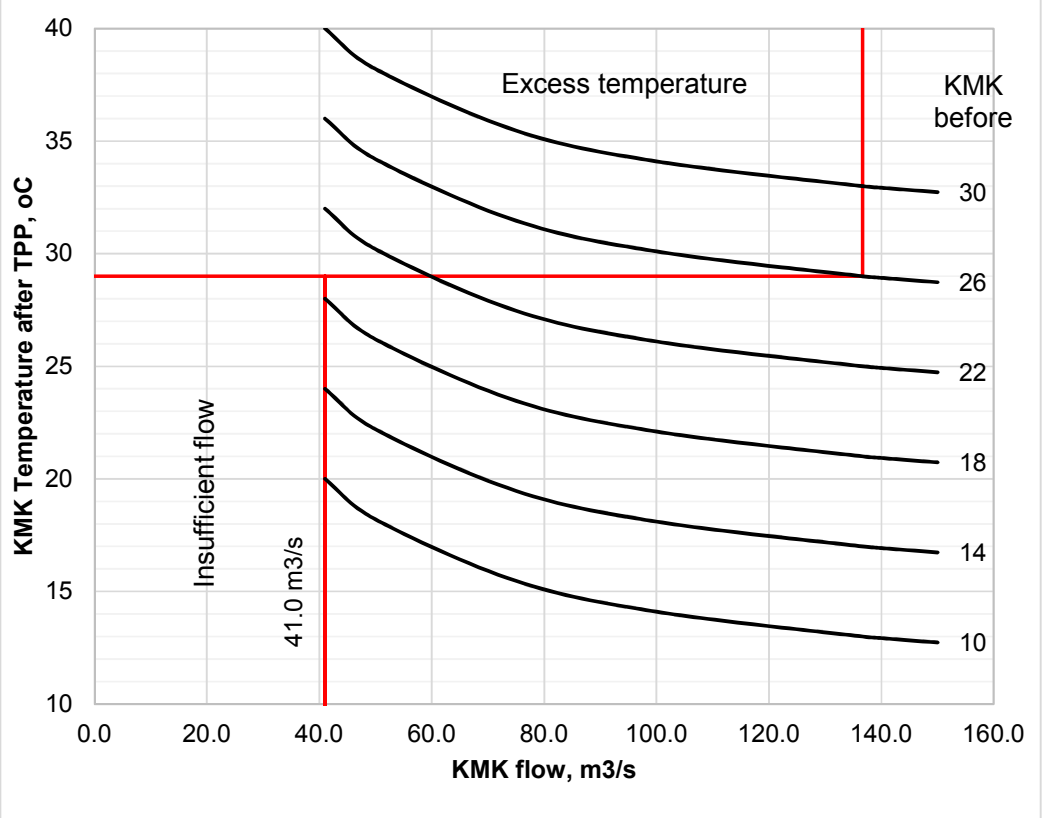
607. Further, the TPP1 EIA concluded that the discharge water would increase the ambient KMK water temperature by approximately 2.7 °C to an average of 18.7 °C (assumed to be at the immediate mixing point with the KMK). These figures appear to be based on a direct discharge to the KMK, which is not the case, rather water is discharged to an outfall channel (approximately 600 meters long) before it mixes with the KMK (immediate mixing zone). This channel gives the discharged water additional time to cool before it mixes with the KMK, but probably not enough to reduce water temperatures by the 5-6 °C stated in the TPP1 EIA which was perhaps a result of calculations based on the high average flow.

608. TPP0 currently monitors water temperature at a point approximately 150 meters beyond the immediate mixing zone. The most recent results indicate that the average water temperature during 2016 / 2017 was 25°C. This also suggests that TPP1 EIA average discharge temperatures are not accurate, but also that the differences are currently in line with national regulations.

609. All of the above points illustrate that the conclusions made in the TPP1 EIA relating to thermal discharge were based on a rather simplistic set of data that has been updated in this EIA through a more thorough investigation.

610. Using new data obtained as part of this EIA we can estimate periods of the year when thermal discharge from TPP0 and TPP1 would not meet the regulatory standards (**Figure G-15**).

Figure G-15: Thermal Discharge, TPP0 & TPP1



612. The graph above indicates that there could in fact be certain periods when the discharge regulatory limit is breached, for example when the "KMK before" temperature is 22 °C and KMK flow is less than 60 m^3/s.

613. However, TPP1 and TPP0 have the capacity to operate in both OTC mode and re-circulation mode due to the limited water availability in the KMK during the winter months. This means that both plants, in combination, or individually, have the capacity to switch to re-circulation mode to prevent a breach of the thermal discharge limits.

614. There is no real-time continuous monitoring of temperature in the KMK at the immediate mixing point, or anywhere in the KMK for that matter. Therefore it is uncertain how TPC staff would know when to put the plant into re-circulation mode to prevent any breaches of the thermal discharge limits, possibly it is simply based on the KMK flow rate. Accordingly, it is recommended that monitoring equipment be installed as part of the TPP1 project in order for TPC staff to monitor and manage the issue of thermal pollution.

615. The information above describes how TPP0 and TPP1 can meet the national regulatory requirements. However, TPC should also consider international best practice, which in this instance is provided by the IFC's guidelines for Thermal Power Plants.

616. The current guidelines state that "*Temperature increase by thermal discharge from cooling system should be a site specific requirement to be established by the EA. The EA should consider the requirements depending on the sensitive aquatic ecosystems around the discharge point."*[38] Considering that the KMK was constructed specifically as an irrigation channel then it cannot be described as a sensitive aquatic ecosystem. A number of fish can be found in the KMK, but none of them are listed in the IUCN red list (this was confirmed by an ADB commissioned fish study of the KMK). Reportedly there are commercial fisheries operating in the Talimarjan Reservoir, although the Project will not impact upon these fisheries. Recreational fishing occurs in the KMK and no livelihoods depend upon fishing directly within the KMK. In addition to the above, a fish survey was commissioned by the ADB in November 2017 to determine the status of fish in the KMK. The report provided the following key findings:

- It is a reasonable assumption that the fish species in KMK will not be much different from the fish species in Talimarjan Reservoir where there are **no critical fish species**.
- The key conclusion of the Nishon District Inspection of the State Committee for Ecology is:
    - In KMK, there are mainly Wild Carp, Chinese Carp, Bream, Crucian Carp, Asp, White-Eye, Barbel and **all these species are not critical species**;
    - The temperature increase due to discharged cooling water coming out from TTPP into the canal **will have no harm to the fish in KMK.**
- A fish screen is designed to prevent fish from swimming or being drawn into the Talimarjan water storage and KMK from the Amu Darya.
- In the zone of thermal influence of Sirdarya TPP (in Uzbekistan) increased water temperature is used for fish breeding.
- Based on the study we can state that there is **no negative** impact of Talimarjan Thermal Power Plant on aquaculture of Karshi Main Canal.

617. Older versions of the IFC guidelines for Thermal Power Plants state that "The effluent should result in a temperature increase of no more than 3°C at the edge of the

[38] Environmental, Health and Safety Guidelines – Thermal Power Plants. IFC

zone where initial mixing and dilution take place. Where the zone is not defined, use 100 meters from the point of discharge when there are no sensitive aquatic ecosystems within this distance." [39] The KMK is not considered a sensitive aquatic ecosystem, so in that respect the edge of the mixing zone in the KMK can be considered to be 100 meters downstream from the initial mixing point.

618. Accordingly, any thermal discharge from the TPC, whether it is from TPP0, TPP1 or TPP2 or a combination of all three, should not exceed 3°C at the edge of the zone where initial mixing and dilution take place.

619. A sample of water temperature was undertaken in November 2017 as several points, including the 2km upstream of the TPC to establish ambient temperatures (17°C), at the water intake point to TPC (17 °C), at the immediate discharge point to the TPC feeder channel (20 °C) and at the immediate mixing zone with the KMK (19.4 °C). The results show that the current thermal discharge from TPP1 and TPP0 are within IFC and national guideline limits.

620. **Water Use -** A cumulative total of 57 m^3/s of water will be required for operation of the TPC. A review of the water balance provided by UE in TPP1 Preliminary Governmental Feasibility Study is summarized in **Table G-19** and **Table G-20**. We consider these figures to be the worst case scenario and a number of optimizations are offered in the Projects Technical Due Diligence Report.

[39] Thermal Power: Guidelines for New Plants. World Bank Group. 1998.

Figure G-16: Intake and Discharge Areas

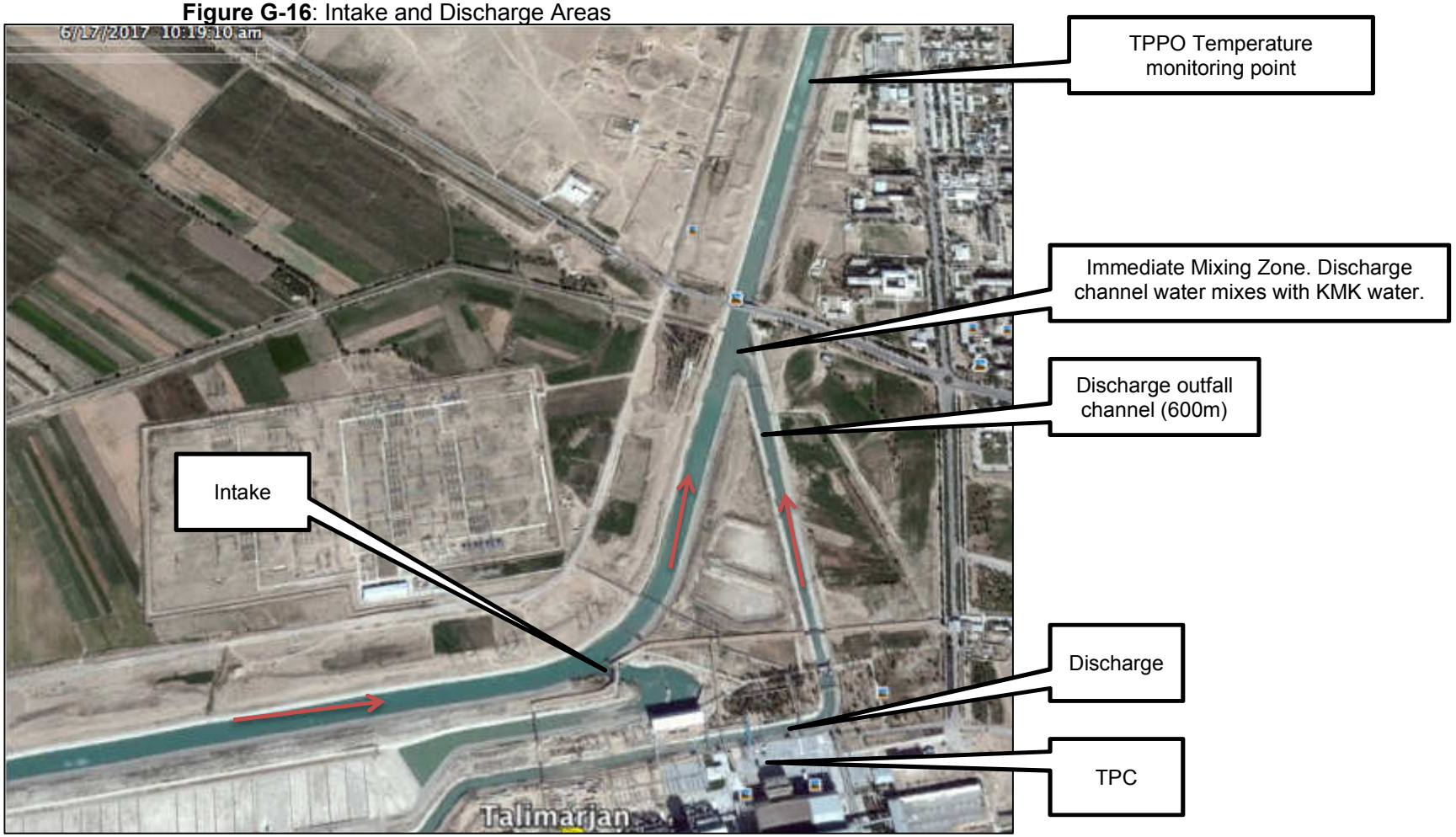


Table G-19: Water Balance for OTC Mode			
	Water Use (m^3/h)		Water Use (m^3/s)
In from KMK	Talimarjan Reservoir Pumping Station	3,926	1.09
	Regulator 4 (TPP2)	56,400	15.66
	Regulator 1 (TPP0)	90,945	25.26
	Regulator 1 (TPP1)	50,280	13.96
	Total	**201,551**	**55.98**
Losses		**911**	**0.25**
Out to KMK		**200,640**	**55.73**

621. Certain periods of the year when the KMK flow is lower than 56 m^3/s OTC will be suspended and recirculation mode started for a combination of units, depending upon the KMK flow at that time and also the temperature at the thermal pollution monitoring points.

Table G-20: Water Balance for Re-circulation Mode			
	Water Use (m^3/h)		Water Use (m^3/s)
In from KMK	Talimarjan Reservoir Pumping Station	8,621	2.39
	Regulator 4 (TPP2)	0	0
	Regulator 1 (TPP0)	0	0
	Regulator 1 (TPP1)	0	0
	Total	**8,621**	**2.39**
Losses		**3,863**	**1.07**
Out to KMK		**4,758**	**1.32**

622. Water losses during OTC mode would account for approximately 0.25 m^3/s, or 0.5% of the minimum TPC required flow of 55.7 m^3/s). This is not considered significant and will not impact upon downstream water users. **Figure G-16** above also shows the proximity of the intake and discharge points of the TPC and the KMK between these points which is no more than 500 meters. The water level in this point between the intake and discharge points never decreases below the water level in the KMK, accordingly a passage for the movement of fish always remains, even when flow is low in the winter periods (which is dictated by agricultural requirements, not the TPC).

623. During re-circulation mode 2.39 m^3/s will be pumped from the Talimarjan reservoir pumping house to the Talimarjan power complex. According to TPP0 staff, TPC has a license to pump 10 m^3/s from the reservoir.

624. **Effluent Pollution** – Effluent pollution may potentially result from the following locations and activities:

1. Desalinization Plant Waste Water - Wastewater is discharged, after being neutralized at tat the chemical treatment area, via a pipeline to a concrete lined drying pit where the water evaporates. However, during site visits small cracks were noted in the concrete lining and the pipeline was leaking. In addition, there is no monitoring of the water quality from the pit at the immediate discharge point from the pits. According to the TPP0 Environmental Manager, this pit has never had its sludge removed. When

the pit becomes full of dried sludge the waste water is discharged into one of the other drying pits adjacent to the pit currently used, see **Section B.6.2.6** for more details.
2. Chemical treatment Plant Discharge - Neutralised before it discharges to the afore mentioned concrete lined drying pits.
3. Waste Water – Site drainage is channeled through a closed loop system constructed for the TPC as a whole. The risk of pollution from this system is considered to be low.
4. Sewage Water - Sewage is sent to the sewage treatment plant which was constructed as part of the original TPC design to treat all the sewage from TPP0, Nuriston and any future plant additions to the TPC (up to 3,200MW). Regular testing of the water discharge is undertaken at the plant to ensure that it meets the national regulatory requirements.
5. Discharge to the KMK – Sodium hypochlorite will be used as a biocide treatment for cooling water and will be discharged back into the KMK during OTC mode in small doses. TPC currently monitors a range of parameters in the discharge water to the KMK, however, only two of the parameters currently monitored are included on the IFC Thermal Power Plant guideline list of recommended effluent monitoring parameters (pH and Iron).

Mitigation Actions

625. **Intake -** The intakes for the water pumps in the main pump-house designed and constructed for TPP2 will meet the IFC guidelines, including recommended intake velocity of 0.15 m/s and a mesh size of 9.5mm.

626. **Sewage Water** – Discharge water from the sewage treatment plant shall be monitored against both national and IFC standards.

627. **Thermal Pollution** – There are certain parameters within which TPP2, and TPC as a whole has to function including water discharge temperature. First, and foremost, to meet the national regulatory requirements the water temperature discharge from the TPC must not exceed 29°C in the KMK. In addition, TPC should comply with the IFC guidelines for thermal power projects.

628. Looking at the data provided by **Figure G-15** for the immediate mixing zone we can see that the temperature in this zone varies with flow rate. Discussions with TPC staff indicated that additional flow in the KMK to supply the TPC can be provided, however flow rate is predominantly driven by water requirements in KMK irrigation system and it must be agreed with by the authority in charge of the KMK system. Pumping more water into the KMK raises several issues, such as; a) the need for new permits, b) diverting water from the Amu Darya and its downstream users (and its associated transboundary impacts) and c) the additional water needed for the TPC may not be required in the irrigation system and would simply run out into the desert. Accordingly, it is recommend that flow rate should not be used as a tool to reduce the temperature in the KMK mixing zone. Instead, real time continuous monitoring stations should be provided within the KMK to determine when thermal pollution limits are reached and when the TPC, or a combination of units, should switch to re-circulation mode in order to meet the national regulations and international guidelines.

629. Four locations should be monitored:

1. Approximately 200 meters upstream from TPC to determine ambient water temperature.
2. At discharge point to KMK feeder channel.
3. At the immediate mixing point where the feeder channel meets with the KMK.

4. At a point 100 meters downstream of the immediate mixing point, i.e. the edge of the mixing zone.

630. If at anytime the discharge water temperature a) reaches 29 °C at the immediate mixing point all units; or b) reaches 3 °C above the ambient temperature at the edge of the mixing zone TPP2, or a combination of TPC units shall switch to recirculation mode.

631. Adoption of such a monitoring program would ensure that water temperatures do not exceed national standards at the immediate mixing zone, or IFC guidelines 100 meters downstream of the immediate mixing zone, thereby preventing any significant impacts to fish within the canal, ensuring efficient use of the KMK water, eliminating impacts to water users downstream of the Amu Darya and also avoiding transboundary issues.

632. Notwithstanding the above, a detailed fish survey for baseline data on fish population (abundance and richness) and behavior in the KMK, will be conducted in May-June 2018 by the Engineer. This survey will be repeated annually to determine if the TPC is impacting upon the ecology of the KMK specifically fish mortality. Although the ADB commissioned fish study indicates that fish mortality is unlikely, further assessment of this issue for the first five years of operation of TPP2 is considered prudent If fish mortality is found to be occurring due to increased temperatures in the KMK then TPC will be responsible for ensuring thermal discharge temperatures are reduced below the current limits to eliminate fish mortality. This would be achieved through detailed assessments undertaken by UE and Goskompriroda and fish specialists and necessary.

633. **Effluent Pollution** – The concrete lined sludge pit used for the chemical treatment plant discharge and desalinization plant discharge needs to be rehabilitated to ensure that there are no leaks from the pits that could contaminate the soils around the pits. The sludge from the existing pit should be replaced in the adjacent empty sludge drying pit while repairs area made. The pipeline to the pit also needs to be replaced so that it no longer leaks and to reduce levels of Iron within the water. Monthly monitoring of the water quality from pit is also required according to national and IFC standards during construction and operational phases. The TPP0 EM should also make routine inspections of the pit and the pipeline to ensure it functions appropriately.

634. The water treatment for the cooling system of TPP2 will include biocide (sodium hypochlorite) dosage performed by a control and global monitoring equipment with automatic dosage calibration. Total residual chlorine will 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. In addition, monitoring of effluent parameters specified in the IFC Thermal Power Plant EHS guidelines (Table 5) shall also be undertaken on a monthly basis at the TPC discharge point throughout the operational period of the Project.

