EIA Report
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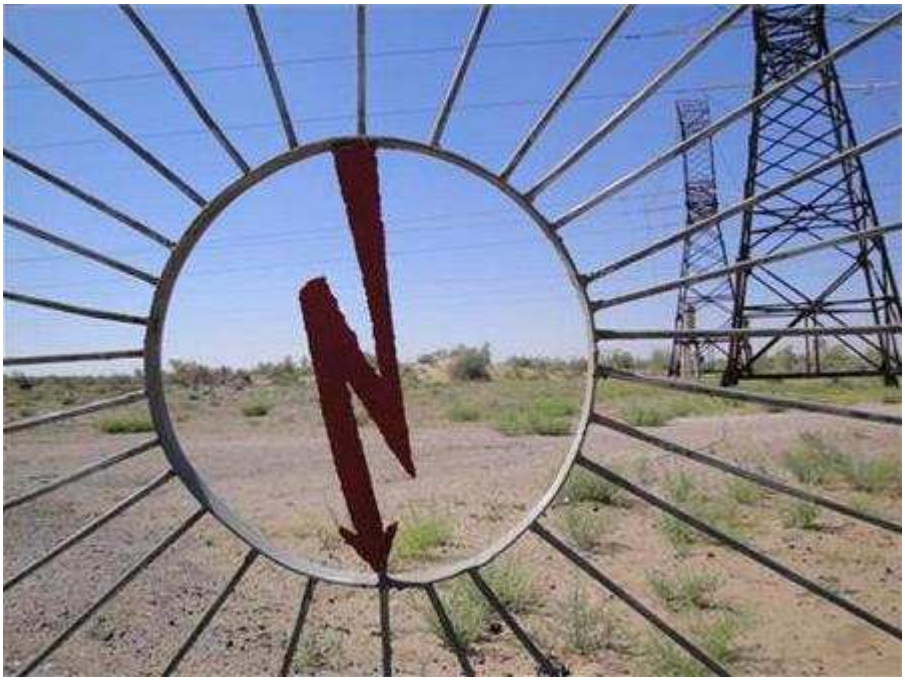
Zerger Regional Power Generation Project

Environmental Impact Assessment
submitted by the State Power Corporation "Turkmenenergo" of the Ministry of Energy of Turkmenistan



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Abbreviations and Acronyms

ADB	Asian Development Bank
AP	Affected Person
CCPP	Combined Cycle Power Plant
CHSP	Community Health and Safety Plan
CSO	Civil Society Organisation
EIA	Environmental Impact Assessment
EPC	Engineering, Procurement and Construction
EMD	Environmental Management Department
EMP	Environmental Management Plan
GHG	Greenhouse Gas
GIZ	German International Cooperation
GT	Gas Turbine
HRSG	Heat Recovery Steam Generator
IA	Implementing Agency
IEE	Initial Environmental Examination
IR	Involuntary Resettlement
IUCN	International Union for the Conservation of Nature
kV	Kilovolt
KWh	Kilowatt-hour
MOA	Ministry of Agriculture
MOE	Ministry of Energy
MNP	Ministry of Nature Protection
MOC	Ministry of Culture
MOG	Ministry of Oil and Gas Industry and Mineral Resources
MMA	Ministry of Municipal Affairs
MPH	Ministry of Public Health and Medical Industry
MWE	Ministry of Water Economy
MW	Megawatt
NGO	Non-Governmental Organization
OCPP	Open Cycle Power Plant
OHSP	Operational Health and Safety Plan
OM	Operations Manual ADB
OP	Operational Policy of World Bank
PCR	Physical Cultural Resources
PIC	Project Implementation Consultant
PIU	Project Implementation Unit
LARP	Land Acquisition and Resettlement Plan
LARPF	Land Acquisition and Resettlement Policy Framework
REA	Rapid Environmental Assessment
SEE	State Environmental Expertise
SPS	Safeguard Policy Statement ADB
UNDP	United Nations Development Program
WB	World Bank
WWF	World Wide Fund for Nature

1. Executive Summary

1.1 Introduction

The present Environmental Impact Assessment (EIA) study assesses the environmental impacts of the planned 400 MW Open Cycle Gas Turbine natural gas-fired power plant in Zerger, Serdarabad district, Lebap province, Turkmenistan (TKM).

There is existing Lebap power plant with 3 open-cycle gas turbines with total capacity of 150 MW at the site.

1.2 Institutional and Legislative Framework

Customer of the project is the State Electrical Power Corporation Turkmenenergo of the Ministry of Energy of Turkmenistan (MOE).

National Legal Framework

Following main laws govern the protection of the environment in Turkmenistan:

Law/Code	Date	Key areas
On the Protection of Nature	11/12/1991	The basic law regulating environmental relations, defines the basic legal principles of environmental and natural resource management and environmental protection
On Standardization and Metrology	01/10/1993	Regulation of product requirements, providing security for people and the environment
On the Protection and rational Use of Flora	12/28/1993	Regulates relations in the protection and use of natural vegetation
On the State Environmental Review	15/06/1995	Legal and regulatory framework to ensure environmental safety
On Air Protection	12/20/1996	The legal regulation of activity of state bodies, enterprises, institutions, organizations, public associations and citizens in the area of air protection
On the Protection and rational Use of Fauna	12/06/1997	Regulates relations in the protection, use and reproduction of the animal world
Assessment of the environmental impact of planned economic and other activities in Turkmenistan. Home Civil Service "Turkmenstandartlary."	2001	Represents the Turkmen State Standard (TDS 579-2001) to implement the EIA for the development of design and project documentation
Code of Turkmenistan On Water	10/25/2004	Regulates water relations, rational use of water for the needs of the population and economy, as well as protect the rights of enterprises, institutions, organizations, enterprises and citizens "daikhan" in the field of water relations
Code of Turkmenistan On Earth	10/25/2004	Regulates land relations, rational use of land, protects the rights of enterprises, institutions, organizations, and citizens "daikhan" farms in the area of land relations
Forest Code Turkmenistan	06/04/2011	Regulates relations in the use and protection of forests, contains general provisions on the functions, membership of forests and forest funds and regulates the use and restoration of forest resources
On specially protected Natural Areas	31/04/2012	Legal, environmental, economic and organizational basis for the creation, management and protection of unique natural complexes, which are of national wealth and national property for the benefit of present and future generations.