G.6.7 Groundwater Hydrology

Potential Impacts

Construction Phase

635. From the construction activities, there will be significant use of fuel and

lubricant and other hazardous liquids such as paints. Without a standardized materials handling and storage protocol in place, spills and contamination of groundwater and soils is possible. Other impacts to groundwater could occur from the washing out of concrete mixers onto bare soils and a lack of oil and grease interceptor tanks in camp drainage systems.

Operational Phase

636. Hazardous solids and liquids will be used during the operational phase, they may include; ammonia, hydrazine and phosphate. These materials will be stored in the chemical dosing building. In addition, other hazardous liquids will also be stored and used on site, such as fuel, lube oil, paints, etc.

637. TPP2, as TPP1 and TPP0, have been designed with containment measures to trap any spills or leaks of hazardous liquids.

638. It has not been possible to determine if there are groundwater users within the vicinity of the K-3-2 drain. However, given the high salinity of groundwater in the region and the fact that a large portion of the population in this area are linked to networked potable water supplies it is considered unlikely that there are many groundwater users close to K-3-2.

Mitigation Actions

Construction Phase

639. The mitigation measures outlined in **Section G.6.5 – Soils**, **Section 8.3 – Waste Management** and **Section 8.4 – Construction Camps and Concrete Batching Plants** will help prevent impacts to groundwater.

Operational Phase

640. Impacts to groundwater during the operational phase of the project would result from poor management of effluent discharge from the TPC which is discussed above under **Section G.6.6** and also from the poor management of hazardous liquids which are discussed above under **Section 6.5**.

G.6.8 Geology & Seismicity

Potential Impacts

641. The project is located in a seismically active area.

Mitigation Actions

642. The Project will be designed taking into account all relevant seismic codes.

G.7 Ecological Resources

G.7.1 Flora

Potential Impacts

643. Potential impacts to flora are limited due to the fact that the Project will be located inside of the site boundaries within an area that is currently utilized as a lay-down area for TPP1 construction materials.

Mitigation Actions

644. No mitigation measures required.

G.7.2 Avifauna

Potential Impacts

645. The addition of four new discharge stacks to the TPC might have an effect on overflying birds following migration routes. The hot exhaust from the stacks will have a significant vertical velocity at the point of discharge and also positive buoyancy that will cause the exhaust to rise, and this might possibly affect any migrating flocks flying through it. However, any additional impact of this sort over that from the existing 270 m stack of TPP0, the two TPP0 stacks of the preheat and district heating boilers, and the four stacks of TPP1 is likely to be minimal.

G.7.3 Fauna

Potential Impacts

646. Talimarjan Reservoir – The Talimarjan Reservoir provides a man-made wetland habitat and regular changes in the water level during the year allow marginal vegetation to thrive along the banks. The construction and operation of the TPP2 would not result in any significant change in the existing pattern of water level changes in the reservoir, and therefore in the habitat that it provides.

647. KMK – The KMK is an engineered watercourse, fed by a pumping system from the Amu Darya. It does not constitute a natural freshwater ecosystem. However, as noted a number of fish species can be found in the KMK. The main impact from the TPC will be the thermal discharge to the KMK which is discussed in detail under **Item G.5**.

Mitigation Actions

648. None, other than those specified for thermal discharge under **Section G.6.6**.

G.7.4 Forests and Protected areas

Potential Impacts

649. No protected areas are within 100 km of the Project area.

Mitigation Actions

650. None required.

G.8 Economic Development

G.8.1 Infrastructure & Transportation Facilities

Potential Impacts

651. During the construction phase of TPP1 the access roads to Talimarjan and Nuriston have been somewhat degraded by the movement of heavy goods vehicles transporting equipment to the TPP1 site. The main route to the site is shown by **Figure G-17**. It is likely that these roads will suffer further damage during the construction phase of TPP2.

Figure G-17: Access road to TPP2

652. Equipment for the construction of TPP2 will need to be transported long distances, often by road. During the TPP1 construction phase the Project was delayed significantly due to poor logistics planning. Issues included the poor condition of existing roads in Uzbekistan (and regionally) which led to the delay of equipment reaching the site. In addition, due to the size of certain pieces of equipment overhead transmission lines had to be lifted in order for delivery trucks to pass underneath them (the maximum height for transmission lines above a roadway is around 8m). These issues can lead to temporary disruptions to traffic.

653. Traffic levels are not anticipated to change significantly during the operational period of the Project. It is assumed that most of the 76 TPP2 workers will live in Nuriston or Karshi and as only a maximum of 20-30 additional car journeys will be undertaken per day. Nuriston has a population of more than 5,000 and Karshi has a population of more than 200,000. 80 additional TPP2 workers (many of which will may already live in Nuriston, Karshi or villages in between) will not place any additional pressure on accommodation in these areas.

Mitigation Actions

Transportation

654. To mitigate the potential impacts the EPC Contractor should:

- Submit a Traffic Management Plan to local traffic authorities prior to mobilization and include the plan as part of his SSEMP;
- Provide information to the public about the scope and schedule of construction activities and expected disruptions and access restrictions;
- Allow for adequate traffic flow around construction areas;
- Provide adequate traffic signs, appropriate lighting, well-designed traffic safety signs, barriers and flag persons for traffic control; and
- Provide temporary access where accessibility is temporarily restricted due to civil works.

655. The volume of construction traffic is considered to be intensive truck traffic and will need to be managed both in terms of surface damage. A road condition survey will be conducted prior to construction in order to gauge the damage to the road as a result of the intensive heavy traffic. If the Engineer considers that the EPC Contractors vehicles have caused damage to access roads during construction he will be asked to rehabilitate the road to a condition acceptable to the Engineer.

Utilities

656. The size of equipment being transported may require overhead transmission lines to be lifted to allow access. The EPC Contractor should, as part of his traffic management plan, indicate how he intends to manage this issue to avoid delays.

G.8.2 Land use

Potential Impacts

638. None identified.

Mitigation Actions

657. None Warranted.

G.8.3 Waste Management

Potential Impacts

658. Non-hazardous and hazardous wastes will be generated that will require to be transported and disposed of in a manner protective of the natural and human environment. Improper storage, handling and transport of solid and liquid wastes at the power plant can lead to loss of containment and spillages which could give rise to soil and ground water contamination.

659. Construction wastes will comprise general domestic waste including sanitary and food waste, office waste, organic material, small volumes of wastes arising from mobile plant, chiefly waste lubricating oil and packing materials (e.g. crates).

660. Operational phase waste streams are as follows:

- Used generator and turbine lube oil (collected in a tank on site and then removed off-site in drums for controlled disposal);
- Spent gas turbine fabric air filter cartridges;
- Spent gas turbine lube-oil filter cartridges;
- Spent office consumables (paper, printer cartridges etc.);
- Organic waste food from canteen operations and organic cooking oil waste from canteen operations;
- Glass waste and metal can waste from canteen operations;
- Scrap steel and copper from irreparable mechanical equipment;
- Scrap plastics from equipment packaging;
- Dry solids (mineral salts) recovered from zero discharge reverse osmosis process;
- Spent resins from water demineralization;
- Waste solvents and grease from workshop equipment cleaning operations; and
- Spent laboratory chemicals from water testing and water treatment.

661. The precise volumes of waste are not currently known for TPP2 and no data has been made available by UE to compare with TPP1. The only data for comparison is from TPP0 which is illustrated BY **Table G-21** below.

Table G-21: TPP0 Water Types and Volumes (2016)

Waste Type	Volume	Disposal Location
Solid Waste	1,046 tons	Nurtiston 'Brake Yard'
Various Fluorescent Lightbulbs	35.7 kg	No details
Waste Oil	0.145 tons	0.14 tons recycled at TPC for lubrication
Oily Rags	0.195 tons	Burned in TPP0 boiler
Ferrous Metals	249 tons	Sold for recycling
Non-ferrous Metals	18 tons	Sold for recycling
Tyres	0.6 tons	Stored in TPC garage.

662. Waste sewage water from TPP2 will be disposed of to the existing sewage treatment plant. Other liquid wastes will be treated and disposed of as per the waste water disposal method outlined in **Section G.6.6**.

Mitigation Actions

663. To ensure waste management is adequately controlled during both the construction and operational phase of the Project, the EPC Contractor shall be responsible for a range of measures including:

1. Waste Management Plan (WMP) – The WMP shall include items relating to the safe handling and management of:
- Domestic waste
- Food waste
- Recycled Waste
- Plastic
- Metals
- Wood
- Construction Waste

- Hazardous Waste
- Liquid Waste

For the construction phase oversight of the implementation of the WMP is the responsibility of the Engineer as outlined in the EMP. During the operational phase a waste management plan shall be prepared as part of an overarching ESMS.

2. Recycling and Reuse – Where possible, surplus materials will be reused or recycled – this should include asphalt, concrete, wood, plastic, metal and glass. A plan for the recycling of materials should be included in the WMP.

3. Storage of Hazardous Wastes – Oils, fuels and chemicals are substances which are hazardous to human health. They need to be stored properly in correctly labeled containers, both within the construction camp and also at construction areas. Oil and fuel should be stored in tanks with lined bunds to contain spillage (the bund should be able to contain at least 110% of the volume of the largest storage tank within the bund).

4. Waste Disposal – Waste, both hazardous and non-hazardous, shall be collected and disposed of by a licensed waste management contractor at a licensed waste management facility. The EPC Contractor will keep copies of the waste management company's licenses on file at his site office. The EPC Contractor shall also keep a record of the waste volumes and types removed from the site and the waste transfer notes provided by the waste management contractor.

TPP2 waste will not be disposed of in any landfill, including the location close to Nuriston, until all necessary licenses have been obtained by the landfill operator and the licenses have been reviewed by the Engineer.

7. Liquid Waste – The issue of liquid waste, including concrete sludge, camp run-off water, vehicle washing water, batching plant wastewater, etc., is discussed above under item **G.6.6 – Surface Water Hydrology** and **G.8.4 Construction Camps & Concrete Batching Plants.**

664. As part of the operational phase ESMS a waste management plan should be provided describing the waste management procedures for the TPC as a whole. The plan shall include a list of all waste types generated at the site and their final disposal locations which shall be GoU approved sites.

G.8.4 Construction Camps & Concrete Batching Plants

Potential Impacts

665. Construction camps constitute a temporary land use change and raise issues related to activities such as impacts to air quality; poor sanitation arrangement and improper methods used for disposal of solid wastes and effluent; and transmission of communicable diseases to the local people by the construction workers due to inappropriate health monitoring facilities. Specific issues may arise as a result of the following:

- Design and Siting – Improper siting and design of construction camps can have negative impacts to hydrology through inappropriate disposal of liquid waste and spills of hazardous liquids. Poor management of sanitary waste and accidental spills of hazardous liquids from construction camps can also have negative impacts on ground and surface water. Concrete batching plants can also have impacts on

sensitive receptors located downwind of the sites if the plants are too close to the urban areas.

- Concrete Batching Plants – Potential pollutants in batching plant wastewater include cement, sand, aggregates and petroleum products. The main sources of wastewater at batching plants are; contaminated storm water runoff, dust control sprinklers, the agitator washout station, the agitator charging station, the slumping station, and cleaning and washing areas. These substances can adversely affect the environment by:
  - increasing water pH
  - increasing the turbidity of waterways (turbidity is a measure of the cloudiness of a suspension).

Mitigation Actions

666. Construction Camps – It is assumed that the EPC Contractor will use the same construction camp facilities currently in place for TPP1. No extra accommodation areas would be needed as the construction works will require the same number of workers (approximately 800) as TPP1. However, should the new Contractor decide to remove the existing camp and construct his own, the following conditions will apply.

667. In the first instance, no construction camp shall be located within one kilometer of an urban area (or 500 meters of an individual property) and at least 50 meters from any surface water course, this will help reduce noise, water and air quality impacts. The Engineer shall approve the locations of the EPC Contractors camps prior to the establishment of the camp, In addition, the EPC Contractor shall be responsible for the preparation of a Construction Camp Site Plan which will form part of the SSEMP. The Plan shall indicate the system proposed and the locations of related facilities in the site, including latrines, holding areas, etc. The EPC Contractor shall ensure the following conditions are met within the Plan:

(1) Rain-water run-off arising on the site shall be collected, removed from the site via a suitable and properly designed temporary drainage system and disposed of at a location and in a manner that will cause neither pollution nor nuisance. The drainage system should be fitted with oil and grease interceptors.
(2) There shall be no direct discharge of sanitary or wash water to surface water. Septic tanks shall be provided at construction camps for sewage water. Licensed contractors will be required to collect and disposal of liquid waste from the septic tanks on regular basis.
(3) Disposal of materials such as, but not limited to, lubricating oil and onto the ground or water bodies shall be prohibited.
(4) Liquid material storage containment areas shall not drain directly to surface water.
(5) Waste water from vehicle washing bays should be free of pollutants if the wash bay has been constructed correctly. **Appendix F** provides a schematic of a vehicle washing bay that should be considered by the EPC Contractor.
(6) Lubricating and fuel oil spills shall be cleaned up immediately and spill clean-up materials shall be maintained at the storage area.
(7) Construction and work sites will be equipped with sanitary latrines that do not pollute surface waters and are connected to septic tanks, or waste water treatment facilities.
(8) Discharge of sediment-laden construction water directly into surface watercourses will be forbidden. Sediment laden construction water will be discharged into settling lagoons or tanks prior to final discharge.
(9) Washing out concrete trucks at construction sites shall be prohibited unless specific concrete washout areas are provided for this purpose at the

construction site (e.g. a bridge site). The washouts should be impermeable and emptied when 75% full.

(10) Spill clean up equipment will be maintained on site (including at the site maintenance yard and vehicle fueling areas). The following conditions to avoid adverse impacts due to improper fuel and chemical storage:

- Fueling operations shall occur only within containment areas.
- All fuel and chemical storage (if any) shall be sited on an impervious base within a bund and secured by fencing. The storage area shall be located away from any watercourse or wetlands. The base and bund walls shall be impermeable and of sufficient capacity to contain 110 % of the volume of tanks.
- Filling and refueling shall be strictly controlled and subject to formal procedures and will take place within areas surrounded by bunds to contain spills / leaks of potentially contaminating liquids.
- All valves and trigger guns shall be resistant to unauthorized interference and vandalism and be turned off and securely locked when not in use.
- The contents of any tank or drum shall be clearly marked. Measures shall be taken to ensure that no contaminated discharges enter any drain or watercourses.
- Disposal of lubricating oil and other potentially hazardous liquids onto the ground or water bodies will be prohibited.
- Should any accidental spills occur immediate clean up will be undertaken and all cleanup materials stored in a secure area for disposal to a site authorized to dispose of hazardous waste.

668. Site plans shall be devised to ensure that, insofar as possible, all construction camps are located at least 50 meters away from a watercourse, stream, or canal. If determined warranted by the Engineer, the EPC Contractor shall provide a wash pit or a wheel washing and/or vehicle cleaning facility at the exits from the sites. If so requested, the EPC Contractor shall ensure that all vehicle are properly cleaned (bodies and tires are free of sand and mud) prior to leaving the site areas. The EPC Contractor shall provide necessary cleaning facilities on site and ensure that no water or debris from such cleaning operations is deposited off-site. The Engineer shall undertake regular monitoring of the construction camps to ensure compliance with the SSEMP and the Construction Camp Site Plan.

669. Concrete Batching Plants – The EPC Contractor will most likely utilize the existing concrete batching plant servicing TPP1. During the construction phase a number of environmental issues were identified at the concrete batching plant. To ensure that the concrete batching plant operates in a manner to prevent pollution the contractor shall ensure that the existing plant meets the conditions specified below:

- To limit impacts from dust, the following conditions shall apply:
  - The entire batching area traversed by vehicles – including driveways leading into and out of the area – should be paved with a hard, impervious material.
  - Sand and aggregates should be delivered in a dampened state, using covered trucks. If the materials have dried out during transit they should be re-wetted before being dumped into the storage bunker.
  - Sand and aggregates should be stored in a hopper or bunker which shields the materials from winds. The bunker should enclose the stockpile on three sides. The walls should extend one metre above the height of the maximum quantity of raw material kept on site, and extend two metres beyond the front of the stockpile.

  - The hopper or bunker should be fitted with water sprays which keep the stored material damp at all times. Monitor the water content of the stockpile to ensure it is maintained in a damp condition.
  - Overhead storage bins should be totally enclosed. The swivel chute area and transfer point from the conveyor should also be enclosed.
  - Rubber curtain seals may be needed to protect the opening of the overhead bin from winds.
  - Conveyor belts which are exposed to the wind and used for raw material transfer should be effectively enclosed, to ensure dust is not blown off the conveyor during transit. Conveyor transfer points and hopper discharge areas should be fully enclosed.
  - Conveyor belts should be fitted with belt cleaners on the return side of the belt.
  - Weigh hoppers at front end loader plants should be roofed and have weigh hoppers shrouded on three sides, to protect the contents from the wind. The raw materials transferred by the front end loader should be damp, as they are taken from a dampened stockpile.
  - Store cement in sealed, dust-tight storage silos. All hatches, inspection points and duct work should be dust-tight.
  - Silos should be equipped with a high level sensor alarm and an automatic delivery shut-down switch to prevent overfilling.
  - Cement dust emissions from the silo during filling operations must be minimised. The minimum acceptable performance is obtained using a fabric filter dust collector.
  - Totally enclose the cement weigh hopper, to ensure that dust cannot escape to the atmosphere.
  - An inspection of all dust control components should be performed routinely – for example, at least weekly.
  - Batching Plants will not be permitted within 1 kilometer of urban areas.
- All contaminated storm water and process wastewater should be collected and retained on site.
- All sources of wastewater should be paved and bunded. The specific areas that should be paved and bunded include; the agitator washout area, the truck washing area, the concrete batching area, and any other area that may generate storm water contaminated with cement dust or residues.
- Contaminated storm water and process wastewater should be captured and recycled by a system with the following specifications:
  - The system's storage capacity must be sufficient to store the runoff from the bunded areas generated by 20 mm of rain.
  - Water captured by the bunds should be diverted to a collection pit and then pumped to a storage tank for recycling.
  - An outlet (overflow drain) in the bund, one metre upstream of the collection pit, should divert excess rainwater from the bunded area when the pit fills due to heavy rain (more than 20 mm of rain over 24 hours).
  - Collection pits should contain a sloping sludge interceptor, to separate water and sediments. The sloping surface enables easy removal of sludge and sediments.
  - Wastewater should be pumped from the collection pit to a recycling tank. The pit should have a primary pump triggered by a float switch and a backup pump which automatically activates if the primary fails.
  - Wastewater stored in the recycling tank needs to be reused at the earliest possible opportunity. This will restore the system's storage capacity, ready to deal with wastewater generated by the next rainfall event. Uses for recycling tank water include concrete batching, spraying over stockpiles for dust control and washing out agitators.

G.8.5 Borrow Pits

Potential Impacts

670. Opening and operating of borrow pits can result in multiple environmental and social impacts, including degradation of productive soils, elevated levels of noise, degradation of air quality, etc.

Mitigation Measures

671. Several mitigation measures are recommended for borrow pits:

- If the EPC Contractor intends to use borrow pits operated by an independent organization then a due diligence review shall be carried out by the Engineer to confirm that the new site identified for use by the EPC Contractor is indeed operating or operable in an appropriate manner. This will include review of the borrow pits operational license and its potential environmental impacts, such as its proximity to sensitive receptors (No borrow pit shall be located within 500 m of a sensitive receptor, or within 50 m of a surface water course). A copy of the agreement between the operator and the EPC Contractor should also be provided to the Engineer.
- For any new borrow pit to be opened and operated by the EPC Contractor, the Contractor will be responsible for the preparation of a Borrow Pit Action Plan (BAP). The BAP will be submitted to the Engineer prior to the start of construction. The plan will identify the locations of all proposed borrow pits which will also be approved by both the Engineer, Goskompriroda and representatives of the EA. The plan shall ensure that:
  - Pit restoration will follow the completion of works in full compliance with all applicable standards and specifications.
  - Arrangements for opening and using material borrow pits will contain enforceable provisions.
  - The excavation and restoration of the borrow areas and their surroundings, in an environmentally sound manner to the satisfaction of the Engineer will be required before final acceptance and payment under the terms of contracts.
  - Additional borrow pits will not be opened without the restoration of those areas no longer in use.

G.9 Social and Cultural Aspects

G.9.1 Employment Creation, Skills Enhancement and Local Business Opportunities

672. The Project is expected to generate positive impacts on the local economy and livelihoods in terms of employment and skills enhancement and local business opportunities through the procurement of goods and services.

673. Positive impacts will be primarily associated with the construction phase and therefore temporary in nature. The termination of construction contracts will occur once construction activities are completed. Workers who have relocated to the area for the Project are likely to leave the area in search of other opportunities, especially if they are permanent employees of contractors and subcontractors.

674. Those who have worked on the Project will have an advantage when seeking alternative jobs on similar projects due to the experience and any training received through this Project.

675. The construction phase will last approximately 36 months (including 12 months commissioning phase) in duration and it is expected that approximately 800 direct employment opportunities will be available during the peak of construction. The breakdown of skills required during the construction phase will be as follows:

- Skilled labour: 58 percent;
- Semi-skilled labour: 20 percent; and
- Unskilled labour: 22 percent.

676. It is assumed that most of the construction staff will move directly from TPP1 construction phase to the TPP2 construction phase.

677. The power plant will be operated on a 24 hour, 7 days a week basis for the duration of the operation phase. As the plant will operate 24 hours a day, three full-time shifts will be created per day, and the breakdown of the skills required will be as follows:

- Skilled labor: 65 – 70 percent;
- Semi-skilled labor: 15 – 20 percent; and
- Unskilled labor: 10 – 15 percent.

678. Indirect employment through the construction supply chain will be limited as the major components of the power plant are highly specialized and will be manufactured outside of Uzbekistan. Local procurement is going to benefit the hospitality and service industries primarily, such as accommodation, catering, cleaning, transport and security services. Local businesses will benefit during the construction phase as there will be increased spending within the area by the wage labor who will have improved buying power while employed by the Project.

679. During the operation phase the contracts that were in place during the construction phase will be terminated and procurement opportunities will be centered around maintenance activities, and providing goods and services to the Project. For those companies that meet eligibility criteria, become approved suppliers and enter the supply chain, there will be long-lasting and sustained benefits to the businesses and their employees through increased experience, capacity and training. As such, during the operation phase there will be opportunity for local business growth and development.

G.9.2 Community Health and Safety

Potential Impacts

680. The presence of the Project could affect the health, safety and security of the communities in the area of influence as a result of worker-community interactions, in-migration to the area, increased incomes in the local community that may be used for drugs, alcohol and prostitution, the risk of injury associated with construction and operational activities, increased pressure on health care resources and changes to the environment.

Construction Phase Impacts

681. Potential impacts due to the proposed construction can be identified as follows:

- Workforce, Jobseekers and Social Conflict. In some instances the local population may not be able to provide the necessary skilled workers for the Project. In such cases workers from other regions, or other countries may be employed by the EPC Contractor. This could lead to social tensions and potential conflict if these workers are not aware of local customs and practices. An increase in disposable income within the Project area (among Project workers, both local and external) may also result in a change in spending habits and behavior resulting in increase in alcohol and drug abuse, increased incidences of prostitution and casual sexual relations, which poses a threat to community health and safety.
- Pressure on Social Infrastructure and Services. During the construction phase workers will be accommodated on-site and as such there will be no pressure on local housing stock. In addition, the EPC Contractor will also have his own on-site medical facilities. Any serious injuries will be treated either at the Nuriston medical center or at the Karshi Hospital (TPC does not have an ambulance to transport injured patients).
- Road Safety. Construction of TPP2 will require a large amount of vehicle movements, locally and nationally. These may result in a slight increase in the total number of road traffic accidents between vehicles, pedestrians and vehicles (especially in the areas close to schools and colleges) and livestock and vehicles.
- Air quality and noise. Potential air and noise issues and their impacts to the local population are discussed above under items **G.6.1 – Air Quality**, **Item G.8.4 – Construction Camps and Batching Plants** and **Item G.9.6 – Noise.**

Commissioning Phase Impacts

682. Air Quality & Noise – Potential air and noise issues and their impacts to the local population are discussed above under items **G.6.1 – Air Quality**, **Item G.8.4 – Construction Camps and Batching Plants** and **Item G.9.6 – Noise.**

Operational Phase Impacts

683. Workforce, Jobseekers and Social Conflict. During the operational phase around 75 people will be employed on TPP2. This low number of staff will not create significant social conflict with locals as most of the staff will be either locally sourced, or from Uzbekistan.

684. Potable Water. It has been noted that residents of Mekhnatabad have been drinking water from the KMK upstream from the TPC. Although Mekhnatabad is upstream of the TPC and there are no impacts from the TPC upstream, the water should still not be consumed as potable water due to the fact the water is only intended to meet water quality guidelines for irrigation water.

685. Road Safety. The operational phase of the Project will not require a significant amount of vehicle movements and no road safety issues are anticipated.

686. Air Quality & Noise – No significant air quality or noise impacts from the TPC are anticipated to affect the residents of Nuriston or Mekhnatabad. These issues are discussed in detail above under items **G.6.1 – Air Quality**, **Item G.8.4 – Construction Camps and Batching Plants** and **Item G.9.6 – Noise** and below under SGCC.

687. SGCC – Various comments were made during the consultation process about air emissions from SGCC affecting the health of the population in Nuriston. SGCC is

not part of the Project itself and is owned and operated by Uzbekneftegas. However, the SGCC does supply processed gas from Shurtan gas fields to the TPC. Concerns regarding air emissions from SGCC were also raised by residents during the consultations for the Oltin Yol EIA. Discussions with Doctors at the health facility in Nuriston indicated that air emissions from SGCC could be impacting upon the health of SGCC workers and potentially to the population living in the immediate vicinity of the SGCC. However, they also noted that no emissions related health impacts had been identified associated with the TPC.

688. A HIA undertaken as part of this EIA lacked enough long term data to determine if SGCC was in fact the source of health issues in the Project area. However, it is clear that the local population feel that SGCC is the source of high levels of air emissions that are making people unwell.

689. In addition, air quality modeling of TPP2 indicates that there are no significant levels of emissions from TPP2 that would cause harm to human health if the plant operates to its intended specification.

Mitigation Measures

Construction Phase Mitigation

690. Mitigation measures to limit community health and safety impacts include:

691. Road Safety – The EPC Contractor will be responsible for preparing a traffic management plan (TMP) for the construction phase of the Project. The TMP will include specific conditions for traffic management around Nuriston.

692. Social Conflicts. The EPC Contractor shall provide regular health and safety training to their workers which will include sessions on social and cultural awareness. The EPC Contractor will also sub-contract an organization to develop and implement an HIV/AIDS policy and information document for all workers directly related to the Project. The information document will address factual health issues as well as behavior change issues around the transmission and infection of HIV/AIDS. In addition, the EPC Contractor shall develop an induction program, including a Code of Conduct, for all workers directly related to the Project. A copy of the Code of Conduct is to be presented to all workers and signed by each person. The Code of Conduct must address the following aspects:

- Respect for local residents and customs;
- Zero tolerance of bribery or corruption;
- Zero tolerance of illegal activities by construction personnel including:
    - unlicensed prostitution;
    - illegal sale or purchase of alcohol;
    - sale, purchase or consumption of drugs; and
    - illegal gambling or fighting.
- No alcohol and drugs policy during working time or at times that will affect ability to work; and
- Description of disciplinary measures for infringement of the Code and company rules. If workers are found to be in contravention of the Code of Conduct, which they signed at the commencement of their contract, they will face disciplinary procedures that could result in dismissal.

Operational Phase Mitigation

693. SGCC - As noted in the air quality assessment above, air emissions from TPC will not result in any levels of NOx or CO above national and EU air quality standards. In addition, real time monitoring of air emissions from the TPC stack (NOx and CO) and continuous ambient air quality monitoring in Nuriston shall be undertaken during the operational phase of the Project to continually assess air quality in the Project area and ensure that emissions to air from the TPC are not affecting the local community. The ambient air quality monitoring stations in Nuriston will measure NOx and CO as well as SO_2 and Benzene (elevated levels of which were identified in the Oltin Yol EIA which is located adjacent to SGCC).

694. Potable Water – Residents of Mekhnatabad are drinking water from the KMK despite the fact that they can purchase potable water from water tanker trucks. Although a water supply system is beyond the scope of the Project, ADB may wish to consider future funding of such a project in Mekhnatabad to resolve this situation. However, this may no completely eliminate the issue which also requires an increased understanding within the population of the health issues associated with drinking non-potable water.

G.9.3 Workers' Rights & Occupational Health and Safety

695. Workers' rights including occupational health and safety need to be considered to avoid accidents and injuries, loss of man-hours, labor abuses and to ensure fair treatment, remuneration and working and living conditions. These issues will be considered not only for workers who are directly employed by the Project but also contractors (including sub-contractors) and workers within the supply chain. The main risks in relation to worker's management and rights are associated with the use of contractors and subcontractors and the supply chain.

Potential Impacts

696. The Project is expected create 800 direct employment opportunities during the peak of the construction period, which will be approximately 36 months in duration. The majority of workers will be engaged by the Contractor and will consist of a semi-skilled to skilled workforce. The operation phase is planned for a lifespan of 25 – 30 years and will involve around 75 permanent site employees including skilled and semi-skilled staff.

697. The expected impacts on worker rights and H&S as a result of construction, operation and decommissioning activities and Project operation are as follows:

- Risk to workers H&S due to hazardous construction activities;
- Risk to workers H&S due to hazardous operation activities (including exposure to elevated noise levels); and
- Violation of workers' rights.

698. Construction and operational activities will involve the operation of heavy equipment and trucks, working at height, working in confined spaces, construction traffic, use of electric devices, handling of hazardous materials and other hazardous activities. Due to the nature of the activities being undertaken during construction, worker H&S is a key risk with the potential for accidents that may result in injuries and fatalities as well as lost man-hours.

Mitigation Actions

699. An Occupational Health and Safety (OHS) Plan shall be prepared by the EPC Contractor to manage worker safety. The OHS Plan shall include the following items:

1. OHS Risk Assessment. The assessment will identify all hazards in the workplace, assess the significance of the risks and propose measures to eliminate or control the risks.
2. Safety Training Program. A Safety Training Program is required and shall consist of:
    a. Initial Safety Induction Course. All workmen shall be required to attend a safety induction course before they can access the site.
    b. Periodic Safety Training Courses. Period safety course shall be conducted not less than once every six months. All Subcontractor employees will be required to participate in relevant training courses appropriate to the nature, scale and duration of the subcontract works. Training courses for all workmen on the Site and at all levels of supervision and management.
3. Safety Meetings. Regular safety meetings will be conducted on a weekly and monthly basis and shall require attendance by the safety representatives of Subcontractors unless otherwise agreed by the Engineer. The Engineer will be notified of all safety meetings in advance. The Engineer may attend in person or by representative at his discretion. The minutes of all safety meetings will be taken and sent to the Engineer within seven days of the meeting.
4. Toolbox Meetings – Daily toolbox OHS sessions shall be provided by the EPC Contractor to his staff. EPC Contractor staff shall be informed a day in advance of the toolbox sessions and attendance will be compulsory. A record of all toolbox training sessions will be kept by the EPC Contractor, including of log signed by participants.
5. Safety Inspections. The EPC Contractor shall regularly inspect, test and maintain all safety equipment, scaffolds, guardrails, working platforms, hoists, ladders and other means of access, lifting, lighting, signing and guarding equipment. Lights and signs shall be kept clear of obstructions and legible to read. Equipment, which is damaged, dirty, incorrectly positioned or not in working order, shall be repaired or replaced immediately.
6. Personal Protective Equipment (PPE) – Workers shall be provided (before they start work) with of appropriate PPE suitable for electrical work such as safety boots, helmets, gloves, protective clothes, goggles, and ear protection at no cost to the workers.
7. A plan for annual medicals to test workers hearing and general health.

700. The OHS plan shall be in compliance with the following regulations:

- Law about Labor (1993);
- Law about Industrial Safety of dangerous industrial bodies (2006);
- 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-transmission equipment. (1991);
- The Order of Uzbek Supervision Agency of Ruz in Power industry “Uzgos nadzor” “About confirmation of rules for personal work organizing (2002); and
- IFC EHS Guidelines for Thermal Power Plants and Community Health and Safety.

701. Regarding noise exposure levels, during the construction and operational phase of the Project workers shall not be exposed to noise levels greater than 85 dB(A) for an eight hour period without hearing protection. During the construction phase periodic monitoring of noise levels around the construction site should be undertaken by the Contractors environmental staff. This can be achieved using hand held noise monitoring equipment. Likewise, during the operational phase of the Project the TPP0 Environmental Manager shall also undertake periodic assessments of noise levels around TPC using hand held noise monitoring equipment to ensure that in areas generating noise above 85 dB(A) workers are wearing the appropriate PPE.

702. In addition, all Project sub-contractors will be supplied with copies of the SSEMP and its OHS Plan. Provisions will be incorporated into all sub-contracts to ensure the compliance with the SSEMP at all tiers of the sub-contracting. All subcontractors will be required to appoint a safety representative who shall be available on the Site throughout the operational period of the respective sub-contract unless the Engineers approval to the contrary is given in writing. In the event of the Engineer's approval being given, the Engineer, without prejudice to their other duties and responsibilities, shall ensure, as far as is practically possible, that employees of subcontractors of all tiers are conversant with appropriate parts of the SSEMP.

703. UE TPP shall also prepare an OHS plan for the operational phase of the Project. The OHS plan should form part of an overarching ESMS.

G.9.4 Emergency Response Planning

Potential Impacts

704. Emergency situations may arise during the construction, commissioning and operational phase of the Project, for example, fires and explosions (through poor management and storage of fuels and chemicals), or impacts caused by earthquakes.

Mitigation Measures

Construction and Commissioning Phase

705. The EPC Contractor will be responsible for preparation of an Emergency Response Plan (ERP) which will include sections relating to:

- Containment of hazardous materials;
- Oil and fuel spills;
- Fire, gas leaks and explosions;
- Community Health and Safety;
- Work-site accidents; and
- Earthquake and other natural hazards.

706. The plan will detail the process for handling, and subsequently reporting, emergencies, and specify the organizational structure (including responsibilities of nominated personnel). The plan will be submitted to the Engineer for approval. Implementation of the plan will be monitored by the Engineer. Any emergencies, and how they were handled, will be reported in monthly progress reports by the EPC Contractor to the Engineer. The Engineer will also provide periodic monitoring of the EPC Contractors works throughout construction to ensure the ERP is implemented effectively. The plan will be compliant with all aspects of the IFC EHS Guidelines for Thermal Power Plants and Community Health and Safety.

707. The Contractor shall also prepare a series of community briefings in Mekhnatabad and Nuriston relating to emergency response and the ERP. The first briefings shall occur before the start of the construction phase and then re-occurring on a six month basis throughout the construction and commissioning phases.

708. UE TPP will also need to prepare a ERP for the operational phase of the Project. The ERP should form part of a TPC wide ESMS.

G.9.5 Physical and Cultural Resources

Potential Impacts

709. No physical or cultural resources have been identified within the TPP2 site. However, although considered highly unlikely, chance finds could occur during excavation work at the site.

Mitigation Actions

710. In the event of any chance finds during the construction works procedures shall apply that are governed by Uzbek legislation and guidelines.

G.9.6 Noise

711. Assumptions and Limitations - This assessment of noise impacts is based on an assumed plant inventory for the construction and operational phases of the Project. These will be confirmed by the EPC Contractor prior to commencement of each phase. Should there be significant differences between the assumed plant inventory and that used on site, additional assessments may be needed and the proposed noise mitigation measures should be updated and implemented accordingly.

712. Sensitive Receptors – The nearest sensitive receptors are the residents of Nuriston which is located approximately 500 meters north east from the front gates of TPP0, over 870 meters from TPP0 Main Power Block, and more than 1,100 meters from TPP2. The front gates of the TPC do not produce any significant noise. The nearest source of high noise levels to Nuriston is the afore mentioned TPP0 power block.

713. Other residential properties can be found more than 1,700 meters to the west of TPP2.

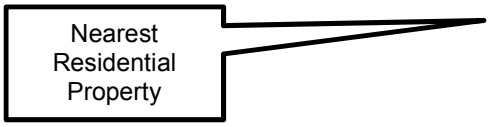
714. Assessment Methodology - The methodology adopted for the noise impact assessment is based on standard acoustics principles. The procedures of the assessment are summarized as follows:

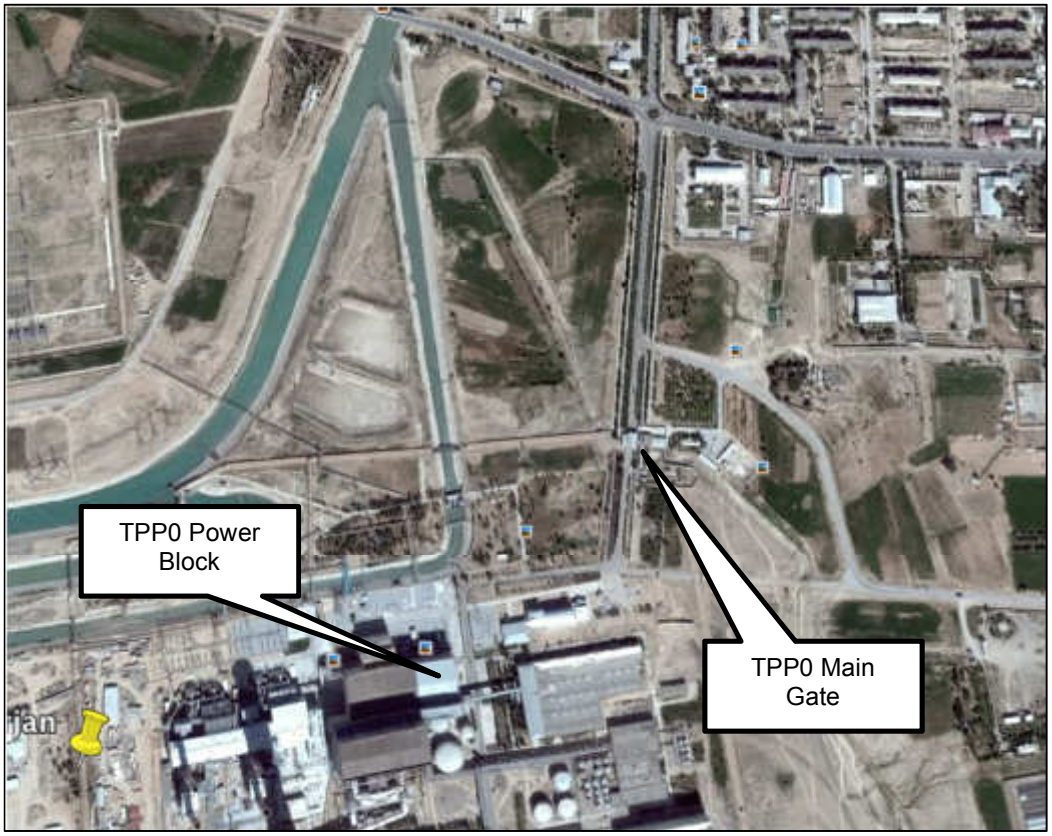
- Locate sensitive receptors that may be affected by the works;
- Assign Sound Power Level (SWL) to each plant item proposed and calculate the overall SWL associated with the proposed plant inventory;
- Determine the notional noise source positions of Project work sites; and
- Predict the construction noise levels at sensitive receptors on the basis of the plant activity and in built design controls.