Turkmenistan has ratified the Kyoto Protocol to the United Nations Framework Convention on Climate Change in 1998. Turkmenistan has no

quantitative obligations from the Kyoto Protocol and may engage in greenhouse gas (GHG) emissions trading through the implementation of projects within the Clean Development Mechanism (CDM).

Turkmenistan has not ratified the Stockholm convention.

1.3 Project Description

In Turkmenistan, the Project includes a new gas-fired 400 MW open cycle gas turbine (OCGT) power plant with a future upgrade possibility to Combined Cycle (CCGT). The Project will increase generation capacity in Turkmenistan and thereby allowing TKM to export power to AFG.

The plant configuration and technical characteristics of the proposed alternative are described in Chapter 1.5 and in more detail in Chapter 6.3.

The selected Project location "Zerger" is a semi-desert area situated in the industrial belt of Turkmenabat, the second biggest city of Turkmenistan. Natural gas is considered to be the cleanest fossil fuel as the combustion by-products are mostly carbon dioxide (CO_2) with very small amounts of nitrogen oxides (NO_2 / NO_x) and hardly any other substances. To produce the same quantity of electricity through combustion, natural gas will produce approximately 30 % less CO_2 than oil and 45 % less CO_2 than coal. Technical alternatives are discussed. Due to the open cycle technology the energy efficiency will reach around 33-37 %.

The access point to the Turkmenenergo power grid will be via a new 110 kV / 220 kV-substation located on the property of the new OCGT PP. The site is close to a gas pipeline with sufficient pressure (55 bar). Access to water supply is possible via 6.5 km long pipelines. Before discharge, water will be cleaned if necessary and cooled down in retention ponds. An asphalted access road exists. During construction a workers camp will be built and lay down areas demarcated. These areas will later be used for the construction of workshops and other buildings of the PP complex.

Ancillary Infrastructure	Length
Water pipelines (supply/discharge)	2 x 6.5km
Gas pipeline	7 km
Electrical Connection	50 m
Water retention pond	2400 m^3
Workers camp and lay down areas	approx. 15.000 m²
Workshops and area for employees	approx. 15.000 m²

1.4 Baseline Conditions

The Project area covers the potential area of influence of the Project which is the site of the planned power plant and its direct environment. It is situated next to the existing Lebap power plant, 7 km from the settlement of Zerger and 20 km from the town centre of Turkmenabat in Lebap province (Velayat) of Turkmenistan. The selected location is 38°58'42.69''N / 63°27'54.21''E. The topography of the Project area is characterized by a flat landscape at the southern fringe of the industrial belt at the outskirts of Turkmenabat. The area is situated between 188-192 altitude a.s.l.

The project area is a steppe/ desert area with the topsoil being composed of shifting sands. It contains 50 % sand-size particles with the rest consisting of impurities such as feldspar, mica, and cement of silica, iron or carbonates. Most of the soils from these rocks are coarse in texture, acid, deep, and low in nutrients.

In the close vicinity of the Project's future installations there is an open air waste dump. Additionally, there is an important industrial unit, which is assumed to be a fertilizer factory, 8 km from the Project area. In general, the air quality in the Project area is already degraded. Air pollution at the Project site is assessed to be significant with Northern winds blowing smoke from the chemical industry plants as well as from the waste disposal site towards the existing substation and thus the project site.

Ambient air measurements initiated by the Consultant and conducted by the Centre for Environmental Monitoring / MNP in August 2012 have shown some high values of TSP. If the TSP value was fully attributable to PM 2.5 or PM 10 (worst case) national and international standards would be exceeded. A comparison of TSP with PM 10 / PM 2.5 and application of WHO standards does not seem appropriate. The Interim Target 1 for PM10 and PM 2.5 will be more appropriate for Turkmenistan given its developing country status. If one compares with this standard, given the normal fraction of PM10 and PM2.5 in TSP, the ambient standards may be complied with. Other values are within the limits of international standards.

According to the Ministry of Water Resources, there are two surface water sources near the Project site, Hojaily Channel and main left bank collector (GLK-Collector). Hojaily Channel is located in 3.5 km distance. It has a flow of 0.5-1.0 m^3/sec and a salinity of 0.7 g/l. The main left bank collector (GLK) is located at 6.5 km distance from the Project site. Its flow is 10-18 m^3/s and its salinity content is 1.5-3 g/l. The water level in winter is lower than in summer. The channels are not directly linked to each other. The indirect link is that the GLK Collector receives the infiltrated irrigation water from the Hojaily Channel after utilization.

In terms of vegetation and biodiversity it is obvious that the Project site borders an industrial zone in the North and extending into the desert in the South. In the area of influence around the Project site, landscape and vegetation do not change significantly (except existing infrastructure). The

plant communities are dominated by the perennial Chenopodiaceae, large shrubs such as white and black saxaul (*Haloxylon persicum, H. alba*), sand acacia (*Ammodendron*), kandym (*Calligonum*), ephedra (*Ephedra strobilacea*), and ephemeral plants.

At the Project site skylarks, crested larks, saxaul sparrows (*Passer ammoderdri*), wagtails, hoopoes and desert sparrows have been recorded. No threatened species as for example the imperial eagle (*Aquila heliaca*) and saker falcon (*Falco cherrug*) have been identified there.

In the irrigation channels and drainage collectors silver carp (*Hypophthalmichthys molitrix*), grass carp (*Ctenopharyngodon idella*), bighead carp (*Aristichthys nobilis*), crested loach (Nemacheilus *longicaudus*), snakehead (*Channa argus warpachowskii*) pikeperch, bream and potentially channel catfish (*Ictalurus punctatus*) have been identified in consultation with local fishermen. No threatened or endemic species have been recorded in the Hojaily Canal or GLK collector.

The socio-economic conditions have been assessed, including education, health, land-use pattern, agriculture, industrial development gender relations and ethnic minorities. The Project area is not inhabited; the nearest settlements are located in a distance of more than 6 km. No land-use exists at the Project site. The Project area is not a tourism site and it has been confirmed that there are no cultural monuments near the selected Project site.

1.5 Analysis of Alternatives

The “Zero-Alternative” describes the situation without the project: “No construction of a new power plant." This alternative would prevent the country to export substantial amounts of electricity to Afghanistan and reduce the benefits of the new 500kV line, construction of which is nearly completed. The increase in demand and supply of power for export will increase emissions of CO_2. The "Zero"- alternative would signify that at the site at Zerger, only 150 MW capacity open cycle gas turbines would be installed and not the additional 400 MW.