Potential TPP2 Construction Noise Impacts

715. During construction and commissioning of TPP2 there will be short-term impacts on local residents caused by construction noise and vibration. Sources of noise will include increased traffic, construction equipment, venting of equipment during cleaning and testing, and test-running equipment (commissioning).

Figure G-18: Location of Nearest Sensitive Receptors





716. An indicative construction plant inventory for the construction activities during daytime period of the Project is summarized in **Table G-21.** Construction works will be carried out during daytime period from 0700 to 2000 hours. Construction works during nighttime and holidays will be carried out on an irregular basis, such as during testing and commissioning. It is expected that the construction equipment that will be used during nighttime period will not be more than that to be used during daytime period, as shown in **Table G-21**.

Table G-18: Indicative Plant Inventory Cumulative Noise Levels

Plant Item	Quantity during Peak Hour	Unit SWL, dB(A)[40]	Sub-total SWL, dB(A)	Overall SWL, dB(A)
Excavator	3	106	111	121
Bulldozer	3	109	114	
Dump Truck	3	109	114	
Batching Plant	1	108	108	
Vibrating Compactor	5	106	113	
Concrete Truck	3	100	105	
Concrete Pump	2	107	110	
Compressor	1	103	103	

[40] Noise and Vibration Control on Construction and Open Sites, Part 1. Code of Practice for Basic Information and Procedures for Noise and Vibration control. British Standard, BS5228: Part 1: 2009.

Genset (120kVA)	1	110	110	
Crawler Crane	3	95	100	
Hydraulic Crane	3	95	100	

717. Using 121 dB(A) as the cumulative noise level at the TPP2 construction site the noise level at in Nuriston (1.1 km distance from TPP2) would be approximately 60 dB(A). In Mekhnatabad (1.7 km to the west of TPP2) the noise level would be 56 dB(A). It is unlikely that all equipment items would be operating at one time, and that all would be emitting the maximum noise levels at one time. It is also noted that TPP1 and TPP0 will act as noise barrier between TPP2 and Nursiton. This may lead to a reduction of between 3 and 5 dB which would reduce actual noise levels in Nuriston to approximately 55-57 dB(A). .

718. To meet nighttime standards stricter guidelines, such as prohibiting certain types of noisy equipment during the night would reduce noise levels in residential areas below the IFC limits for nighttime noise.

Potential Operational Noise Impacts

719. Sources of Noise – For most gas-fired power plants, the major noise sources during base load operation are the air-cooled condenser (ACC) or cooling tower, steam turbine (ST), gas turbine, combustion inlet filter house, and the exhaust stack or HRSG. During startup or other transient conditions in combined cycle configurations, the high-pressure steam piping and condenser is a major noise producer, with steam bypassing the ST. The combustion turbine and generator are typically housed in acoustical enclosures, thereby dropping their respective noise source ranking. The following summarizes the noise issues from these pieces of equipment.

- Cooling Tower. The cooling tower, depending on the availability of water on site, is a major noise source for most facilities. For a cooling tower, noise emission is primarily due to the fans themselves, and propagation is a concern due to the high fan elevation above ground. At startup, more fans and cells are used for the larger condensing load. For a cooling tower, the fans also make noise, but water-fall noise is dominant. As an example, the noise level from a 9 x 4 cell cooling tower can range from 40 to 70 dB(A) at 125 meters away, with and without mitigation, respectively.
- ST. Another major noise source, the ST, actually consists of multiple sources: the steam turbine, generator, condenser, and condensate pumps. The steam turbine and generator usually come from the manufacturer with a weather enclosure.
- Steam Piping. In combined cycle facilities where startup or shutdown operation is included in the noise regulation, the high-pressure steam piping and condenser fans are major noise sources. High-pressure steam moving along pipes, elbows, valves, and vents causes high levels of mid-to-high-frequency noise.
- Exhaust Stack. The exhaust stack or HRSG is often the primary noise source in situations where low frequency is a concern.

720. **Table G-22** indicates the indicative plant inventory list and the noise emissions from each item.

Table G-22: Plant Inventory List and Noise Levels			
Plant Item	Quantity during Peak Hour	Sound Pressure Level (SPL) at 1m dB(A)	Overall SPL, dB(A)

HRSG	2	80	92
HRSG Stack	2	80	
Bypass Stack*	2	80	
GT Air Inlet	2	80	
GT Generator	2	80	
GT Transformer	2	80	
ST Hall	2	80	
ST Transformer	2	80	
Cooling Tower	1	80	

* Does not operate in tandem with HRSG Stack.

721. TPP1 includes contractual specifications stating that equipment should not generate noise levels above 80 decibels within 1 meter of the source of the noise, and TPP2 will be constructed to the same specifications. **Table G-22** indicates the indicative plant inventory list and assuming the noise levels from each of these areas in TPP2 is 80 decibels, the combined noise level would be approximately 92 dB(A) which should result in noise levels from TPP2 around 37 dB(A) in Nuriston.

722. There will be certain times when unusual operations are required, e.g. safety valve operation, start up operation or turbine bypass valves operation during plant start-up, plant shut-down and equipment failure or unit trip. Equipment specifications will state that noise levels will not exceed 95 dB(A) at the distance of 3 meters from the safety valve silencers, the start up valves silencers, and the turbine bypass valves. It is noted that TPP2 will however, be operated as a base load plant, therefore, these unusual operations are not likely to happen very often.

723. During the shut-down operation for maintenance purposes, the duration is about 60 minutes for turbine bypass valves operation. For the cold start-up (start-up after more than 45 hrs shut-down), the duration is up to 210 minutes for start up vent and turbine bypass valves operation. However, these occurrences will be only for scheduled maintenance shut-down (every 12,000 equivalent operating hours for Gas Turbines). Therefore, it is only about once a year or less per one block. In case of warm start, or hot start, or unit trip, the duration would be about 90 minutes or less. In case of equipment failure (and safety valve opens), the duration would be about 5 minutes. However, these occurrences are rare.

724. For planned shut-down and start-ups the community shall be informed in 4 hours in advance. In addition, no planned shut-down or start-ups shall occur between 10pm and 7am.

725. The vibration levels produced by the TPP2 CCGT equipment will be minimized by ensuring that equipment is maintained properly in balance at all times to reduce the generation of vibration at its source, and by providing suitable vibration isolation for all plant items such as turbines, generators, pumps, compressors, and fans from foundations or other structures and from connecting vents, ducts and pipes that might transmit the vibrations to the ground or to other plant items. The expected vibration level from sources in the TPP2 CCGT units will not exceed 50 dB(A) and will not be felt beyond operational area.

Design Phase Mitigation

726. As part of the EPC contract, noise emission performance specifications will be set for all major equipment items and for the plant overall including the requirement that ensures 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.

727. If equipment items in areas facing or radiating noise in the direction of Nuriston are limited to noise levels of 80 dB(A) at 1 m, attenuation as a function of distance alone will be sufficient to limit the noise exposure of residents to less than 45 dB(A) from TPP2. Unusual operations, which may lead to levels of noise as high as 95 dB(A) at the TPP2 site will not result in noise levels higher than 45 dB(A) in Nuriston.

728. All major equipment items will be located in buildings that will provide further attenuation of noise. The design of any additional noise attenuation measures for individual equipment items or for the buildings in which they are located, can be undertaken once equipment has been specified and selected and the specific noise emission characteristics of each item are known. However, as a guideline the following measures should be considered:

c) Cooling Towers: mitigation options include fan selection (larger, slower-turning fans), fan deck acoustic barrier walls, and air inlet acoustic baffles.
d) STG: An STG acoustic enclosure and pedestal barrier.
e) Combustion Inlet Filter House: acoustic baffles.
f) Exhaust Stack: Vertical silencers in the stack and horizontal silencers within the HRSG. Increase case thickness.
g) Steam Piping: an acoustical building housing the main pipe rack coupled with an acoustic shroud for the finger racks running along the HRSGs.

729. In addition, TPP1 and TPP0 will act as a natural noise barrier to the residential area of Nuriston to the north east of TPP2. All equipment items and plant designs will also include appropriate noise suppression on all air intakes, exhausts, and process vents. Potentially noisy pipe- and duct-work will have suitable noise insulation applied.

730. All equipment with the potential to create significant levels of vibration will be specified and installed with suitable vibration isolation from its foundations and also with flexible connections or other vibration isolation methods from all connected pipes and ducts where necessary. Pipes and ducts that may experience vibrations as a result of connected equipment or flow regimes will be hung or restrained using suitable vibration isolating mountings to prevent the transmission of vibrations to plant structures or other plant items.

731. Prior to the start of construction, and as part of his SSEMP, the EPC Contractor should also develop a noise management plan that would include the mitigation measures outlined below for the construction phase.

Construction Phase Mitigation

732. During the construction phase the EPC Contractor shall be responsible for the following:

- Implement nighttime noise restrictions between 20.00 and 07.00. This includes prohibiting the use of the equipment specified in **Table G-19** (that generates noise levels greater than 100 dB(A) during this period. If it is necessary to implement these activities during this time, the project must inform responsible local organizations and communities one week in advance.
- The Contractor shall measure site noise daily at the north east, west and southern boundary of TPP2. If noise levels are above 70 dBA the Contractor will place a limit

on the number and types of equipment that can operate at any one time so as to reduce noise levels below 70dBA at the boundary and thereby meet IFC noise limits for daytime noise in residential areas.

- Inform potentially noise-affected neighbours about the nature of construction stages and noise reduction measures.
- Give notice as early as possible for periods of noisier works such as excavation. Describe the activities and how long they are expected to take. Keep affected neighbours informed of progress.
- Within normal working hours, where it is reasonable to do so:
  - schedule noisy activities for less sensitive times.
  - provide periods of respite from noisier works (for example, periodic breaks from jackhammer noise).
- The weekend/evening work hours in the schedule (including Saturday afternoon or Sunday) are more sensitive times and have noise requirements consistent with quieter work.
- The weekend/evening periods are important for community rest and recreation and provide respite when noisy work has been conducted throughout the week. Accordingly, work should not usually be scheduled during these times.
- Site buildings, access roads and plant should be positioned such that the minimum disturbance occurs to the locality. Barriers such as hoardings or temporary enclosures should be used. The site should be planned to minimise the need for reversing of vehicles.
- All mechanical plant is to be silenced by the best practical means using current technology. Mechanical plant, including noise-suppression devices, should be maintained to the manufacturer's specifications. Internal combustion engines are to be fitted with a suitable muffler in good repair.
- Maintenance tools, machines and equipment so that they are in good conditions. When some wrong is found, they must be fixed immediately in order to reduce noise from the equipment.
- Fit all pneumatic tools with an effective silencer on their air exhaust port.
- Install less noisy movement/reversing warning systems for equipment and vehicles that will operate for extended periods, during sensitive times or in close proximity to sensitive sites. Occupational health and safety requirements for use of warning systems must be followed.
- Turn off plant when not being used.
- All vehicular movements to and from the site to only occur during the scheduled normal working hours, unless approval has been granted by the relevant authority.
- Keep good conditions of trucks that use to transport construction materials so they cause no loud noise and control the truck speed, to be not exceeded 40 km/hr when driving through communities, and not exceeded 80 km/hr when driving on highways.
- Where possible, no truck associated with the work should be left standing with its engine operating in a street adjacent to a residential area.
- Noise from the site needs to comply with the requirements of the schedule, except for:
  - unavoidable works [41]
  - night period low-noise or managed-impact works approved by the local authority.

[41] Unavoidable works are works that cannot practicably meet the schedule requirements because the work involves continuous work — such as a concrete pour — or would otherwise pose an unacceptable risk to life or property, or risk a major traffic hazard. Affected premises should be notified of the intended work, its duration and times of occurrence. The relevant authority must be contacted and any necessary approvals sought.

- Provision of noise protection kits such as ear plug, earmuff, for workers who are working in the area with noise level is higher than 85 dB(A). It is designated as a regulation that workers must wear protection kits in case of working in a noisy area.

Operational Phase Mitigation

733. During the operational phase of the Project UE TPP shall be responsible for the following:

- Preparation of a noise management plan, including a routine noise monitoring program. The noise management plan should form part of an overarching ESMS.
- Install signs or warning boards in the area with noise levels higher than 80 dB(A).
- Provision of noise protection kits, such as ear plug, earmuff, for workers who are working in the area with sound level is higher than 80 dB(A). There must be sufficient amount of these kits.
- Regular maintenance machineries and selection of relevant noise source control methods to reduce loud noise properly such as installation silencers mufflers at acoustic wall together with control noise devices at HRSG and gas turbine.
- Sound levels received by workers should not be over 85 dB(A), during continuation of 8 working hours.

Cumulative Noise Impacts

734. As noted above, TPP2 on its own will not have significant impacts on noise levels in Nuriston, or to TPC workers if the correct PPE is employed and exposure levels are controlled. TPP1 will function in an almost identical mode to TPP2, and as such the noise levels from TPP1 alone will also not lead to significant impacts to noise levels in Nuriston.

735. The most recent noise monitoring results undertaken for this EIA show maximum daytime noise levels at the boundary between TPP0 and TPP1 of 75 dB(A). This boundary is in the middle of the TPC, more than 1km from the nearest residential property, not the TPC site boundary.

736. The TPP1 EIA of 2009 reported noise levels from certain pieces of TPP0 equipment of more than 100 dB(A). Taking a relatively high level of 105 dB(A) as a representative noise level from TPP0 and combine with TPP1 and TPP2 noise levels (92 dB(A)) the cumulative noise levels from the TPC as a whole would be 101 dB(A). **Table G-23** illustrates how this cumulative noise from the TPC would reduce over distance.

Table G-23: Cumulative Noise Levels (dB(A))

#	Distance from source	TPP0	TPP1	TPP2	Cumulative*
1	1 m	105	92	92	105
2	100 m	65	52	52	65
3	250 m	57	44	44	57
4	500 m	51	38	38	51
5	750 m	47	34	34	47
6	1 km	45	32	32	45

* Cumulative noise is measured using the following equation: SPL= 10xLog ($10^{11.3}$+10^{90}+10^{90})

737. **Table G-23** shows that the cumulative noise levels during the operational phase of the TPC would be lower than the IFC and Uzbek noise standards for both

daytime and nighttime noise at residential receptors within 1km. It is noted that neither TPP1 or TPP2 actually contribute to cumulative noise levels and it is TPP0 that generates the high cumulative values. Therefore cumulative noise issues are an issue to be addressed by TPP0.

738. It is noted that 72 dB(A) was recorded at location 9 on the southern boundary of the TPC during independent noise monitoring for this EIA. The source of this elevated noise was TPP0 (assuming the noise emission performance specifications for TPP1 are being met), but is it not known exactly what piece of equipment caused this elevated noise level during the monitoring exercise. In addition, by using the cumulative noise level of 105 dBA from **Table G-23** it can be seen that noise levels at 870 meters (the distance from the nearest piece of high noise generating equipment at TPP0) would be 46dBA, one decibel above IFC nighttime guideline limits.

739. TPP0 is the route cause of the elevated cumulative noise levels. IFC guidelines specify that noise at the boundary of TPC should not exceed 70 dBA, this in turn will mean that noise levels do not exceed 45 dBA at any of the residential properties around TPC. Accordingly, TPP0 should not be generating noise levels greater than 70 dBA at the TPC boundary. This issue has been noted in the CAP for TPP0 and measure outlined to consider this issue further.

G.10 Compliance Impacts

740. In addition to the impacts associated with the construction and operation phases of the project several compliance impacts have also been identified as follows:

1. Lack of Environmental Clauses in Contracts – The EIA is an environmental statement prepared by UE. While it is prepared by the EIA consultant the EIA defines the commitment by the GOU through the proponent and its contractors and consultants, to implement the mitigation and monitoring actions listed in the EIA. For the measures proposed in the EIA‘s EMP to be taken seriously, they must become legally binding through inclusion as environmental clauses in the loan agreement between the GOU and the ADB as well as the specifications in the contract-bid documents. This will be achieved by integrating the EMP into the contract specifications as a clause and using the EMP to prepare the SSEMP defining specific steps to be taken by the contractors and the government during the project construction phase. References to the EMP will be made in the loan agreement between the GOU and ADB. It will be the Engineers responsibility to review the environmental mitigation and monitoring activities undertaken by the Contractor, with payments made only after verification that each work component has been completed as prescribed.

2. Lack of Construction Compliance Inspection Services and Environmental Training – While the EMP and the environmental covenants can be very clear and specific, if there is no one knowledgeable to undertake compliance monitoring, inspection and regular reporting, little of the EMP will be implemented or completed. The Engineer, through his Environmental Manager (EM) and International Environmental Specialist (IES), will ensure that compliance inspections are undertaken on a regular basis. In addition, the Engineers IES will also provide training to the EPC Contractor and his Environmental Officer in the correct implementation of the SSEMPs prior to the commencement of works.

G.11 Decommissioning

741. A detailed decommissioning and rehabilitation plan must be developed prior to decommissioning TPP2 and associated infrastructure. This plan should include, but not be limited to, management of socio-economic aspects such as employment loss, removal, re-use and recycling of materials and vegetative rehabilitation to prevent erosion.

742. The decommissioning activities will be similar to construction activities and therefore recommendations outlined to manage construction phase impacts should be adhered to during decommissioning. Management actions should focus on the rehabilitation of disturbed areas and the removal of infrastructure.

G.12 Induced Impacts

743. Only around 80 workers will be required to operate TPP2. No significant induced impacts are anticipated to arise from this increase in population that would most likely be spread between Karshi and Nuriston.

H. Environmental Management Plans and Institutional Requirements

H.1 Introduction

744. This section of the report provides the Projects Environmental Management Plan (EMP) and the necessary institutional requirements to implement the Plan. In addition, the approximate costs of the EMP is outlined.

H.2 EMP Institutional Requirements

745. The PMU will be responsible for implementation of the EMP to comply with ADB's safeguards requirements and environmental national regulations. For this, the PMU will hire a national environmental consultant to work together with the TPC environmental manager, who will work in the capacity of the PMU staff. The PMU will be assisted by the environmental specialists of the Engineer in overseeing the implementation of EMP.

746. The cost for implementing mitigation measures as outlined in the EMP will be included in the EPC contract, and the cost for environmental instrumental monitoring and supervision will be included in the consulting service of the Engineer, the cost for the assistance from the environmental consultant and capacity building will be included in PMU budget. A grievance redress mechanism (GRM) to handle both environmental and social safeguard issues will be established after the project affectivity.

747. If any change in design, unanticipated environmental or social impacts become apparent during project implementation, the PMU will be required to immediately inform ADB and (i) assess the significance of such unanticipated impacts; (ii) evaluate the options available to address them through a CAP; and (iii) prepare or update the EIA. ADB helps UE mobilize the resources required to mitigate any adverse unanticipated impacts or damage.

748. UzbekEnergo (UE) is responsible for CAP implementation using UE own resources. It is mandatory that ZVOS (Uzbekistan EIA) be prepared and relevant approvals be obtained from Glavgosecoexpertiza of Goskompriroda prior to the commencement of the project activities. The Provincial Nature Protection Committee will receive the project's semi-annual environmental monitoring reports from the PMU.

749. EPC Contractor will be responsible for implementing mitigation measures. Within 30 days after contract award and prior to commencing any physical works, Site-specific Environmental Management plans (SSEMPs) will be developed by the EPC Contractor under the guidance of the Engineer, and be endorsed by the Engineer before submission to PMU for approval. The SSEMP is the document that the EPC Contractor shall prepare outlining how he intends to implement the EMP at a specific site or for a specific issue to ensure that all mitigations are implemented as specified in the EMP.

750. PMU is responsible for supervising the Engineer and EPC Contractors in EMP implementation for overall compliance with SPS 2009 requirements and project environment-related legal covenants. The PMU's responsibilities include the following, but not limited to:

- Implement the EMP, including public health monitoring plan (PHMP), developed within the EIA, follow up with UE on CAPs for associated and existing facilities;
- Ensure the bidding documents of Engineer and EPC Contractor include all tasks as described in the approved EMP;
- Supervise the Engineer and EPC Contractor in EMP implementation for overall compliance with SPS 2009 requirements and project environment-related legal covenants;
- Ensure all necessary government permits and license, including ecological expertise opinion, for all civil works will be obtained;
- Approve SSEMPs which will be prepared by the EPC Contractor and endorsed by the Engineer;
- With assistance of the Engineer, prepare, submit to UE and ADB, and disclose semi-annual environmental monitoring reports on ADB website and in UZB;
- Report in a timely manner to ADB of any non-compliance or breaches with ADB safeguard requirements and take corrective actions promptly;
- Update the EIA in case of technical design changes or unanticipated impacts;
- Establish a Grievance Redress Mechanism (GRM) after the project effectivity and act as the GRM secretary to make sure that the GRM is operational to effectively handle environmental and social concerns of project affected persons;
- Build up and sustain institutional capacity in environmental management, health and safety, including conducting public awareness programs

751. UE Environmental Manager: TPP0 already has a functioning Environmental Manager. His responsibilities will also now include TPP1 and TPP2. The EIA recommends that UE TPP prepare an ESMS for the TPC during operational phase and that UE need to hire additional staff for environmental management.

752. EPC Contractor is responsible for implementing mitigation measures and should hire a full-time Environmental Officer (EO). The EO will be responsible for the preparation of weekly environmental checklists and an environmental section of the EPC Contractor's monthly progress reports that shall be submitted to the Engineer for review.

753. The monthly reports, which will include the weekly environmental checklists, shall contain sections relating to:

(1) General Progress of the Project.
(2) Environmental Incidents; e.g. spills of liquids, accidents, etc.
(3) Progress of any environmental initiatives, e.g. energy savings, recycling, etc.
(4) Records of any environmental monitoring, both observational and instrumental.
(5) Conclusions and Recommendations.

754. The EO shall provide daily toolbox training at the construction camp and construction sites. The EO shall keep a record of all monthly training and toolbox training undertaken.

755. The Engineer is responsible for reviewing designs, conducting environmental instrumental monitoring including public health monitoring plan (PHMP), providing

guidance and ensure safeguard compliance of civil works by the EPC contractor. The Engineer shall have the right to suspend works or payments if the EPC Contractor is in violation of any of his obligations under the EMP and SSEMPs. The Engineer will hire a part-time International Environmental Specialist (IES) and a full-time national Environmental Specialist (NES)

756. The IES will prepare a detailed action plan including environmental monitoring checklists to be completed by the NES. He/she will conduct environmental training and briefings to provide environmental awareness on ADB and the government environmental safeguards policies, requirements and standard operating procedures in conformity with the government's regulations and international practice for project and TPP2 PMU staff; ensure baseline monitoring and reporting requirements to UE and ADB.

757. The NES will (i) review all documents and reports regarding the integration of environmental including contractor's environmental action plan, (ii) supervise the contractors' compliance to EMP, and (iii) prepare monthly compliance reports.

H.3 Environmental Management Plan

758. The following table (**Table H-1**) provides the environmental mitigation and monitoring for the Project. Instrumental monitoring is also required as outlined below in **Table H-2**, **Table H-3** and **Table H-4**.

Table H-1: Mitigation and Monitoring Plan

Subject	Potential Impact / Issue	Mitigation Measure	Standards and Guidelines	Mitigation Responsibilities	Monitoring	Monitoring Responsibility & Schedule
		Pre-Construction Phase				
Air Quality	Construction impacts	Preparation of an Air Quality Plan (AQP).	• IFC EHS Guidelines for Air Emissions and Ambient Air Quality • IFC EHS Guidelines for Thermal Power Plants • National Air Quality Standards	• EPC Contractor to prepare AQP • Review and approve AQP.	Review and approve plan.	Engineer / Prior to the start of construction.
	Air quality impacts from stationary sources	• Locations for borrow pits and concrete batching plants require approval from the Engineer and Goskompriroda. • No borrow pit or batching plant shall be located within one kilometer of any urban area or sensitive receptor.	• IFC EHS Guidelines for Air Emissions and Ambient Air Quality • IFC EHS Guidelines for Thermal Power Plants • National Air Quality Standards	EPC Contractor to select sites.	Approval of sites.	Engineer and Goskompriroda / prior to construction.
	Ambient Air Quality	Installation of continuous ambient air quality monitoring stations.	• IFC EHS Guidelines for Air Emissions and Ambient Air Quality • IFC EHS Guidelines for Thermal Power Plants	EPC Contractor to install monitoring stations	N/A	N/A
	Stack emissions	• Designs to include 85 meter high emissions stacks. • Emission limits guaranteed to meet 50 mg/Nm³) for NO_x.	IFC EHS Guidelines for Thermal Power Plants	• EPC Contractor to design emission stacks according to the requirements. • EPC Contractor to	• Review and approve designs. • Review perform ance tests.	• Engineer / Prior to the start of construction • Engineer / during performance tests.

				guarantee values.		
Climate Change	Project related greenhouse gases	Prior to the start of the Project UE shall investigate options to offset Project related GHG emissions. This could involve forestation projects or renewable energy projects.	IFC EHS Guidelines for Thermal Power Plants	UE to prepare assessment and undertake project.	ADB	ADB to review and approve offset proposal.
Fish	Thermal pollution	A detailed fish survey for baseline data on fish population (abundance and richness) and behavior in the KMK, will be conducted in May-June 2018.	IFC EHS Guidelines for Thermal Power Plants	Engineer to commission the survey.	N/A	N/A
Cooling System	Water treatment	The water treatment for the cooling system of TPP2 will include biocide (sodium hypochlorite) dosage performed by a control and global monitoring equipment with automatic dosage calibration. Total residual chlorine will be measured at the discharge point continuously.	• IFC EHS Guidelines for Thermal Power Plants • IFC EHS General Guidelines	EPC Contractor	N/A	N/A
Surface Water	Thermal Pollution	Development of an operational model to ensure that thermal pollution of the KMK does not occur. The model shall ensure that If at anytime the discharge water temperature a) reaches 29 °C at the immediate mixing point all units; or b) reaches 3 °C above the ambient temperature at the edge of the mixing zone TPP2, or a combination of TPC units shall switch to recirculation mode.	• IFC EHS General Guidelines • National limits for thermal discharge to water bodies	EPC Contractor and TPP0 Management.	N/A	N/A
	Water Intake	The intakes for the water pumps in the main pump-house will meet the IFC guidelines, including recommended intake velocity of 0.15 m/s and a mesh size of 9.5mm.	IFC EHS Guidelines for Thermal Power Plants	EPC Contractor	Review and approve designs.	Engineer / prior to construction.

	Water Use	Ensure licenses for water abstraction from the KMK are up to date.	IFC EHS Guidelines for Thermal Power Plants	UE TPP	Review of permits	Engineer / prior to construction.
Borrow Pits	New Borrow Pits	• Obtain all necessary permits from the regulatory authorities. • Prepare a Borrow Pit Action Plan (BAP).	• IFC EHS Guidelines for Construction Materials Extraction. • National Regulations	EPC Contractor to select borrow sites and apply for approval from Goskompriroda and any other regulatory agencies.	Review borrow locations, licenses and approvals from Goskompriroda.	Engineer / prior to construction.
Soils	Contamination of Soils and Groundwater	Preparation of a Spill Response Plan	IFC EHS General Guidelines	• EPC Contractor to prepare AQP • Review and approve AQP.	Review and approve plan.	Engineer / Prior to the start of construction.
Waste and Spoil	Waste Management	• Prepare a Waste Management Plan (WMP). • Prior to start of construction, develop an inventory of waste fractions expected to be generated during construction for approval of disposal routes and sites by the Engineer. • Prior to the start of construction ensure that waste management contracts have been signed for all types of wastes.	• IFC EHS General Guidelines – Waste Management. • National Regulations.	• EPC Contractor to prepare WMP (including waste inventory, disposal site and haul routes). • EPC Contractor to arrange contracts with waste management contractors.	Review and approve WMP and review waste management contracts.	Engineer / Prior to the start of construction.
Construction Camps	Selection of Construction Camp Site	• Preparation of a Construction Camp Site Plan. • Construction camps shall not be located within one kilometer of an urban area and at least 50 meters from any surface water course.	IFC EHS General Guidelines	EPC Contractor to prepare camp site plan.	• Review & approve Site Plan. • Approve camp locations.	Engineer to approve site plan and construction camp prior to construction.

		• Coordinate all construction camp activities with neighboring land uses.				
Concrete Batching Plants	Concrete Batching Plants	No batching plant shall be located within one kilometer of an urban area and at least 50 meters from any surface water course.	IFC EHS General Guidelines	EPC Contractor to select site.	Approval of site location.	Engineer / prior to the start of construction.
Infrastructure	Road condition	Conduct an initial road condition survey in order to gauge the damage to the road as a result of the intensive heavy traffic.	N/A	EPC Contractor to undertake survey.	Review results of the survey	Engineer / prior to the start of construction.
Occupational Health and Safety	Worker Health and Safety	Prepare an Occupational Health and Safety Plan (OHS Plan) that is compliant with the Uzbekistan Labour Code and KMK "KMK 3.01.02-00 "Safety engineering during construction" and IFC EHS Guidelines.	• IFC EHS General Guidelines – OHS • Law about Labor (1993); • Law about Industrial Safety of dangerous industrial bodies (2006); • 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-transmission equipment. (1991); • The Order of Uzbek Supervision Agency of Ruz in Power industry "Uzgos nadzor" "About confirmation of rules for personal work organizing (2002); and • IFC EHS Guidelines for	EPC Contractor to prepare OHS Plan.	Review and approval of plan.	Engineer / prior to the start of construction.

			Thermal Power Plants and Community Health and Safety.			
	HIV / AIDS	Subcontract with an Approved Service Provider to provide an HIV Awareness Program to the Contractor's Personnel and the Local Community.	IFC EHS General Guidelines	EPC Contractor to prepare sub-contract.	• N/A	• N/A
	Traffic Safety	Submit a Traffic Management Plan to local traffic authorities prior to mobilization.	• IFC EHS General Guidelines • National regulations.	EPC Contractor to prepare Traffic Management Plan.	Review and approve Traffic Management Plan.	Engineer / prior to the start of construction.
Community Health and Safety	Community safety	A Quantitative risk assessment will be undertaken of the detailed design, to confirm no increase in risk to local community. This will feed into the ERP (see below).	IFC EHS General Guidelines	EPC Contractor to undertake assessment and include findings in the ERP.	N/A	N/A
Natural Hazards	Fires, explosions, earthquakes, etc.	Preparation of an Emergency Response Plan (ERP).	IFC EHS General Guidelines	EPC Contractor to prepare ERP .	Review and approval of plan.	Engineer / prior to the start of construction.
Noise	Equipment Noise	As part of the EPC contract, noise emission performance specifications will be set for all major equipment items and for the plant overall including the requirement that ensures 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.	• IFC EHS General Guidelines • IFC EHS Guidelines for Thermal Power Plants • National noise standards	EPC Contractor to guarantee values.	Review performance tests.	Engineer / during performance tests.
	Construction Noise	Prior to the start of construction, and as part of his SSEMP, the EPC Contractor should also develop a noise management plan.	• IFC EHS General Guidelines • IFC EHS Guidelines for Thermal Power Plants • National noise standards	EPC Contractor to prepare plan .	Review and approval of plan.	Engineer / prior to the start of construction.

Vibration	Equipment vibration	All equipment with the potential to create significant levels of vibration will be specified and installed with suitable vibration isolation from its foundations and also with flexible connections or other vibration isolation methods from all connected pipes and ducts where necessary. Pipes and ducts that may experience vibrations as a result of connected equipment or flow regimes will be hung or restrained using suitable vibration isolating mountings to prevent the transmission of vibrations to plant structures or other plant items.	• IFC EHS General Guidelines • IFC EHS Guidelines for Thermal Power Plants	EPC Contractor	Review and approval of designs	Engineer / prior to the start of construction.
Hazardous Materials	Ammonia	For storage of pure liquefied ammonia in quantities >100m3 ammonia will be stored in double-walled underground pressurized tanks. Tanks of lesser capacity shall be manufactured using annealing processes.	IFC EHS General Guidelines	EPC Contractor to meet these specifications	Review and approval of designs	Engineer / prior to the start of construction.
EMP Requirement	Preparation of SSEMPs	Prepare SSEMP.	N/A	• EPC Contractor to prepare SSEMP. • Engineer to review and approve SSEMP.	N/A	N/A
	Incorporation of Items into Bid Documents	A specific environmental section shall be included within the main Bid Documents indicating that the Contractor shall be responsible for conforming with the requirements of the EMP.	N/A	UE to ensure EMP is included within Bid Documents.	N/A	N/A
	Training	Four week EMP Training program for the PMU and TPP2 Environmental Staff.	N/A	Engineers IES	N/A	N/A
Environmental Management	ESMS	Develop and implement ESMS for TPP0 and TPP1	ISO 14001	UE	ADB	N/A

Permits and Regulations	Emissions Limits	Permits relating to national emissions limits will be obtained prior to the start of construction. If any national limits are more stringent than IFC guidelines they shall be adhered to.	National permit requirements	UE	Review of permits	Engineer / prior to the start of construction.
Construction Phase						
Air Quality	Open burning of waste materials	No burning of debris or other materials will occur on the at any camp or construction site.	• IFC EHS Guidelines for Air Emissions and Ambient Air Quality • National Air Quality Standards	EPC Contractor	Engineers NES	Daily site inspections, throughout construction period
	Fuel Emissions	No furnaces, boilers or other similar plant or equipment using any fuel that may produce air pollutants will be installed without prior written consent of the Engineer.	• IFC EHS Guidelines for Air Emissions and Ambient Air Quality • National Air Quality Standards	EPC Contractor	N/A	N/A
	Exhaust emissions from the operation of construction machinery and vehicles	• Construction equipment shall be maintained to a good standard and fitted with pollution control devices. • Fuel-efficient and well-maintained haulage trucks shall be employed to minimize exhaust emissions. • Smoke-belching vehicles and equipment shall not be allowed and shall be removed from the project site. • A maintenance programme for construction vehicles will be implemented to ensure optimum performance and reduced emissions.	• IFC EHS Guidelines for Air Emissions and Ambient Air Quality • National Air Quality Standards	EPC Contractor	Engineers NES	• Daily site inspections, throughout construction period • Periodic review of maintenance documentation.
	Fugitive emissions.	• Conveyor belts (e.g. at batching plants) shall be fitted with wind-boards, and conveyor transfer points and hopper discharge areas shall be enclosed to minimize dust emission. • All trucks used for transporting materials to and from the site	• IFC EHS Guidelines for Air Emissions and Ambient Air Quality • National Air Quality Standards	EPC Contractor	Engineers NES	Daily site inspections, throughout construction period

		will be covered with canvas tarpaulins. • All roads within the construction areas of the Site and on haul-routes shall be sprayed at least twice each day, and more if necessary.				
Borrow Pits	Operation of Borrow Pits	• Ensure that borrow pits are kept free of waste and debris. • Removal of waste materials from the borrow pit.	• IFC EHS Guidelines for Construction Materials Extraction. • National Regulations	Borrow pit owner to implement mitigation.	Engineers NES to routinely monitor borrow pit.	Weekly inspections, throughout construction period
	New Borrow Pits	Additional borrow pits will not be opened without the permission of the Engineer.	• IFC EHS Guidelines for Construction Materials Extraction. • National Regulations	Engineer to approve any new borrow pits.	N/A	N/A
Soil Contamination	Contamination of Soils	• All fuel and chemical storage (if any) shall be sited on an impervious base within a bund and secured by fencing. The storage area shall be located away from any watercourse. The base and bund walls shall be impermeable and of sufficient capacity to contain 110% of the volume of tank (or one tank if more than one tank is located in the bund). • Underground emergency oil drain tanks from Gas Turbine and Steam Turbine will be double skinned, comprising cast-in-place, reinforced-concrete structures, manufactured from concrete on the basis of sulfate-resistant portland cement lined with a steel inner tank. The tanks will be routinely monitored to detect leaks. • All transformers shall be located on an impervious base within a bund and secured by	• IFC EHS General Guidelines • National regulations	EPC Contractor	Engineers NES	Daily site inspections, throughout construction period

		fencing. The base and bund walls shall be impermeable and of sufficient capacity to contain 110% of the volume of tank (or one tank if more than one tank is located in the bund). • The construction camp maintenance yard shall be constructed on impervious hardstanding with adequate drainage to collect spills, there shall be no vehicle maintenance activities on open ground. • Filling and refueling shall be strictly controlled and subject to formal procedures. Drip pans shall be placed under all filling and fueling areas. Waste oils shall be stored and disposed of by a licensed contractor. • All valves and trigger guns shall be resistant to unauthorized interference and vandalism and be turned off and securely locked when not in use. • The contents of any tank or drum shall be clearly marked. Measures shall be taken to ensure that no contaminated discharges enter any soils. • No bitumen drums or containers, full or used, shall be stored on open ground. They shall only be stored on impervious hardstanding. • Areas using bitumen shall be constructed on impervious hardstanding to prevent seepage of oils into the soils. • All hazardous liquids shall be				

		stored with copies of their Material Safety Data Sheets (MSDS).				
	Leaks from waste water pits	Repair waste water pits and pipeline to ensure there are no leaks from these areas.	National regulations	EPC Contractor	Engineers NES	Inspection of pit and pipeline after repair works are completed.
Hydrology	Ground and surface water pollution.	• Implementation of the specific mitigation measures outlined in **Section G.6.4** of the EIA. • Ensure spill kits are located in areas where hazardous liquids are in use.	• IFC EHS General Guidelines • National regulations	EPC Contractor	Engineers NES	Daily site inspections, throughout construction period
	Water Use	Record levels of potable water consumed via water meters.	• IFC EHS General Guidelines	EPC Contractor	N/A	N/A
Waste and Spoil	Recycling and re-use	Where possible, surplus materials will be reused or recycled.	• IFC EHS General Guidelines • National regulations	EPC Contractor	Engineers NES	Monthly reviews of waste manifests to determine waste recycling rates
	Inert Solid & Liquid waste	• Provide refuse containers at each worksite in signed and adequately sized waste storage areas. • Maintain all construction sites in a cleaner, tidy and safe condition. • Train and instruct all personnel in waste management practices and procedures. • Collect and transport non-hazardous wastes to all approved disposal sites.	• IFC EHS General Guidelines • National regulations	• EPC Contractor to implement mitigation. • Goskompriroda to approve any waste disposal site.	Engineers NES	• Daily site inspections, throughout construction period • Annual review of waste management contractors licenses • Monthly review of waste manifests
	Hazardous Waste	• Storage of hazardous waste shall be in specific secure locations as identified by the waste management plan. • Hazardous liquids must be stored within impermeable bunds.	• IFC EHS General Guidelines • National regulations	EPC Contractor to implement mitigation. • Goskompriroda to approve any waste disposal site.	Engineers NES	• Daily site inspections, throughout construction period • Annual review of waste management