The selected site at Zerger (38°58'30" N / 63°28'00" E) is an optimization of several factors:

- distance to sensitive receptors (e.g. more than 5km to settlements)
- low ecological value and importance
- short distance to a gas pipeline with sufficient pressure
- short distance to the existing grid (including future grid expansion)
- good water supply possibilities
- good accessibility via main road (M37) and
- sufficient proximity to train rails.

The site is located in an industrial zone where the existing industrial pollution level (“preload”) is considerable. The power plant will figure

among the cleaner infrastructures. It is noted that the power plant needs to meet the emission standards irrespective of the pollution from other sources.

The proposed open cycle gas turbine (OCGT) power plant is part of Turkmenistan's power system expansion plan which involves conversion of OCGT to combined cycle (CCGT) capacity as well as new open cycle gas turbine capacity. The project to be commissioned in 2018 will contribute to establishing sufficient reserve capacities and enabling the export of power to Afghanistan. The type of plant is the least cost solution for the project and the most effective way to generate power for export. Although a CCGT power plant would consume less gas due to its higher efficiency (around 50% compared to the 37% of the OCGT), the savings in fuel costs are not sufficient to offset the higher investment costs of a CCGT, given the subsidized gas prices in Turkmenistan.

The initial request from the Afghan Government was for Turkmenistan to make available a capacity for import in the range of 300 MW. Although closer investigation has shown that this capacity will only be demanded gradually and after some years, the total demand growth in Turkmenistan and for export justifies this capacity addition.

The higher efficiency of a CCGT plant compared with the steam generation or further operation of OCGT would lower CO_2 emissions per generated kWh. An upgrade possibility with steam generators to shift from Open Cycle to Combined Cycle in a second step is foreseen.

Proposed Alternative
The proposed power plant will be an open cycle type (OCGT) as decided TE. Primary fuel will be natural gas and will be supplied by a pipeline connection to the local gas grid.

As water supply source, the GLK drainage collector is suggested. In principle, groundwater wells would be an alternative source of water supply, but due to the 10 times higher salinity and no further information about the abundance of groundwater at the project site, the alternative, GLK collector water is selected. A small pumping station will be installed to facilitate the transport of water through a feed pipe of 6.5 km length. Power connection is nearby and the pumping station will be located near the road for accessibility. The quantity of water needed is estimated at 75 m^3/h (19 l /sec.) which will be partly further processed (through reverse osmosis (RO) for use in the power plant.

The wastewater system shall be designed to also handle the wastewater from all processes, buildings and installations. All wastewater from the power plant will be discharged to the GLK Collector after proper treatment and cooling. The following process wastewater sources are to be considered as main sources:

- sewage drain from sanitation, about 5 to 10 m³/h
- waste water from raw water treatment processes: about: 36 m³/h

- waste water from boiler blow down, about: 30 m³/h.

The various wastewater streams must be piped to the wastewater treatment plant. Surface water from unpolluted areas may be used directly for irrigation or sent directly to the GLK collector.

With a mean flow of 15-18 m^3/ sec. the collector has enough capacity to accept the treated domestic and plant wastewater from the power plant. The treated wastewater stream to the collector is calculated at a rate of about 70 m³/h (approx. 19 l/sec.). As an alternative, the water can be used for irrigation at the project site.

The nearest railroad line is located about 4km to the East. A rail spur to the project site is not foreseen. A highway (M37) is located about 3.5 km to the East. There is a paved road from the plant site.

1.6 Environmental Impact Assessment

Impact of/on	Sensitivity	Extent of Impact before mitigation	Extent of Impact after mitigation	Duration of Impact	Direct/ Indirect Impact	Comment
Landscape and Visual Aspects	■	■	■	Long term during construction	Direct	The construction will be visible from the main road M 37 creating a visual impact for passing vehicles. Being located in the industrial belt of Turkmenabat next to a existing power plant, substation site and various high-voltage transmission lines the landscape is assessed to be not sensitive; there is no present tourist value. The additional visual impact of the power plant and the ancillary infrastructure is assessed to be low. No mitigation required.
Land Use	■	■/O	O	Long term	Direct	The land is owned by the Serdarabat Etrap (Municipality) and there are no existing lease contracts or other permits for land use according to municipality officials. During the site visit no traces of an existing land use could be identified. No mitigation required as shepherds can easily choose another passage.
Soil and Erosion	■■■	■■	■	Long term	Direct	Removal of vegetation shall be minimised. Borders of access roads will be rehabilitated and replanted. Measures to stabilize sand and prevent deflation shall be implemented for all areas where existing vegetation is removed and adjacent areas that are exposed to wind.
Land Acquisition and Resettlement	■	O	O	-	-	Land use is officially and practically inexistent. No resettlement necessary; no mitigation required.
Physical Cultural Resources	■	■	O	Long term	Direct	As confirmed by the Ministry of Culture, there are no cultural sites or historic monuments in the Project area. In case of chance finds, the construction has to be stopped immediately and the Department of Protection of Monuments and Historical Sites has to be informed to agree on further steps. Chance find procedure has to be implemented.
Flora and Fauna	■■	■	■	Short term during	Direct	Due to the specificity of the Project location (industrial

Impact of/on	Sensitivity	Extent of Impact before mitigation	Extent of Impact after mitigation	Duration of Impact	Direct/ Indirect Impact	Comment
				construction (noise etc.), Long term due to removal of vegetation on the Project site		area) the impact is assessed to be low. Noise and dust are not expected to impact flora and fauna at the construction site. Vegetation shall be replanted on unused areas to provide prevention of sand deflation and habitats for birds, reptiles and insects
Protected Areas and Wetlands	■	O	O	Short term	Direct	The closest protected areas are Repetek Biosphere Reserve (70 km distance) and Amu Darya Nature Reserve (90 km distance). The sensitivity of a protected area is generally assessed to be high, but as no protected area, wetland or sensitive ecosystem is located at the Project site no impact during construction of the Project will occur; no mitigation is necessary.
Traffic	■	■	O	Short term	Direct	Little additional traffic on the M 37 is expected. The construction of the gas pipeline will have to cross the main road and block or hinder traffic during the construction period. The traffic not being very dense the impact is assessed to be low. Following mitigation measures shall be implemented: Signing of the construction site on the M 37 to prevent accidents; access to the substation shall not be blocked during the construction work, a deviation on the M 37 for the time of gas pipeline construction shall be proposed.
Noise	■	■	■	Short term during construction	Direct	Due to the limited time of the construction period and the remoteness of the site, the annoyance of the population by noise generated during construction activities will be low. A proper EHS Management Plan will address the issue 'noise' regarding workers. All workers will be fitted with personal protective equipment (PPE) as ear plugs etc..
Air Emissions/ Ambient Air Quality	■	■	■	Short term during construction	Direct	Due to the characteristics of the area, the distance to settlements and a predominant wind direction from North-Northeast most of the dust and other emissions generated during construction