		• Training and suitable PPE will be provided to all personnel handling hazardous waste. • Disposal of waste materials shall be undertaken by a licensed waste management company. • Keep records of the types and volumes of waste removed from the site on a weekly basis.				contractors licenses • Monthly review of waste manifests
Construction Camps	Soil and water pollution	In the first instance, no construction camp shall be located within one kilometer of an urban area (or 500 meters of an individual property) and at least 50 meters from any surface water course, this will help reduce noise, water and air quality impacts. The Engineer shall approve the locations of the EPC Contractors camps prior to the establishment of the camp, In addition, the EPC Contractor shall be responsible for the preparation of a Construction Camp Site Plan which will form part of the SSEMP. The Plan shall indicate the system proposed and the locations of related facilities in the site, including latrines, holding areas, etc. The EPC Contractor shall ensure the following conditions are met within the Plan: (11) Rain-water run-off arising on the site shall be collected, removed from the site via a suitable and properly designed temporary drainage system and disposed of at a location and in a manner that will cause neither pollution nor nuisance. The drainage	• IFC EHS General Guidelines • National regulations	EPC Contractor	Engineers NES	Daily site inspections, throughout construction period

		system should be fitted with oil and grease interceptors. (12) There shall be no direct discharge of sanitary or wash water to surface water. Septic tanks shall be provided at construction camps for sewage water. Licensed contractors will be required to collect and disposal of liquid waste from the septic tanks on regular basis. (13) Disposal of materials such as, but not limited to, lubricating oil and onto the ground or water bodies shall be prohibited. (14) Liquid material storage containment areas shall not drain directly to surface water. (15) Waste water from vehicle washing bays should be free of pollutants if the wash bay has been constructed correctly. **Appendix F** provides a schematic of a vehicle washing bay that should be considered by the EPC Contractor. (16) Lubricating and fuel oil spills shall be cleaned up immediately and spill clean-up materials shall be maintained at the storage area. (17) Construction and work sites will be equipped with sanitary latrines that do				

		not pollute surface waters and are connected to septic tanks, or waste water treatment facilities. (18) Discharge of sediment-laden construction water directly into surface watercourses will be forbidden. Sediment laden construction water will be discharged into settling lagoons or tanks prior to final discharge. (19) Washing out concrete trucks at construction sites shall be prohibited unless specific concrete washout areas are provided for this purpose at the construction site (e.g. a bridge site). The washouts should be impermeable and emptied when 75% full. (20) Spill clean up equipment will be maintained on site (including at the site maintenance yard and vehicle fueling areas). The following conditions to avoid adverse impacts due to improper fuel and chemical storage: – Fueling operations shall occur only within containment areas. – All fuel and chemical storage (if any) shall be sited on an impervious base within a bund and secured by fencing. The storage area				

		shall be located away from any watercourse or wetlands. The base and bund walls shall be impermeable and of sufficient capacity to contain 110 % of the volume of tanks. - Filling and refueling shall be strictly controlled and subject to formal procedures and will take place within areas surrounded by bunds to contain spills / leaks of potentially contaminating liquids. - All valves and trigger guns shall be resistant to unauthorized interference and vandalism and be turned off and securely locked when not in use. - The contents of any tank or drum shall be clearly marked. Measures shall be taken to ensure that no contaminated discharges enter any drain or watercourses. - Disposal of lubricating oil and other potentially hazardous liquids onto the ground or				

		water bodies will be prohibited. – Should any accidental spills occur immediate clean up will be undertaken and all cleanup materials stored in a secure area for disposal to a site authorized to dispose of hazardous waste.				
	Water Supply	Ensure that potable water for construction camps and workers is filtered and meets the necessary water quality standards.	• IFC EHS General Guidelines • National regulations	EPC Contractor	Engineers NES to review water test results.	Monthly, throughout construction period
Concrete Batching Plants	Concrete Batching Plants	• To limit impacts from dust, the following conditions shall apply: – The entire batching area traversed by vehicles – including driveways leading into and out of the area – should be paved with a hard, impervious material. – Sand and aggregates should be delivered in a dampened state, using covered trucks. If the materials have dried out during transit they should be re-wetted before being dumped into the storage bunker. – Sand and aggregates should be stored in a hopper or bunker which shields the materials from winds. The bunker should enclose the stockpile on three sides. The walls	• IFC EHS General Guidelines • National regulations	EPC Contractor	Engineers NES	Daily site inspections, throughout construction period

		should extend one metre above the height of the maximum quantity of raw material kept on site, and extend two metres beyond the front of the stockpile. - The hopper or bunker should be fitted with water sprays which keep the stored material damp at all times. Monitor the water content of the stockpile to ensure it is maintained in a damp condition. - Overhead storage bins should be totally enclosed. The swivel chute area and transfer point from the conveyor should also be enclosed. - Rubber curtain seals may be needed to protect the opening of the overhead bin from winds. - Conveyor belts which are exposed to the wind and used for raw material transfer should be effectively enclosed, to ensure dust is not blown off the conveyor during transit. Conveyor transfer points and hopper discharge areas should be fully enclosed. - Conveyor belts should be fitted with belt cleaners on the return side of the belt. - Weigh hoppers at front end loader plants should be roofed and have weigh hoppers shrouded on				

		three sides, to protect the contents from the wind. The raw materials transferred by the front end loader should be damp, as they are taken from a dampened stockpile. – Store cement in sealed, dust-tight storage silos. All hatches, inspection points and duct work should be dust-tight. – Silos should be equipped with a high level sensor alarm and an automatic delivery shut-down switch to prevent overfilling. – Cement dust emissions from the silo during filling operations must be minimised. The minimum acceptable performance is obtained using a fabric filter dust collector. – Totally enclose the cement weigh hopper, to ensure that dust cannot escape to the atmosphere. – An inspection of all dust control components should be performed routinely – for example, at least weekly. – Batching Plants will not be permitted within 1 kilometer of urban areas. • All contaminated storm water and process wastewater should be collected and retained on site. • All sources of wastewater should be paved and bunded.				

		The specific areas that should be paved and bunded include; the agitator washout area, the truck washing area, the concrete batching area, and any other area that may generate storm water contaminated with cement dust or residues. • Contaminated storm water and process wastewater should be captured and recycled by a system with the following specifications: – The system's storage capacity must be sufficient to store the runoff from the bunded areas generated by 20 mm of rain. – Water captured by the bunds should be diverted to a collection pit and then pumped to a storage tank for recycling. – An outlet (overflow drain) in the bund, one metre upstream of the collection pit, should divert excess rainwater from the bunded area when the pit fills due to heavy rain (more than 20 mm of rain over 24 hours). – Collection pits should contain a sloping sludge interceptor, to separate water and sediments. The sloping surface enables easy removal of sludge and sediments. – Wastewater should be pumped from the collection pit to a				

		recycling tank. The pit should have a primary pump triggered by a float switch and a backup pump which automatically activates if the primary fails. – Wastewater stored in the recycling tank needs to be reused at the earliest possible opportunity. This will restore the system's storage capacity, ready to deal with wastewater generated by the next rainfall event. Uses for recycling tank water include concrete batching, spraying over stockpiles for dust control and washing out agitators.				
Infrastructure	Roads	• If abnormal loads are required, the appropriate arrangements will be made to obtain the necessary transportation permits and the route agreed with the relevant authorities to minimize the impact of other road users. • A designated access point to the site must be created and clearly marked to ensure safe entry and exit. • Where possible, construction vehicles to avoid travelling on the public roadway during the morning and late afternoon commute time, to reduce the impact on other road users.	• IFC EHS General Guidelines • National regulations	EPC Contractor	Engineers NES	Daily site inspections, throughout construction period •

		• All internal and access roads that will be used during the operational phase of the Project must be maintained. • At the end of the construction phase road conditions will be re-assessed against the initial road condition survey to determine if any repairs to roads are required by the Contractor.				
Occupational Health and Safety	HIV / AIDS	Repeat the HIV Awareness Program at intervals not exceeding four months	N/A	Service Provider to implement training.	Engineer to review program.	Every four months
	Worker Health & safety	• Develop a Safety Training Program. • Workers shall be provided (before they start work) with of appropriate personnel safety equipment. • Safety Meetings conducted on a monthly basis. • Regularly inspect, test and maintain all safety equipment. • Equipment, which is damaged, dirty, incorrectly positioned or not in working order, shall be repaired or replaced immediately. • Safety equipment and protective clothing are required to be available on the Site at times. • All construction plant and equipment used on or around the Site shall be fitted with appropriate safety devices. • A fully equipped first aid base shall be provided. • Coordinate with local public health officials and shall	• IFC EHS General Guidelines • National regulations	EPC Contractor	Engineers NES	Daily site inspections, throughout construction period

		reach a documented understanding with regard to the use of hospitals and other community facilities. • Ensure that all workers on site are aware of the proper procedure in case of a fire occurring on site.				
	Sub-contractor H&S	• All sub-contractors will be supplied with copies of the SSEMP. • Provisions to be incorporated into all sub-contracts to ensure the compliance with the SSEMP. All sub-contractors will be required to appoint a safety representative who shall be available on the Site.	• IFC EHS General Guidelines • National regulations	EPC Contractor	Engineers NES to routinely monitor Contractors and sub-contractors activities.	Daily site inspections, throughout construction period
	Noise	Zones with noise level above 80 dBA must be marked with safety signs and appropriate PPE must be worn by workers.	• IFC EHS General Guidelines	EPC Contractor	Engineers NES	Daily site inspections, throughout construction period
Community Health and Safety	Traffic safety	• Provide information to the public about the scope and schedule of construction activities and expected disruptions and access restrictions. • Allow for adequate traffic flow around construction areas. • Provide adequate signalization, appropriate lighting, well-designed traffic safety signs, barriers and flag persons for traffic control. • Access roads for borrow pits, batching plants, etc, should be maintained during the construction phase and rehabilitated at the end of construction.	• IFC EHS General Guidelines • National regulations	EPC Contractor	Engineers NES	Daily site inspections, throughout construction period

		• Conduct regular safety awareness campaigns for both the workforce and the general public, particularly focusing on local schools.				
Noise	Construction Noise and Vibration	• Implement nighttime noise restrictions between 20.00 and 07.00. This includes prohibiting the use of the equipment specified in **Table G-19** (that generates noise levels greater than 100 dB(A) during this period. If it is necessary to implement these activities during this time, the project must inform responsible local organizations and communities one week in advance. • The Contractor shall measure site noise daily at the north east, west and southern boundary of TPP2. If noise levels are above 70 dBA the Contractor will place a limit on the number and types of equipment that can operate at any one time so as to reduce noise levels below 70dBA at the boundary and thereby meet IFC noise limits for daytime noise in residential areas. • Inform potentially noise-affected neighbours about the nature of construction stages	• IFC EHS General Guidelines • National regulations	EPC Contractor	Engineers NES	Daily site inspections, throughout construction period

		and noise reduction measures. • Give notice as early as possible for periods of noisier works such as excavation. Describe the activities and how long they are expected to take. Keep affected neighbours informed of progress. • Within normal working hours, where it is reasonable to do so: – schedule noisy activities for less sensitive times. – provide periods of respite from noisier works (for example, periodic breaks from jackhammer noise). • The weekend/evening work hours in the schedule (including Saturday afternoon or Sunday) are more sensitive times and have noise requirements consistent with quieter work. • The weekend/evening periods are important for community rest and recreation and provide respite when noisy work has been conducted throughout the week. Accordingly, work should not usually be scheduled during these times. • Site buildings, access roads and plant should be positioned such that the minimum disturbance occurs to the locality. Barriers such as hoardings or temporary enclosures should be used. The site should be planned to				

		minimise the need for reversing of vehicles. • All mechanical plant is to be silenced by the best practical means using current technology. Mechanical plant, including noise-suppression devices, should be maintained to the manufacturer's specifications. Internal combustion engines are to be fitted with a suitable muffler in good repair. • Maintenance tools, machines and equipment so that they are in good conditions. When some wrong is found, they must be fixed immediately in order to reduce noise from the equipment. • Fit all pneumatic tools with an effective silencer on their air exhaust port. • Install less noisy movement/reversing warning systems for equipment and vehicles that will operate for extended periods, during sensitive times or in close proximity to sensitive sites. Occupational health and safety requirements for use of warning systems must be followed. • Turn off plant when not being used. • All vehicular movements to and from the site to only occur during the scheduled normal working hours, unless approval has been granted by the relevant authority. • Keep good conditions of trucks that use to transport				

		construction materials so they cause no loud noise and control the truck speed, to be not exceeded 40 km/hr when driving through communities, and not exceeded 80 km/hr when driving on highways. • Where possible, no truck associated with the work should be left standing with its engine operating in a street adjacent to a residential area. • Noise from the site needs to comply with the requirements of the schedule, except for: – unavoidable works [42] – night period low-noise or managed-impact works approved by the local authority. • Provision of noise protection kits such as ear plug, earmuff, for workers who are working in the area with noise level is higher than 85 dB(A). It is designated as a regulation that workers must wear protection kits in case of working in a noisy area.				
Physical and Cultural Heritage	Chance finds	Follow chance find procedures specified by Uzbek legislation and guidelines.	National regulations	EPC Contractor	N/A	N/A
EMP Implementation	Training Program	Quarterly training sessions for PMU and TPP2 Environmental staff.	N/A	Engineers IES	N/A	N/A
Operational Phase						

[42] Unavoidable works are works that cannot practicably meet the schedule requirements because the work involves continuous work — such as a concrete pour — or would otherwise pose an unacceptable risk to life or property, or risk a major traffic hazard. Affected premises should be notified of the intended work, its duration and times of occurrence. The relevant authority must be contacted and any necessary approvals sought.

Environmental Management Systems	ESMS	• Updating of the TPC ESMS to include TPP2. • Certification of ESMS to ISO 14001.	ISO 14001	UE TPP	N/A	N/A
Air Quality	Air Emissions	• Emission limits guaranteed to meet 50 mg/m^3 • SO_2 and PM emissions must be less than 1% of emission standards. • Critical components must be in stock to ensure the availability of spares in the event of mechanical faults.	EPC Contract	UE TPP to ensure critical components are in stock.	N/A	N/A
Soil and Groundwater Pollution		• Preparation of a spill and leak response plan as part of an overarching ESMS. • Ensure hazardous liquids are managed according to the requirements of **Section G.6.4** of the EIA.	• ISO 14001 • IFC EHS General Guidelines • National regulations	UE TPP	N/A	N/A
Climate Change		• Climate Change Assessment to determine the long-term impacts of climate change on the TPC including the impacts upon the ambient temperature of the KMK. • Follow the thermal discharge operational model prepared in the pre-construction phase.	N/A	UE TPP	N/A	N/A
Hydrology	Water Temperature	Follow the thermal discharge operational model prepared in the pre-construction phase.	• IFC EHS Guidelines – Thermal Power Plants • National regulations	UE TPP	N/A	N/A
	Effluent	Monitor effluent discharges (from sludge pits sewage treatment plant and from TPC to the KMK) to national and IFC standards.	• IFC EHS Guidelines – Thermal Power Plants • IFC EHS General Guidelines • National regulations	UE TPP	N/A	N/A
	Water Quality	• Ensure hazardous liquids are managed according to the requirements of **Section G.6.4** of the EIA. • Implementation of an inspection program to	• IFC EHS General Guidelines • National regulations	UE TPP	N/A	N/A

		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. • All surface water management infrastructure will be inspected and repairs made as soon as practically possible.				
Energy	Energy reduction	As part of an ESMS prepare a strategy to reduce energy use across the site.	• IFC EHS General Guidelines • ISO 14001	UE TPP	N/A	N/A
Solid and Liquid Waste	Waste Management	• Preparation of a waste management plan (WMP) as part of an overarching ESMS. • Coordinate all waste management activities with TPP1 and TPP0.	• IFC EHS General Guidelines • National regulations • ISO 14001	UE TPP	N/A	N/A
	Recycling and re-use	As part of the WMP prepare a strategy of recycling and waste reduction.	• IFC EHS General Guidelines	UE TPP	N/A	N/A
Occupational Health and Safety	Noise Worker Health & safety	• As part of an overarching ESMS prepare an OHS plan which will include the following elements: 1. Safety Training Program. 2. Safety Meetings schedule 3. Schedule for regular inspection, testing and maintenance of all safety equipment.	• IFC EHS General Guidelines • National regulations • ISO 14001	UE TPP	N/A	N/A

		4. Procedures to ensure that all equipment, which is damaged, dirty, incorrectly positioned or not in working order, shall be repaired or replaced immediately. 5. Guidelines for the use of safety equipment and protective clothing. • As part of an overarching ESMS prepare an Emergency Response Plan • In addition: 1. All construction plant and equipment used on or around the Site shall be fitted with appropriate safety devices. 2. A fully equipped first aid base shall be provided. 3. Coordinate with local public health officials and shall reach a documented understanding with regard to the use of hospitals and other community facilities. Both plans shall ensure compliance with all aspects of the IFC EHS Guidelines for Thermal Power Plants and Community Health and Safety.				
	Sub-contractor H&S	• All sub-contractors will be supplied with copies of the ESMS. • Provisions to be incorporated into all sub-contracts to ensure the compliance with the ESMS. All sub-contractors will be required to appoint a safety representative who shall be available on the Site.	• IFC EHS General Guidelines • ISO 14001	• UE TPP to provide copies of the ESMS to sub-contractors • Sub-contractors to ensure compliance with the ESMS	N/A	N/A
Noise	Equipment noise	• Regular, scheduled maintenance of equipment,	• IFC EHS General Guidelines	UE TPP	N/A	N/A

		including exhaust and intake mufflers will be undertaken. • Noisy areas shall be indicated by signs and workers provided with ear protection to limit noise levels to the regulatory standards.				
	Control room noise	Noise in the Control room will not exceed 60 dBA.	• IFC EHS Guidelines – Thermal Power Plants	UE TPP	N/A	N/A
	Boundary noise	Noise levels from TPP2 shall not exceed 70 dBA at the boundary of the TPC.	• IFC EHS General Guidelines	UE TPP	N/A	N/A
Community Health and Safety	Health	Implementation of the Public Health Monitoring Plan described in **Section E.9**.	N/A	UE TPP	N/A	N/A

H.4 Instrumental Monitoring Plan

759. Regular monitoring of air quality, water quality and noise levels against Uzbek and IFC standards shall be carried out throughout the construction and commissioning periods. The party responsible for monitoring will be the Engineer (with the exception of CEMS monitoring during the commissioning phase), who will report the results monthly to the TPP2 PMU. The reports shall clearly indicate the monitoring dates, times, locations, weather conditions, types of equipment used and calibration information. **Table H-2** provides the monitoring actions required during the construction phase of the Project. **Table H-3** provides the monitoring actions for the commissioning phase and **Table H-4** provides the monitoring actions for the operational phase of the Project.

760. All instrumental monitoring results, in all Project phases, will be reviewed by a third party contracted by the GoU. This will include a review of the monitoring methodology, the results and calibration of equipment.

Table H-2: EMP: Construction Phase Instrumental Monitoring

Issue	Parameters / Standards	Locations	Schedule	Responsibilities	Reporting
Air Quality	• NO_2 (30 min / 1 hour averaging period)	• At the monitoring six locations specified by **Appendix G**.	• Baseline prior to construction • PM Weekly • CO, SO_2 and NO_2 monthly	• Engineer	• Monthly

	• SO_2 (30 min / 20 min averaging period) • CO (One time) • PM^{10} (24 hour averaging period) • $PM^{2.5}$ (24 hour averaging period) IFC EHS Guideline limits shall be applied as well as national standards.				
Air Quality – Ambient Air Quality	• NOx • NO_2 IFC EHS Guideline limits shall be applied as well as national standards.	• At two monitoring locations (boundary of Nuriston and Mekhnatabad)	• Continuous	• UE TPP	• Monthly
Noise	• Laeq IFC EHS Guideline limits shall be applied as well as national standards.	• At the monitoring six locations specified by **Appendix G**.	• Monthly (daytime and nighttime)	• Engineer	• Monthly
	• Laeq IFC EHS Guideline limits shall be applied as well as national standards.	• At the north east, west and southern boundary of TPP2.	• Daily	• EPC Contractor	• Weekly to the Engineer

Table H-3: EMP: Commissioning Phase Instrumental Monitoring

Issue	Parameters / Aspect	Locations	Schedule	Responsibilities	Reporting
Air Quality	• NO_X To meet guaranteed values per the contract.	• From the emissions stacks (via CEMS)	• Weekly	• EPC Contractor	• Weekly

	• SO_2 (30 min / 20 min averaging period) • CO (One time) • PM^{10} (24 hour averaging period) • $PM^{2.5}$ (24 hour averaging period) IFC EHS Guideline limits shall be applied as well as national standards.	• At the monitoring six locations specified by **Appendix G**.	• Weekly	• Engineer	• Weekly
Air Quality – Ambient Air Quality	• NOx • NO_2 IFC EHS Guideline limits shall be applied as well as national standards.	• At two monitoring locations (boundary of Nuriston and Mekhnatabad)	• Continuous	• TPP2 Environmental Department	• Monthly
Noise	• Laeq IFC EHS Guideline limits shall be applied as well as national standards.	• At the six locations specified by **Appendix G**.	• Monthly (daytime and nighttime)	• Engineer	• Monthly
	• Laeq IFC EHS Guideline limits shall be applied as well as national standards.	• Areas of high noise levels	• Daily	• EPC Contractor	• N/A
Water Quality	• Temperature IFC EHS Guideline limits shall be applied as well as national standards.	• Approximately 200 meters upstream from TPC to determine ambient water temperature. • At discharge point to KMK feeder channel. • At the immediate mixing point where the feeder channel meets with the KMK. • At a point 100 meters downstream	• Daily	• EPC Contractor	• Daily

		of the immediate mixing point, i.e. the edge of the mixing zone.			

Table H-4: EMP: Operational Phase Instrumental Monitoring

Issue	Parameters / Aspect	Locations	Schedule	Responsibilities	Reporting
Water Quality – Thermal Pollution	• Water Temperature IFC EHS Guideline limits shall be applied as well as national standards.	• Approximately 200 meters upstream from TPC to determine ambient water temperature. • At discharge point to KMK feeder channel. • At the immediate mixing point where the feeder channel meets with the KMK. • At a point 100 meters downstream of the immediate mixing point, i.e. the edge of the mixing zone.	• Continuous at all locations	• TPP2 Environmental Department	• Daily
Water Quality – Effluent Pollution	• Suspended Solids • COD • BOD • pH • Dissolved solids • Appearance • Other parameters specified by Oblkompriroda • All parameters specified by IFC Thermal Power Plant EHS Guidelines (2017) – Table 5 Effluent Guidelines.	• At discharge point to KMK feeder channel • 100 meters downstream of the immediate mixing point • Immediate discharge point of the sludge drying pit. • Discharge from Sewage treatment plant. • Drain K-3-2. • At locations specified by Kashkadarya Oblkompriroda	• According to the requirements of Kashkadarya Oblkompriroda	• TPP2 Environmental Department	• According to the requirements of Kashkadarya Oblkompriroda
Noise Levels	• Laeq IFC EHS Guideline limits shall be applied as well as national standards.	• At the six monitoring locations specified by **Appendix G**.	• Monthly (daytime and nighttime)	• TPP2 Environmental Department	• Monthly
	• Laeq IFC EHS Guideline limits shall be applied as well as national standards.	• Areas of high noise levels TPP2	• Weekly	• TPP2 Environmental Department	• N/A

Air Quality – Stack Emissions	• NO_X • CO • CO_2 IFC EHS Guideline limits shall be applied as well as national standards.	• Emissions Stacks	• Continuous	• TPP2 Environmental Department	• Daily
Air Quality – Stack Emissions	• An annual emission test will be undertaken in order to have direct measurement of emission levels to counter check the CEMS.	• Emissions stacks	• At least an annual stack emission testing will be carried out. If annual stack emission testing results show constantly (3 consecutive years) a significantly (less than 75%) better than the required levels, frequency of annual stack emission testing can be reduced from annual to every two or three years.	• TPP2 Environmental Department	
Air Quality – Ambient Air Quality	• NOx • NO_2 IFC EHS Guideline limits shall be applied as well as national standards.	• At two monitoring locations (boundary of Nuriston and Mekhnatabad)	• Continuous	• TPP2 Environmental Department	Monthly

H.5. EMP Costs

761. Most costs associated with the environmental recommendations of the EMP are a normal part of preparing the bid and contract documents and ensuring that proper environmental provisions are incorporated therein. The installation of septic systems at construction camps, for example, is an environmental necessity, but not generally considered an "environmental cost". **Table H-5** lists the proposed mitigation measures and indicates where they would be "included in the project budget" as part of a bid document and where additional costs are a likely "environmental cost" beyond what would normally be included in a project budget.

Table H-5: EMP Mitigation Costs

Activity	Item	Number of Units / Unit cost	Cost estimate / US$	Responsibility	Source: ADB Loan	Source: Govt counterpart
Pre-construction						
SSEMPs	SSEMP	Included in Project Budget	-	EPC Contractor	X	
Incorporation of Environmental Items into Bid Documents	Item in Bid Document	Included in Project Budget	-	PMU		X
Operational Model	Operational Model for Thermal Discharge	Included in Project Budget	-	EPC Contractor and TPP0 Management		X
Obtain permits	Permits	Included in Project Budget	-	EPC Contractor	X	
Environmental Management	ESMS for TPP1 and TPP2	4 man months / US$ 20,000	80,000	UE	X	
Construction & Commissioning						
Standard site management Additional environmental measures	Septic Tanks	Included in Project Construction costs	-	EPC Contractor	X	
	Spill Kits	20 / US$200	4,000	EPC Contractor	X	
	Bunds for fuel and oil storage	Included in Project Construction costs	-	EPC Contractor	X	
	Repair of water discharge pits and pipeline	Included in Project Construction costs	-	EPC Contractor	X	
	Waste containers	Included in Project Construction costs	-	EPC Contractor	X	
	Waste Storage areas	Included in Project Construction costs	-	EPC Contractor	X	
	Waste collection and disposal	Included in Project Construction costs	-	EPC Contractor	X	
	Storage areas for hazardous materials	Included in Project Construction costs	-	EPC Contractor	X	
	Drainage (including oil and grease interceptors)	Included in Project Construction costs	-	EPC Contractor	X	

	Vehicle washing bay	Included in Project Construction costs	-	EPC Contractor	X	
	Fire safety	Included in Project Construction costs	-	EPC Contractor	X	
	PPE	Included in Project Construction costs	-	EPC Contractor	X	
	Impervious hardstanding (for maintenance yards, bitumen storage, etc)	Included in Project Construction costs	-	EPC Contractor	X	
	First aid facilities	Included in Project Construction costs	-	EPC Contractor	X	
	Routine maintenance of vehicles	Included in Project Construction costs	-	EPC Contractor	X	
	Water bowsers	Included in Project Construction costs	-	EPC Contractor	X	
	Dust control measures (batching plants)	Included in Project Construction costs	-	EPC Contractor	X	
	Tarpaulins	Included in Project Construction costs	- -	EPC Contractor	X	
Training	Safety Training	Included in Project Budget	-	EPC Contractor	X	
	HIV/AIDS Training from Independent Contractor	4 / US$1,000	4,000	EPC Contractor	X	
	Toolbox Training	Included in Project Budget	-		X	
	PMU Training	Included in Project Budget	-	Engineer	X	
Clean up of construction sites.	Labor, waste disposal	Included in Project Budget	-	EPC Contractor	X	
	Rehabilitation of damaged roads	Included in Project Construction costs	-	EPC Contractor	X	
	Re-instatement of borrow pits	Included in Project Construction costs	-	EPC Contractor	X	
Environmental Staff	EO	36 / US$ 2,000	72,000	EPC Contractor	X	
	HSO	36 / US$ 2,000	72,000	EPC Contractor	X	
	IES	12 / US$ 20,000	240,000	Engineer	X	
	NES	36 / US$ 2,000	72,000	Engineer	X	
	TPP2 PMU Environmental Specialist	36 / US$ 2,000	72,000	UE	X	
Operational						
ESMS	Updating of ESMS by International Consultant	2 man months / US$ 20,000	40,000	UE	X	
	Certification of ESMS	US$ 10,000	10,000	UE		X

Climate Change Assessment	Preparation by a Consultant	2 man months / US$ 20,000	40,000	UE		X
TPC Environmental Staff	3 Deputy Environmental Specialists	3 / US$ 12,000 per annum	36,000 per annum	UE		X
IT Equipment for TPC Environmental Staff	Laptop Computers for each member of staff	4 / US$ 1,000	4,000	UE	X	
Costs						
ADB Cost						**$632,000**
GoU Cost*						**$90,000**
Total Cost						**$722,000**

* not including the annual TPC Environmental Staff Costs

Table H-6: EMP Construction / Commissioning Instrumental Monitoring Costs

Activity / Item	Frequency / Number	Unit Cost / USD	Cost /USD	Responsibility	Funding Source
Construction Phase* Routine Instrumental Monitoring					
1. Ambient Air Quality	Monthly at six locations	50 per site	7,200	Engineer	ADB Loan
2. Noise	Monthly at six locations	50 per site	7,200	Engineer	ADB Loan
3. Hand held noise monitor	One unit	9,000	9,000	EPC Contractor	ADB Loan
4. Third party monitoring of results	Monthly	500	12,000	GoU	ADB Loan
Commissioning Phase Instrumental Monitoring**					
1. Ambient Air Quality	Monthly at six locations	50 per site	3,600	Engineer	ADB Loan
2. Stack Emissions (CEMS)	Continuous	US$780,000	Included in Project Construction costs	EPC Contractor	ADB Loan
3. Noise	Monthly at six locations	50 per site	3,600	Engineer	ADB Loan
4. Water Temp.	Daily at 4 locations	$5,000 per continuous monitoring station	$20,000	EPC Contractor	ADB Loan
5. Third party monitoring of results	Monthly	500	3,000	GoU	ADB Loan
Total ADB					65,600
Total GoU					0
Total					**65,600**

- Construction period of 24 months

** Commissioning Phase 6 months for each unit

Table H-7: EMP Operational Instrumental Monitoring Costs

Activity / Item	Frequency / Number	Cost	Responsibility	Funding Source
Operational Phase Instrumental Monitoring				
1. Stack Emissions (CEMS)	Continuous	None. Operated and maintained by TPP2 technical staff.	UE	N/A
2. Annual check of stack emissions	Annually	US$500	UE	GoU
3. Continuous water temperature	Four units	None, will use existing stations provided in	UE	ADB Loan

monitoring stations (including software)		Commissioning phase.		
4. Operation and maintenance of water temperature units.	Continuous	None. Operated and maintained by TPC Environmental Unit.	UE	N/A
5. Water Quality	Monthly at three locations	None. Monitoring by TPC Environmental Department using existing equipment and TPC laboratory.	UE	N/A
6. Continuous ambient air quality monitoring stations (including software)	Two units	US$20,000	UE	ADB Loan
7. Ambient Air Quality monitoring	Continuous	None. Operated and maintained by TPC Environmental Unit.	UE	N/A
8. Dispersion model ready meteorological station	One unit	US$4,000	UE	ADB Loan
9. Noise Monitoring Equipment	One unit	US$9,000	UE	ADB Loan
10. Noise Monitoring	Weekly at Nuriston	None. Monitoring by TPC Environmental Department.	UE	N/A
11.Third Party Monitoring	Monthly	$500 per month	GoU	GoU
12.Public Health Monitoring	Per the PHMP requirements	$500 per month	GoU	GoU
Total ADB				35,000
Total GoU*				500
Total*				**35,500**

Not including long term Third Party Monitoring costs and Public Health Monitoring.

I. Public Consultation, Information Disclosure & Grievance Mechanism

I.1 Public Consultations

762. According to the ADB Safeguard Policy Statement (2009):

"*The borrower/client will carry out meaningful consultation with affected people and other concerned stakeholders, including civil society, and facilitate their informed participation. Meaningful consultation is a process that:*

1. *Begins early in the project preparation stage and is carried out on an ongoing basis throughout the project cycle;*
2. *Provides timely disclosure of relevant and adequate information that is understandable and readily accessible to affected people;*
3. *Is undertaken in an atmosphere free of intimidation or coercion;*
4. *Is gender inclusive and responsive, and tailored to the needs of disadvantaged and vulnerable groups; and*
5. *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.*

Consultation will be carried out in a manner commensurate with the impacts on affected communities. The consultation process and its results are to be documented and reflected in the environmental assessment report."

763. Category A EIA require two rounds of consultations which were undertaken in November, 2017 and January, 2017.

I.1.1 Scoping Consultations

764. Scoping consultations were held in November, 2016 in two villages within the Project Area, Nuriston and Mekhnatabad. Participants in the consultations were given an overview of the proposed project and then asked what they thought may be the significant issues that would require detailed study as part of an EIA.

765. The following provides an overview of the consultations (names of all attendees can be found in **Appendix H**):

Table I-1: Nuriston Scoping Consultation

Date: 15th November, 2016
Location: Nuriston Town Hall

Panel Members:
Mr. Nick Skinner – International Environmental Specialist
Mr. Nizom Rahimov – National Environmental Specialist

List of Participants:
36 Participants (see **Appendix H** for list)

#	Question / Comment	Answer	EIA Status
1	What will be the main environmental impacts from the project?	Impacts to air quality and noise, as well as water quality have been identified as the key	Addressed by **Sections G.6.1 – Air Quality**, **G.6.6– Surface Water Hydrology** and **G.9.6 - Noise**

		impacts associated with the Project	
2	How can the project reduce noise and air emissions?	Equipment will be housed in such a way to limit noise to 80 dB at a 1 meter distance. Noise from TPP2 will be therefore be limited as a factor of attenuation.	Addressed by **Section G.9.6 - Noise**
3	Is it possible to build taller emissions stacks?	This will be taken into consideration as part of the air dispersion model.	The air dispersion model did not identify the need for any changes to stack heights.
4	We believe that high levels of emissions are being emitted from Shurtan gas fields. We feel that the emissions are having a negative health impact.	We understand that this is a specific issue relating to another project, but it will be reviewed further as part of the EIA study.	The TPC itself is not causing health impacts. However, an assessment of the potential impacts of emissions from SGCC should be undertaken as outlined in **Section G.9.2 – Community Health and Safety**.
5	When is noise going to be measured? During the operational or commissioning phase?	Noise will be monitored during both phases and mitigation measures prepared for both phases	Addressed by **Section G.9.6 - Noise**
6	During the commissioning phase extreme noise events occur, this often disturbs sleeping small children during the day. Will that kind of noise also occur during the start-up period?	It is possible that elevated noise levels will also occur during the start-up period. Although they are unfortunate, they are not frequent.	Addressed by **Section G.9.6 - Noise**
7	We can see NO_X from the TPP1 emissions stacks. We think the TPP1 stacks are too small. We think the stack heights for TPP2 should be bigger.	This will be taken into consideration as part of the air dispersion model.	The air dispersion model did not identify the need for any changes to stack heights.
8	Can landscaping be included in the TPP2 project.	Yes, landscaping will be included in the TPP2 project. How the landscaping is undertaken will be the decision of the EPC Contractor.	No mitigation measures for this item.
9	Local roads are not designed for the heavy goods vehicles that deliver equipment and goods to the site during the construction phase. This is leading to deterioration of the roads.	A road deterioration survey will be undertaken before the start of the Project and upon completion of the construction phase to determine if the EPC Contractor has to repair any roads used as haul routes.	Addressed by **Section G.8.1 – Infrastructure and Transport Services**

Figure I-1: Consultation in Nuriston, 15th November, 2016

Table I-2: Mekhnatabad Scoping Consultation

Date: 15th November, 2016
Location: Mekhnatabad School

Panel Members:
Mr. Nick Skinner – International Environmental Specialist
Mr. Nizom Rahimov – National Environmental Specialist

List of Participants:
17 Participants (see **Appendix H** for list)

#	Question / Comment	Answer	EIA Status
1	Will tariffs decrease for those living closer to the TPC?	There are no plans for such an offer to local residents.	No action warranted.
2	How close can we build to the TPC?	No closer than 1km, this is the boundary of the Sanitary Protection Zone.	No action warranted.
3	We would like UE to consider a community project, such as a new sports hall.	This issue is beyond the scope of the EIA	No action warranted.
4	Noise levels from TPP0 do not affect us or disturb our sleep, we are not concerned about noise levels.	No comment	No action warranted.
5	NO_X is a problem, we can see the emissions when it is cold and we do not think that the stack heights are sufficient.	This will be taken into consideration as part of the air dispersion model.	The air dispersion model did not identify the need for any changes to stack heights.
6	We think that emissions from SGCC are affecting our health.	We understand that this is a specific issue relating to another project, but it will be reviewed further as part of the EIA study.	The TPC itself is not causing health impacts. However, an assessment of the potential impacts of emissions from SGCC should be undertaken as

			outlined in **Section G.9.2 – Community Health and Safety**.
7	We have not suffered any significant impacts during the construction phase of TPP1.	No comment	No action warranted.
8	If TPP2 is constructed to modern designs there will be no issues for us, only benefits through the creation of jobs.	No comment	No action warranted.