Impact of/on	Sensitivity	Extent of Impact before mitigation	Extent of Impact after mitigation	Duration of Impact	Direct/ Indirect Impact	Comment
						will be blown into the desert and will not impact settlement areas. The air shed is already polluted, so the sensitivity of the site is assessed to be low and the generated impact on the air quality will be marginal. For impact mitigation, construction vehicles shall be properly maintained and speed limits shall be respected in order to minimize generated emissions and dust
Water Supply Surface Water Groundwater	■ ■	■ ■	■ ■	Short term during construction	Direct and indirect	Drinking water supply for workers will be done by truck/ water tank till water treatment facility start operating on the existing power plant. Health and safety aspects of drinking water supply need to be respected. Water for construction purposes as well as for dust reduction (spraying) will be brought by truck as long as the water supply pipeline is not operational. Due to its high salinity, groundwater consumption during construction will be limited. The impact on water resources resulting from water supply and consumption will be low during the construction period.
Solid Waste (generated by construction activities and by workers)	■■	■■	■	Short term during construction	Direct and indirect	Without applying mitigation measures impact of solid wastes on water, soil and worker's health are assessed to be medium. All solid wastes containing hazardous materials shall be separated from other solid waste and treated adequately under compliance with international standards in order to avoid potential impacts. Fuels, chemicals and lubricants shall be stored in bounded areas with impervious ground. Non-hazardous solid waste shall be collected and disposed of by licensed waste contractors and land filled in an approved municipal waste disposal facility in compliance with local and international standards. Relevant international guidelines regarding adequate solid waste management shall be respected.
Liquid Waste (generated by	■■	■	■	Short term during	Direct and	Only low amounts of wastewater will be produced

Impact of/on	Sensitivity	Extent of Impact before mitigation	Extent of Impact after mitigation	Duration of Impact	Direct/ Indirect Impact	Comment
construction activities and by workers)				construction	indirect	temporarily by workers at the construction site. For impact avoidance/ mitigation, soil run off shall be controlled (periodic inspection) and adequate site drainage shall be performed. If liquid waste is stored, handled and treated adequately, the impact on water and soil resources of the Project area as well as on worker's health are assessed to be low. Respect of international safeguards and guidelines shall be obligatory .
Hazardous Materials	■■	■	■	Short term limited to construction period	Direct and indirect	Due to the limited quantity of hazardous materials used during the construction period the impact on water and soil resources of the Project area as well as on worker's health are assessed to be low. Hazardous materials as hydrocarbons, explosives and others (to be specified in updated EIA during design of the power plant), shall be stored, handled and treated respecting national and international guidelines.
Natural Disaster Risks	■■	■	O	Long term	Indirect	Natural hazards during construction are related to possible earthquakes (seismic risk) that may lead to the damage of infrastructure, as well as dust storms that may disturb and delay the construction activities. Infrastructure needs to be constructed respecting earthquake safety standards.
Ethnic Minorities	■■	■	O	Short term	Indirect	The Project does not have direct impacts on ethnic minorities. No settlements are concerned. Workers shall be employed irrespective of their ethnic origin. Local population shall have a priority.
Gender Issues	■■	■	O	Short term	Indirect	T. Women shall not be disadvantaged.
Population Influx / Worker's Accommodation	■	■	■	Short term	Indirect	It is not expected that the Project will create a large influx of population during the construction period. Provisions regarding health, safety and security will need to be implemented.
Workforce / Generated Employment	■■	✦	✦	Short term limited to construction period	Direct	During the construction period local workforce will be employed for the construction works. This will contribute to a much needed monetary income. However, the income

Impact of/on	Sensitivity	Extent of Impact before mitigation	Extent of Impact after mitigation	Duration of Impact	Direct/ Indirect Impact	Comment
						generation opportunity is not of long term duration.
Occupational Health and Safety	■■	■■	O/■	Short term during construction	Direct and indirect	In order to meet the health and safety risks from noise and dust emissions, spread of diseases, and potential accidents, an EHS Management System/ Plan shall be developed and implemented during construction, including an EHS Audit on the construction site and training of the workers. Good local and international construction practice in, Environment, Health & Safety (EHS) shall be applied at all times.
Community Health and Safety	■	■	■	Short term during construction	Indirect	The impact on community health and safety is expected to be low.
Decommissioning of existing Substation	■■	■■	■	Short term during construction	Indirect	Recycling and waste management procedures and provisions according to national and international standards will have to be planned for the decommissioning phase and foresee complete dismantling of the existing substation, especially related to PCB analysis and treatment of oil containing equipment

Extent of impact:

■■■ = high negative
■■ = medium negative
■ = low negative
O = nil
✦ = locally positive
✦✦ = regionally positive

Extent of sensitivity

■■■ = high
■■ = medium
■ = low

Impacts during operation phase under consideration of the proposed mitigation measures (see Table 8-2).