I.1.2 Public Consultations

766. A second round of consultations were held in January, 2017 in Nuriston and Mekhnatabad. Participants in the consultations were presented with the initial findings of the EIA (see **Appendix J** for the Powerpoint presentation). The following provides an overview of the consultations (names of all attendees can be found in **Appendix H**):

Table I-3: Nuriston Public Consultation

Date: 11th January, 2017
Location: Nuriston

Panel Members:
Mr. Nick Skinner – International Environmental Specialist
Mr. Nizom Rahimov – National Environmental Specialist

List of Participants:
44 Participants (see **Appendix H** for list)

#	Name	Question / Comment	Answer	EIA Status
1	Juraev Norboy	The temperature of the water in the KMK irrigation channels is too high. We have also noticed contamination from oils in the channels.	We are currently undertaking a monitoring program to assess the water temperature in the KMK. However data provided by UE TPP does not indicate that the temperature in the KMK is elevated above the regulatory requirement.	**Section G.6.6 – Surface Water** discusses the issue of water temperature and makes recommendations to ensure the regulatory requirements are met.
2	Esonov Ibrahim	Will there be any landscaping as part of TPP2?	The EPC Contractor will determine if landscaping will be included as part of the Construction works. During the operational phase of the Project UE will decide how to landscape the facility.	No action warranted.
3	Igabrdeav Yahshiboy	Will the temperature and wind conditions affect air emissions from the stack?	Wind and temperature both affect the dispersion of air emissions. However, as noted in the presentation, NOx emissions are well within the regulatory limits.	**Section G.6.1 – Air Quality** discusses the findings of the air dispersion model.

4	Jaraev Norboy	We are still concerned about emissions from SGCC and their impacts on our health.	We are still investigating this issue further and intend to meet the medical department in Nuriston.	Additional consultations indicated that this is only an issue for those who work in SGCC. See **Item E.4.2.1 – Health** explains this issue further.
5	Hidoyalov Olin	What are the main health impacts of NOx?	The main impacts to health are respiratory problems.	No action warranted.
6	Djurayev Botir	Does the TPP2 discharge water affect agriculture?	If the water discharge is within the set regulatory limits there should be no significant impact to agriculture.	**Section G.6.6 – Surface Water** discusses the issue of water discharge and makes recommendations to ensure the regulatory requirements are met.

767. Other questions and comments raised by the participants, which are not related to environmental issues, are not included in the table above.

Figure I-2: Consultation in Nuriston, January, 2017

Table I.4: Mekhnatabad Public Consultation
Date: 11th January, 2017 **Location:** Mekhnatabad **Panel Members:** Mr. Nick Skinner – International Environmental Specialist Mr. Nizom Rahimov – National Environmental Specialist

List of Participants: 48 Participants (see **Appendix H** for list)				
#	**Name**	**Question / Comment**	**Answer**	**EIA Status**
1	Nazarov Hujaqul	We do not have a direct water supply system, so we take our drinking water from the KMK. We think that the temperature of the water in the KMK is too high.	We do not believe that water should be extracted from the KMK for drinking. We are currently monitoring the water temperature in the KMK, but data provided by UE to us indicates that the water temperature meets the regulatory requirements.	**Section G.6.6 – Surface Water** discusses the issue of water temperature and makes recommendations to ensure the regulatory requirements are met. Mekhnatabad is upstream from the TPC. There will be no impacts from the TPC upstream. Downstream users are connected to a potable water supply network. In addition, people drinking water from the upstream area of KMK have the option to buy potable water from water trucks. However, they chose to take water from the KMK as it is free.
2	Sobhir Yakubov	Will the construction of TPP2 mean that we will no longer have power cuts?	We assume that operation of TPP1 and TPP2 will more or less eliminate power cuts, but obviously there will still be times when power cuts will occur for different reasons.	No action warranted.
3	Hurramov Abdursaul	We need a water supply system to replace water from the KMK	We agree, but this is beyond the scope of the Project.	No action warranted.
4	Holturayeva Nargiza	We would like UE to contribute to the community with a project such as improving the school playing field.	Noted.	No action warranted.
5	Holturayeva Nargiza	What will happen if the Contractor damages roads with his vehicles?	An initial road condition survey will be performed before the start of the Project. At the end of the Project the road condition will be re-assessed for damage. If the roads have been significantly damaged by the EPC Contractor he will be responsible for repairs.	Addressed by **Section G.8.1 – Infrastructure and Transport Services**

Figure I-3: Consultation in Mekhnatabad, January, 2017

I.1.2 HIA Consultations

768. A third round of consultations was undertaken on 30th October, 2017 in Nuriston and Mekhnatabad to discuss health impacts associated with the Project. Representatives of the ADB attended the meeting. The purpose of the consultations was to present the findings of the HIA and discuss any potential issues with Project stakeholders. The following provides a summary of the comments and questions from stakeholders.

769. Nuriston:

- Comment - There are no issues with air quality affecting health from the TPC. The issue is from Shurtan.
- Comment – NOx emissions from TPC are still an issue.
- Comment – Is noise being monitored?

770. The stakeholders were then asked if they though TPC or Shurtan was the main source of emissions affecting health. Around 95% thought that Shurtan was the main source of polluting air emissions. The stakeholders were also asked if they though that noise levels were high from the TPC. None of the stakeholders thought that this was the case and nobody thought that noise levels had increased in Nuriston since TPP1 had become operational.

Figure I-4: Nuriston HIA Consultations, 30th September 2017

Figure I-4: Mekhnatabad HIA Consultations, 30th September 2017

771. Mekhnatabad:

- Comment – We drink water from the KMK.
- Comment – there are no noticeable odors from TPC, but there is a smell of gas from Shurtan at night.
- Comment – We would like a water supply system connected to Mekhnatabad.
- Comment – We have not noticed any increase in noise levels from TPP1. We think the noise mainly comes from TPP0.

772. The stakeholders mentioned that they do drink water from the KMK (although it is taken upstream from the TPC). They also stated that water supply trucks do deliver potable water to Mekhnatabad, but they use the water from KMK instead (probably because they do not want to pay for the potable water).

I.2 Planned Information Disclosure

773. It is anticipated that in compliance with ADB's requirements for EIAs (Category A environmental analyses), the document will be provided for disclosure on the ADB website and in UZB (in local language) prior to ADB Board Approval.

774. The TPP2 PMU will be responsible to notify and inform the public of construction operations prior to construction works, publish an emergency response plan disclosing his intentions to deal with accidents and emergencies, including environmental/public health emergencies associated with hazardous material spills and similar events, etc.

I.3 Grievance Mechanism

775. Complaints consideration procedures aim to provide an effective and systematic mechanism for the Project in responding to queries, feedbacks and complaints from affected persons, other key stakeholders and the general public.

I.3.1 Levels and Procedure for Grievance Redress

776. The Grievance Redress Mechanism (GRM) is available to people living or working in the areas impacted by the project activities. Any person impacted by or concerned about the project activities has the right to participate in the GRM, should have the easy access to it, and be encouraged to use it. The proposed GRM does not replace the public mechanisms of complaint and conflict resolution envisaged by the legal system of the GoU, but attempts to minimize use of it to the extent possible.

777. Overall responsibility for timely implementation of GRM lies with UE through its TPP2 PMU supported by the Engineer involved in managing and supervising the Project, while the EPC Contractor undertakes the actual construction works. Relevant Khokimyats, who are mandated by law to perform grievance redress related tasks, and mediators who are involved in facilitating amicable resolution of grievances are also included in GRM.

778. This GRM envisages two levels of grievance resolution for projects implemented under the supervision of the TPP2 PMU: Grievance Redress Committees (GRC) at the local level and central (Tashkent) level. Local GRCs will be composed of:

- Members nominated from the TPP2 PMU;
- Khokimyats (which must be represented by at least one female member);
- Engineer; and
- EPC Contractor.

Central GRCs will be composed of:

- PMU Social Safeguards Representative; and
- ADB Social Safeguards Representative

GRM: Local Level

779. At the first stage, the resolution of grievance will be attempted through GRC at local level through the following steps.

780. *Grievance registration*: complainants or concerned individuals can visit, call or send a letter or e-mail or fax to the Khokimyat, the EPC Contractor, the Engineer or the TPP2 PMU. Receipt of grievances lodged in person, via phone, through a letter or e-mail or fax will be acknowledged. Grievances will be recorded in a standard format.

781. *Grievance processing*: Queries and complaints that are clarified and resolved at the intake point are closed immediately. Cases requiring further assessment and action are considered by the GRC at the local level. The GRC at the local level: (i) holds meetings on bi-monthly basis, however special ad hoc meetings can be arranged, as needed; and (ii) discusses the grievance case within ten working days and recommend its settlement to parties. The GRC Coordinator at the local level circulates relevant information among the members of GRC, prepares Minutes of GRC meeting and progress reports, and ensures that actions and decisions are properly documented.

782. *Feedback provision*: Receipt of grievances lodged in person or via phone will be acknowledged immediately. Receipt of grievances received through a letter or e-mail or will be acknowledged through a letter / e-mail / fax within 3 working days upon receipt by GRC coordinator at regional level.

783. If the grievance was resolved at the local level, the complaining party will be informed of the outcome. If the grievance was not resolved at the local level and was passed to the GRC at the central level for consideration and resolution, appropriate information will be provided to the complaining party, including the date when the case was passed to GRC at the central level and the date by which the outcome at the central level is expected.

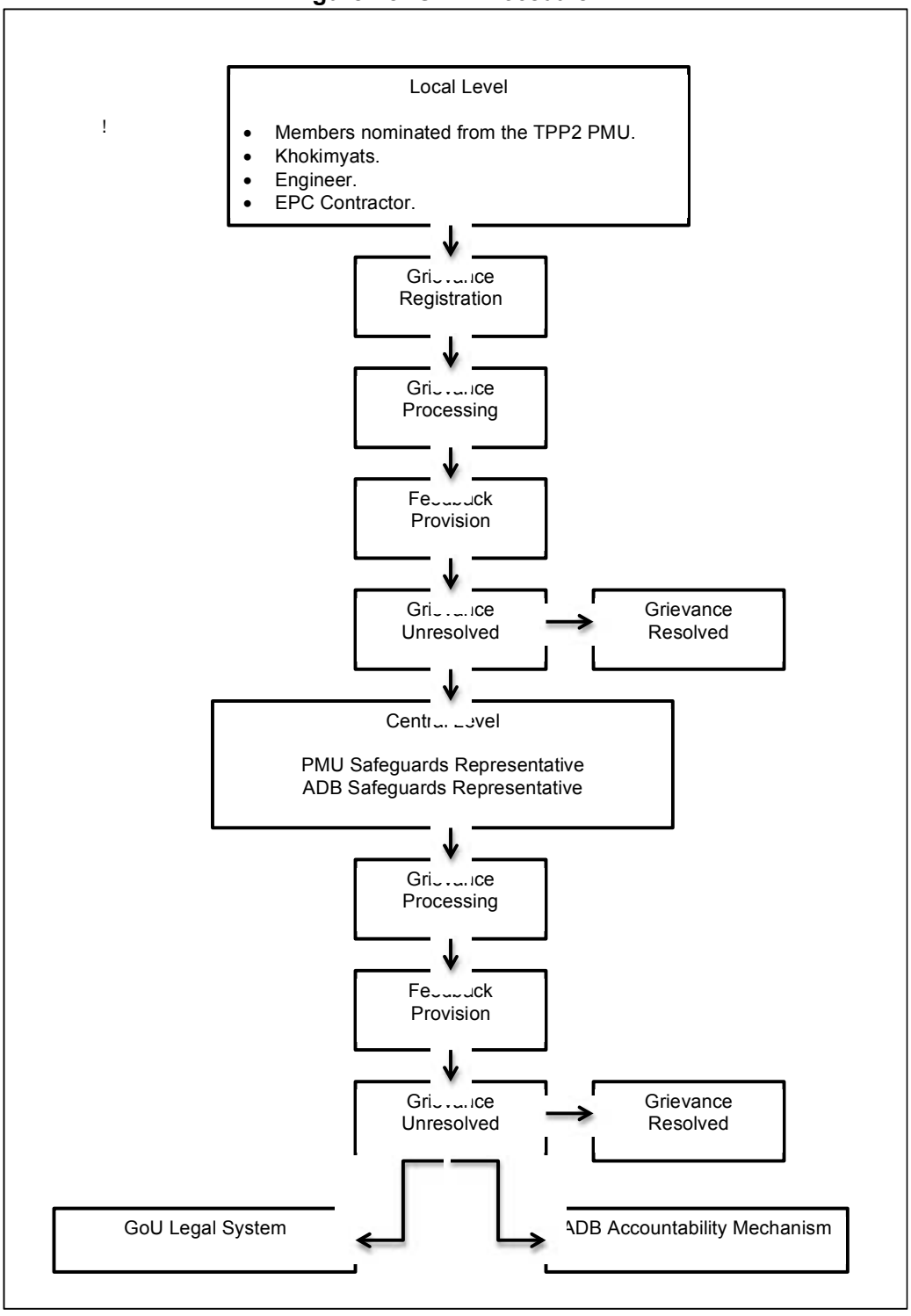
784. In case of anonymous complaints, the printed response will be posted at the information board of the relevant Khokimyat, so as the complaining party can approach and review the feedback.

GRM: Central Level

785. Following unsuccessful consideration of grievance by the GRC at the local level, complaint resolutions will be attempted at a central level through following steps.

786. *Grievance processing*: If grievance cannot be resolved by the GRC at the local level, it will be forwarded for consideration by the GRC at the central level, including all relevant documents. The GRC at central level: (i) holds meetings on monthly basis, however special ad hoc meetings can be arranged, as needed; and (ii) discusses the grievance case within twenty working days and recommend its settlement to parties. GRC Coordinator at central level circulates relevant information among the members of GRC, prepares Minutes of GRC meeting and progress reports, and ensures that actions and decisions are properly documented.

Figure I-5: GRM Procedure



787. *Feedback provision*: If the grievance was resolved, the complaining party will be informed on the outcome of grievance resolution. If grievance was not resolved by the GRC at central level, appropriate information will be provided to the complaining party, including details why the case was not resolved, as well as recommendation to seek for resolution through the GoU legal system.

GRM: Legal System

788. If after the intervention and assistance from the GRCs at both local and central levels, no solution has been reached, and if the grievance redress system fails to satisfy the complaining parties, the case will be referred to the court for resolution in accordance with the GoU legislation.

789. In the meantime, it should also be emphasized that the GRM Guideline does not limit the right of the complaining party to submit the case to the court of law in the first stage of grievance process.

ADB Accountability Mechanism Policy, 2012

790. In addition to the GRM, the ADB has also developed its Accountability Mechanism (AM) Policy. The AM provides a forum where people adversely affected by ADB-assisted projects can voice and seek solutions to their problems and report alleged noncompliance with ADB's operational policies and procedures. It consists of two separate but complementary functions: problem solving function and compliance review function. The objective of the Accountability Mechanism Policy 2012 is to be accountable to people for ADB-assisted projects as a last resort mechanism.

I.3.2 Disclosure of the Grievance Process

791. The complaints resolution process will be disseminated through information brochures and posted to the Khokimyat. The grievance redress mechanism will also be presented during informal meetings at Project area during the construction phase of the Project. The information of grievance resolution will be summarized in TPP2 PMU progress reports to be submitted to ADB.

J. Conclusions and Recommendations

J.1 Conclusions

792. The EIA and its consultation process established that there are several key environmental and social issues associated with the Project, including impacts to water temperature, noise levels and air quality. Detailed assessment of these issues indicates that the potential impacts identified can be managed successfully with the mitigation and monitoring measures provided by this EIA and its EMP. In addition a range of less than significant impacts have been identified that are generic to this type of thermal power plant project, e.g. waste management, occupational health and safety, etc. The EMP also provides mitigation measures for these items to ensure that the Project is implemented in a sustainable manner.

793. Based on the existing ADB Safeguards Policy (2009), this Project falls under ADB's **Category A**. The total estimate costs of the environmental mitigation and management to be funded by the ADB are shown below by **Table J-1**.

Table J-1: Environmental Mitigation and Monitoring Costs (US$)

	ADB Costs	**GoU Costs**	**Total Project Costs**
EMP Mitigation Costs	632,000	90,000	722,000
Construction / Commissioning Instrumental Monitoring Costs	36,600	0	36,600
Operational Instrumental Monitoring Costs	48,000	500	48,500
Total	716,600	90,500	**807,100**

794. This would represent a total cost of US$807,100 for environmental mitigation and monitoring, or less than 1% of the total Project cost.

J.2 Recommendations

J.2.1 Pre-Construction, Construction & Commissioning Phase

795. The EMP, its mitigation and monitoring programs, contained herewith shall be included within the Bidding documents for project works. The Bid documents should state that the EPC Contractor shall be responsible for the implementation of the requirements of the EMP through his own SSEMP which will adopt all of the conditions of the EMP. This ensures that all potential bidders are aware of the environmental requirements of the Project and its associated environmental costs.

796. The EMP and all its requirements shall then be added to the EPC Contractors Contract, thereby making implementation of the EMP a legal requirement according to the Contract. He shall then prepare his SSEMP which will be approved and monitored by the Engineer. The Engineer will employ his own international and national environmental specialists for the duration of the construction and commissioning phases to monitor the EPC Contractors environmental performance. Should the Engineer note any non-conformance with the SSEMP the EPC Contractor can be held liable for breach of the contractual obligations of the EMP. To ensure compliance with the SSEMP the EPC Contractor should employ a national environmental specialist to monitor and report Project activities throughout the Project Construction phase.

797. In addition to the responsibilities of the EPC Contractor, UE and TPP0 management are also responsible for several mitigation measures during these phases. The most important of which will be the development of the thermal discharge operational model which should be developed in conjunction with the TPP2 EPC Contractor.

J.2.2 Operational Phase

798. During the operational phase of the Project UE TPP will be responsible for ensuring that the mitigation and monitoring program specified in this EIA are implemented. International best practice suggests that the best way to organize these items is through an Environmental and Social Management System (ESMS). An ESMS is a dynamic process that requires a complete set of policies and procedures to be in place (e.g. waste management plans), such that all of the mitigation measures would become an integrated way to conduct the business while simultaneously reducing the risk of pollution events and accidents, and allowing UE TPP to monitor and report on its regulatory requirements.

799. The ESMS will be developed according to the requirements of the IFC Performance Standard 1 and will include at least the following sections:

- Environmental and Social Policy of the Company.
- Identification of Risks and Impacts.
- Management Programs.
- Organizational Capacity and Competency.
- Emergency Preparedness and Response.
- Stakeholder Engagement.
- External Communications and Grievance Mechanism.
- On-going reporting to Affected Communities.
- Monitoring and Management Review.

800. The initial set-up of the ESMS would require external assistance from an international environmental specialist who would also provide training to the UE TPP team in the maintenance of the system.

J.2.3 Decommissioning Phase

801. A detailed decommissioning and rehabilitation plan must be developed by TPP2 prior to decommissioning TPP2. This plan should include, but not be limited to, management of socio-economic aspects such as employment loss, removal, re-use and recycling of materials and vegetative rehabilitation to prevent erosion. The decommissioning activities will be similar to construction activities and therefore recommendations outlined to manage construction phase impacts should be adhered to during decommissioning.