Impact of/on	Sensitivity	Extent of Impact before mitigation	Extent of Impact after mitigation	Duration of Impact	Direct/ Indirect Impact	Comment
Electricity Supply , Electricity Export	-	✦ / ✦✦	✦ / ✦✦	Long term	Direct	An increased stability of the electricity supply will be reached, especially if a rising demand is expected, which creates a locally positive impact of the Project. The export of electricity is expected to be regionally positive.
Disaster Risks and Natural Hazards	■■	■	O	Long term	Direct and indirect	It is anticipated that the power plant will be designed to conform to the relevant seismic criteria sufficient to

Impact of/on	Sensitivity	Extent of Impact before mitigation	Extent of Impact after mitigation	Duration of Impact	Direct/ Indirect Impact	Comment
						withstand the level of seismic activity experienced in the area.
Gas Supply / Fuel Oil Provision and Storage	■	■	O	Long term	Direct	Specific measures to minimize gas leaks need to be included in provisions of the constructor and operator.
Noise	■	■	O/■	Long term	Direct	Design mitigation measures to minimize noise impacts include: air compressors shall be equipped with silencers; noisy outdoor equipment shall be designed to a noise limit of 85 dB(A) at 1 m distance. In addition, plant workers will be provided with protective wear in areas with high noise levels. The power plant shall operate in accordance with internationally accepted health and safety measures.
Air Emissions/ Ambient Air Quality	■■	■■	■	Long term	Direct	The future plant will have a limited influence on the air quality in the Project area. The results of the air dispersion modelling show that the expected levels of pollutants resulting from the operation of the power plant will be considerably below the international Air Quality Standards. The modeled plume of the powerplant does not reach sensitive / settlement areas. The measurement of preloads from other polluting sources shall be monitored during construction period and suitable mitigation measures designed. The additional capacity of 150 MW OCGT of existing blocks is included in the emission modelling.
Water Supply	■■	■■	■	Long term	Direct and indirect	Relevant for the assessment are also process water supply, drinking and fire fighting water systems. Mitigation measures include: monitoring of water supply from GLK Collector; fire fighting water supply, storage and pumping of water for fire fighting needs to be assured; implementation of storage and pumps; accessibility and con-tingency planning; regular drinking water supply and quality control of drinking water.

Impact of/on	Sensitivity	Extent of Impact before mitigation	Extent of Impact after mitigation	Duration of Impact	Direct/ Indirect Impact	Comment
Process Wastewater	■■	■ / ■■	■	Long term	Direct	The treated wastewater (blow down) is mixed with the wastewater of the demineralization plant (no significant temperature increase, no significant increase in salt content) and rejected to the GLK collector after cooling in retention pond. Other waste waters will be treated as appropriate, Since the process is not handling any hazardous chemicals, storm water will simply be directed offsite without treatment. Oil polluted waste water will be treated by oil separators.
Solid and Liquid Waste	■	■■	■	Long term	Direct	Solid wastes generated during plant operation include mixed utility waste, absorbents, filtering materials, cleaning tissues and protective clothing as well as slurry from water treatment. Liquid wastes generated during construction include wastewater (e.g. sewage), oil, and other effluents from the construction activities. Liquid wastes, especially if they contain hazardous substances may pollute water and soil of the Project area. Generally the quantities generated during operation of the power plant will be limited. If solid and liquid waste is stored, handled and treated according to international safeguards, the impact on water and soil resources of the Project area as well as on worker's health are assessed to be low. An audit of the disposal procedure shall be done.
Occupational Health and Safety	■■	■	○	Long term during operation	Direct	In order to meet the health and safety risks from noise emissions, drug abuse, potential accidents and safety hazards (i.e. fire safety), an EHS Management System/ Plan shall be developed and implemented during operation, including regular EHS Audits and training of the workers. Instructions on emergency measures necessary to safeguard employees shall be prepared.
Operational Equipment	■	■	■	Long Term during	Direct	Potential negative impacts of operational equipment shall be

Impact of/on	Sensitivity	Extent of Impact before mitigation	Extent of Impact after mitigation	Duration of Impact	Direct/ Indirect Impact	Comment
				operation		mitigated by avoiding unnecessary use and regular maintenance (i.e. vehicles etc.).
Emission of Greenhouse Gases/ Climate Change	■■	■■	■■	Long term during operation	Direct and indirect	In order to mitigate the additional GHG emission from the power plant operation considerable effort would need to be put in the implementation of CDM development projects.

Extent of impact:

■■■ = high negative
■■ = medium negative
■ = low negative
○ = nil
✦ = locally positive
✦✦ = regionally positive

Extent of sensitivity

■■■ = high
■■ = medium
■ = low

Impacts during decommissioning phase under consideration of the proposed mitigation measures (see Table 8-4).

Impact of/on	Sensitivity	Extent of Impact before mitigation	Extent of Impact after mitigation	Duration of Impact	Direct/ Indirect Impact	Comment
Decommissioning						Recycling and waste management procedures and provisions according to national and international standards will have to be planned for the decommissioning phase and foresee complete dismantling of the power plant.
Scrap metal	■	■	+	Long term after op.	Direct and indirect	Steel will be sold as scrap metal and recycled.
Ceramics	■	■	0	Long term after operation	Direct and indirect	Ceramic waste is chemically inert and may be re-used as material for land levelling (e.g. road or other construction)
Transformer oil	■■	■■■	■■	Long term after operation	Direct and indirect	Oil containing equipment (e.g. transformers) shall be analysed on content of PCB. If the oil is PCB free it might be burnt, otherwise it will need to be recycled or disposed off according to international standards.
Non hazardous waste	■	■	■	Long term after operation	Direct and indirect	Non hazardous waste shall be disposed in a proper disposal site / land fill.

Impacts of cumulative and downstream impacts under consideration of the proposed mitigation measures (see Table 8-4).

Impact of/on	Sensi-tivity	Extent of Impact before mitigation	Extent of Impact after mitigation	Duration of Impact	Direct/ Indirect Impact	Comment
						The potential downstream impacts of the power plant on the environment are avoided by the design of the power plant (Choice of OCGT, not requiring big quantities of water for cooling)"). A potential industrial development in Turkmenabat and the development of other sources of emissions / air pollution will need to be controlled by national institutions responsible for environmental monitoring (MNP).
Cumulative and Downstream Impacts	■■■	■■ ✦✦	■ / ■■ ✦✦	Long term	Direct /Indirect	A recently commissioned additional power plant at the same site will lead to generation of cumulative impacts on the ambient air quality. With the planned stack height of 15m international standards of NO_2 will be exceeded at the project site, when the 400 MW OCGT will be constructed. Changing the stack height of the 3x50 GTs from 15 to 40 m will lead to a reduction in the contribution of these units for the air quality degradation at the project site area below the international limits values. The transboundary impact of the electricity export to Afghanistan is assessed as regionally positive

Extent of impact:

■■■ = high negative
■■ = medium negative
■ = low negative
O = nil
✦ = locally positive
✦✦ = regionally positive

Extent of sensitivity

■■■ = high
■■ = medium
■ = low

1.7 Public Consultation and Disclosure

The consultation of relevant stakeholders, affected population, general public as well as civil society organizations is to be carried out during the entire project cycle and will start as early during project preparation as possible.

For the present EIA at feasibility level, stakeholder consultations have been conducted in a manner commensurate with the impacts on affected communities.

Project stakeholders, national and local administration as well as civil society organisations where consulted to the extent possible in order give their feed-back and recommendations on the selection of the project site, potential impacts on resident population and existing land use, fears and expectations related to the project. Representatives of local population were consulted if a risk of any impact had been analysed (i.e. Fishermen potentially impacted by Water-Pipeline). Population in distant villages (beyond 5 km) was not systematically contacted (no impact from the power plant or from ancillary infrastructure) but representatives at municipal, CSO level in charge in order to inform the population about the existence of the project.

Summary of Records:

1. Lebapenergo, Lebapenergo office and Lebap power plant, Turkmenabat, May-July, 2015:
   Issues discussed: Location of the power plant, Design requirements, Land issues, Power Connection
   Feed-Back/ Response:
   Lebapenergo and Lebap power plant representatives explained the choice of the project location and status of technical planning as well as national requirements for the construction of Open and Combined Cycle Gas Power plants. It was made clear that the location was especially selected to make the project have minimal impacts on the environment.

2. Municipality representatives; Municipality of Serdarabat, 22 May 2013
   Issues discussed: Land titles, Water consumption, Waste management
   Feed Back/Response:
   Municipality representatives expressed that land acquisition following the nationally required procedures would not constitute a major problem as the land belongs to the municipality. Water consumption (for cooling purpose) would be a critical issue as water would be used for irrigation. Water consumption should therefore be minimized. The municipality of Serdarabat Etrap, especially Department of Nature Protection and Representation of Women's Union agreed to be the focal point for collection of feed-back and grievances.

3. Association from Nature Protection Ashgabat, Fichtner Project office, 19 May 2013
   Issues discussed: Erosion, Water consumption, Waste management, Forest re-plantation
   Feed Back/Response:
   The National Association for Nature Protection in Ashgabat expressed thanks for being consulted. The representatives mentioned that sand deflation would be an important issue to be prevented. According to the

representatives of the NGO, the project could not create a problem of water consumption, as there was too much water used for irrigation. Also taking water directly from Amu Darya River would not constitute a problem. It was explained that the association was more involved in Forest re-plantation projects than in Water Management.

4. Association for Nature Protection in Turkmenabat; Office of the Association, 21 May 2013
   Issues discussed: Protected Areas, Water consumption, Waste management, Biodiversity
   Feed Back/Response:
   The director of the Association for Nature Protection Branch of Turkmenabat was consulted on Biodiversity potential in the region. According to him, biodiversity hotspots were located in the Protected Areas and the mountain areas but not in the project area. The project area would not be critical from a biodiversity perspective. The area would be recommendable for the construction of a power plant.

5. Meeting with Women's Union; Lebapenergo office, 22 May 2013
   Issues discussed: Gender issues, Employment, Electricity Supply
   Feed Back/Response:
   The representative of the Women's Union agreed that gender relations would not be affected by the project being a power plant located far away from settlement areas and designed for electricity export. It was specified that women should be considered for employment by the project.

6. Local Fishermen, Embankment of GLK Collector, 21 May 2013
   Issues discussed: Fish catches in channels and collectors, water levels, water consumption, water quality
   Feed Back/Response:
   Local fishermen were consulted on water issues and specifically on fish species in the GLK Collector and named around 6-7 species. The catch depended on the season. According to them, there would not be a noticeable increase or decline in the fish population. As long as the project would not affect the water quality and temperature significantly, the project would not affect fisheries in the water channels.

Summary

All interviewed stakeholders confirmed the Project location as suitable and impacts on local population and the local ecosystem as largely inexistent. The land acquisition of 15-20 ha of terrain plus additional ancillary infrastructure at the planned Project site was mentioned to be uncritical by all interviewees. The project will not have direct impacts on the local population. The air emissions are uncritical as the results of the air dispersion modelling show, the water emissions will not have a critically different quality when compared to the quality of the intake water and temperature of the canal will not be increased due to retention ponds to be constructed to cool down process water. There are no houses in the vicinity of 5km.

1.8 Environmental Management Plan (EMP)

An Environmental Management Plan (EMP) for the construction and operation phases has been established. It includes mitigation measures for all impact areas, responsibilities for implementation, monitoring indicators and monitoring responsibilities as well as an indicative date for implementation. Subchapters are dedicated to describe monitoring measures in more detail and to suggest training measures to enhance implementation and monitoring capacities.

A monthly ambient air pollution monitoring program shall be implemented during the entire construction period to monitor air quality at the project site. Together with the monitoring parameters, a log / records, identifying the sources of pollution at the time of measurement shall be maintained and included in the reports. Existing air pollution can best be mitigated at the source of emission.

The remaining impacts during the construction period are easily mitigated by standard construction and supervision procedures. The effective implementation of the chosen design and the internal monitoring and external supervision of the construction process are the core areas of the monitoring measures. During construction semi-annual monitoring reports will have to be submitted.

During construction main impacts are related to air emissions, water supply and evacuation, noise, as well as the emission of GHG.

Other impacts as health and safety, emergency response etc. will be mitigated by standard procedures. The implementation of the EHS Management Plan for the operation to be prepared by the EPC Contractor will be implemented by the plant operator. A comprehensive monitoring program will have to be developed by the EPC Contractor and staff of Turkmenenergo trained.

In order to comply with the requirements of implementation and monitoring of the EMP a responsible person shall be appointed within Turkmenenergo (including regional responsibilities i.e. Lebapenergo) and closely linked to the Safety Department under the Chief Engineer. This person will be responsible for the internal oversight of environmental management during project construction and operation phases. Reporting requirements are semi-annual monitoring reports during construction and annual monitoring reports during operation.

An Environmental Monitoring Plan for the construction and the operation phase is outlined in Chapter 11.2.

Environmental monitoring during the construction phase will be performed by the Contractor. Monitoring results will be included in the project

quarterly progress reports, semi-annual environmental reports and annual reports after commissioning. During operation phase environmental monitoring activities will be performed by the plant operator / Turkmenenergo responsible person in cooperation with MNP.

EHS Audit

An Environment, Health & Safety (EHS) Construction Site Audit shall be performed three times a year during a period of 3 years, 40 man days in Y1, 40 man days Y2, 40 man days Y3.

Air quality monitoring

During Construction baseline air quality survey of NO_2, SO_2, CO and TSP/PM shall be initiated six months ahead of commissioning using air quality monitors and continue during 6 months. Monitoring Indicators are dust levels (TSP/PM10, NO_2, SO_2, CO levels. A quarterly reporting of monitoring results shall be done during construction process. (reference is made to chapter no. 12).

Water Monitoring

Surface water: visual control of downstream water quality (turbidity) during pipeline construction, regular measurements of upstream / downstream basic parameters (pH, temperature, conductivity and if feasible light and heavy metals, pesticides).

Groundwater: selection of existing wells for analysis of basic parameters (pH, temperature, salinity, if feasible heavy metals) and 1-2 measurements during construction period and after completion.

Internal Monitoring is to be initiated by EHS team of TE and EPC contractor and performed by the Ministry of Water Resources (Surface Water) and Turkmengeologiya State Corporation (Groundwater). External Monitoring will be done by the TE and EPC contractor.

Erosion control / Sand Deflation prevention

Implementation of erosion prevention structures shall be made by an experienced company and terminated at the end of the construction process. Implementation shall be monitored after construction period. Monitoring shall be done by Implementing Agency and Construction Site Audit Expert and include visual control and record keeping of construction process and number of structures. Indicators are number and location of anti sand deflation structures and successful replanting of vegetation.

Waste management monitoring

Waste management shall be monitored by visual control and record keeping of proper waste disposal, including recycling during construction period.

Noise Emission Monitoring

Noise emissions during construction process shall be monitored by controlling implementation of good construction principles.

Good construction principles related to noise emissions include:

- diesel engine construction plant equipment to be fitted with silencers
- enforcement of vehicle speed limits
- limited noisy construction activities at night
- use of protective hearing equipment for workers.

Implementation of good construction practices shall be the responsibility of all contractors on site. Noise complaints (indicator) shall be registered and followed up rigorously.

1.9 Overall Findings and Recommendations

It can be concluded that the planned 400 MW **Open Cycle Natural Gas Power Plant** in Zerger (Serdarabat Etrap) can be constructed and operated without having significant adverse impacts on the social and ecological environment on the project site and its surroundings, if all proposed mitigation measures are implemented. The future upgrade to a Combined Cycle Technology (CCGT) is recommended to increase the efficiency of the power plant.

The choice of the location is assessed to be suitable as it is located in an industrial area without competing land use and no resettlement requirements. Neither the Power Plant nor the ancillary infrastructure created by the project will generate any resettlement impacts. Local residents are not affected by the project. The closest settlements are located in a distance of more than 6.5 km. The disturbance of Flora and Fauna is assessed to be low and Protected Areas or Wetlands will not be affected. There are no historical monuments or cultural heritage sites in the Project area.

Impacts of ancillary infrastructure are assessed to be low. The distances to be bridged by additional infrastructure (access roads, pipelines) are smaller than in alternative areas. A new substation will be built on the territory of the Power Plant. A 220 kV transmission line to substation Chardzhev (National Grid) already exists (max. 50 m of new electrical connection is needed).

In the course of the construction of the new power plant, the existing substation will be demolished and a new substation within the boundary of the power plant will be constructed and operated. The decommissioning of the existing substation will result in the generation of hazardous substances and recyclable materials. Whereas scrap metal is a valuable resource and inert ceramics and other building materials are non-hazardous materials to be reused, transformer oil could be of hazardous nature because it might contain PCBs. The oil will be analysed and tested for PCB in a Turkmenenergo owned laboratory. If it contains PCB, it will be transferred to Turkmen Petrochemical Company at Turkmenabat for interim storage and later incineration (where suitable high temperature incinerators are to be in place).

The modelling results show that, considering only the operation of the power plant, the expected levels of pollutants in the area will be well below the international Air Quality Standards.

The future plant itself will have a limited impact on the air quality in the area. An ambient air quality measurement and an air dispersion calculation were carried out in order to assess the existing preloads, and the cumulative impact of a dispersion of the power plant emissions. The modelling included the additional three gas turbines constructed at the site of the existing power plant Lebap.

The Air dispersion calculation shows that these areas and settlement areas in general as well as other sensitive receptors are affected at a low level. Related to NO_2 , which was assessed the most critical pollutant (the other emissions are near to insignificant) the results are summarized in the following:

OCGT plus 3 GT does not significantly contribute to a raise of emissions at sensitive receptor level (1hr NO_2 concentration increases from 93.6 to 98.3 µg/m³ (Baseline value is 88 µg/m³).

The plant does not contribute to an exceedance of NO_x, CO, SO_2, PM concentrations in the settlement area. The calculation shows that in the nearest settlement the increase of air pollution through emissions from the power plant is less than 1% (with in the 25% increment limits of IFC). A long term monitoring of the existing pre-loads during construction phase is suggested that identifies sources of emission.

If mitigation efforts are necessary to reduce the existing pollution levels, a first investment priority would be the proper management of the waste dump instead of selecting a different site with less preload for the Power Plant. Appropriate mitigation measures to reduce emissions from other sources shall be designed and implemented.

The model results reveal that it is not expected that the sensitive receptors are affected by high levels of pollutants originated by the projects' operation. Besides the fact that BATs will be used in order to fulfill international emission limit values, the predominant wind directions (from North) allow the dispersion of the pollution plume away from the residential areas.

For a more comprehensive assessment of existing preloads the EIA shall be updated with a continuous air baseline measurement (summer and winter data) during the construction period in order to monitor existing emission sources and on this basis decide if an investment in reduction of existing air-pollution is necessary.

The recommendation from the EIA is to use collector water, because of its 10-times inferior salinity. If for technical/ economical reasons the groundwater option is envisaged, this would create the necessity to carry out

a suitable groundwater analysis and modelling. A small pumping station will be installed to facilitate the transport of water through a feed pipe. Power connection is nearby and the pumping station will be located near the road for accessibility. All wastewater from the power plant will be discharged back into the GLK Collector after proper treatment and cooling. The treated wastewater stream to the GLK collector is calculated at a rate of about 70 m^3/h (19 l/sec.). Water losses are estimated to be inferior to 10% and water quality will not change significantly. A discharge of 19 l/sec into the GLK collector (15,000-18,000 l/sec) is expected to have an insignificant impact especially after treatment and cooling in retention ponds.

Specific design mitigation measures to minimize noise impacts include air compressors to be equipped with silencers and noisy outdoor equipment to be conform to a noise limit of 85 dB (A) at 1 m distance. In addition, plant workers will be provided with protective wear in plant areas with high noise levels. The power plant shall operate in accordance with internationally accepted health and safety measures. Residential areas for workers shall be located in a sufficient distance of noise emitters in order not to be disturbed during operation of the plant. Buildings shall be noise protected. According to World Bank Standards (World Bank & IFC General EHS Guideline, April 2007) a max. noise level of 45 dB(A) during night time for residential areas shall not be exceeded.

This value will be reached by using BAT (Best Available Technology) with incorporating noise reduction measures such as e.g. silencers for stacks, for the air inlet area, gas turbine compartment, noise reducing measures for piping etc. wherever needed.

All other impacts (i.e. Traffic, Dust, Health & Safety, Cultural Heritage Sites etc.) are assessed to be low or insignificant and can be readily mitigated with compliance to good construction and operation practices.

Additional emissions from the power plant operation are expected to be 1,036,455 t / CO_2 annually. A future upgrade of OCGT to CCGT would save 311,000 t of CO_2 annually for the same electricity output.

The determination of the details is the responsibility of the constructor (EPC contractor) and could therefore not be covered by this EIA/EMP, which should periodically be updated. The entire construction process shall be supervised by an EHS-expert. The duty of such an EHS Audit shall be to ensure that the requirements, stipulated in the Environmental Management Plan (EMP) to this Project are fulfilled. The implementation of the EMP shall be part of the obligations of the EPC contractor, as well as the construction companies and the plant operator

Within Turkmenenergo an Environmental Department does currently not exist. It is recommended to appoint a responsible person and train the staff to cover Environment, Health and Safety aspects as well as monitoring during construction and operation of the power plant and thus ensure efficient implementation of the EMP.

2. Introduction

In 2013 the Concept of energy industry development for 2013-2020 period was accepted. At the framework of the Concept gas turbine power plant construction to cover domestic demand and increase export of electricity to neighbour countries is foreseen. Construction of 500kV high voltage power transmission line to the Afghanistan border has been completed.

The present study assesses the environmental impacts of the planned Open Cycle Natural Gas Power Plant in Zerger / Turkmenistan, with the purpose to generate and export electricity to Afghanistan.

The present study assesses the environmental impacts of the Power Plant Project and establishes the Environmental Management Plan (EMP). Initial clarifications on the national and international institutional and legal framework are discussed in Chapter 3.

The project description and the methods of the study are presented in Chapter 4. Chapter 5 describes the environmental and social baseline and gives data on relevant preloads and sensitive impact areas as far as possible on the basis of available information. The discussion of Alternatives including the no project alternative and technical alternatives is presented in Chapter 6.

The impacts due to the selection of the location (land use, habitats) and the Prediction of Emissions (Air, Water, Noise, Dust) are presented in Chapter 7. Air emissions under consideration of preloads using an air dispersion modelling, impacts on surface water and groundwater and impacts on climate change are considered to be the most relevant impacts and discussed accordingly. Other impacts as Noise, Dust, Traffic, Physical Cultural Resources and Occupational Health etc. are also assessed, differentiated in Construction and Operation Phases and are included in the EMP. Chapter 8 is a summary assessment of the impacts under consideration of the necessary mitigation measures.

Chapter 9 describes the Public Consultation Process. It presents the Environmental Management Plan (EMP) including responsibilities and monitoring as well as grievance redress mechanisms.

Due to the shift of final technical design to the EPC Contractor an exact assessment and quantification impacts was found to be difficult.

3. Institutional and Legislative Framework

3.1 Institutional Framework and National Requirements

The project is implemented by the State Electro Power Corporation Turkmenenergo of the Ministry of Energy (MOE).

The governmental institutions with responsibility related to the environmental management of the project are:

- Ministry of Energy and State Electro Power Corporation Turkmenenergo
- Ministry of Nature Protection
- Ministry of Water Economy
- Turkmengeologyia State Corporation
- Ministry of Oil and Gas and Mineral Resources
- Ministry of Agriculture
- Ministry of Municipal Affairs
- Ministry of Culture / Department for the Protection of Historical Monuments
- State Commission on Clean Development Mechanism (CDM).

Ministry of Energy (MOE)
The Ministry of Energy is the state authority responsible for management of the country's electricity sector. MOE includes Turkmenenergo State Electric Energy Corporation, a vertically-integrated entity managing all state assets in the sector responsible for electricity generation, transmission distribution, and supply. Turkmenenergo was established on 1 July 2005, by renaming Kuvvat State Energy and Technology Corporation, founded in 1992.

Ministry of Nature Protection (MNP)
The Ministry for Nature Protection is the main governmental institution for environmental issues. The Ministry is responsible for Environmental Impact Assessment and accordance of environmental permits, i.e. State Environmental Expertises (SEE).

MNP consists of five departments:

- Department of Protection of Flora and Fauna
- Department of Environmental Protection
- Department of Coordination of Ecological Programmes
- Department of Investments, Material-Technical Supply and Personnel
- Department of Accounting and Finances.

MNP includes five regional departments of nature protection in Akhal, Balkan, Dashoguz, Lebap and Mary, as well as eight state reserves.

Among others, the functions of the MNP include to conduct the State Environmental Expertise. The Department of Environmental Protection

deals with compliance and enforcement of environmental legislation related to the protection of air, land, water and treatment of waste.

The National Institute for Deserts, Fauna and Flora (NIDFF) under the Ministry of Nature Protection (MNP) is the research and development institution, especially its Research and Production Centre for Environmental Monitoring (RPCEM) which carries out air quality measurement and monitoring.

Ministry of Water Economy (MWE)

The Ministry is in charge of water resources research, planning, development, and distribution. It also undertakes the construction, operation, and maintenance of the irrigation and drainage networks at inter-farm level. Water allocations are regularly reduced in order to promote savings and to satisfy the demand from new users and to increase the water flow to the Aral Sea. The institutional structure of water management follows various hierarchical levels: state, velayat, district, farm (or Water User Associations (WUA). The first three come under the MWE and are responsible for the distribution and delivery of water up to the farm inlet, for assistance to the water users in implementing modern technologies, and for the control of water use and water quality. The special reclamation services, at all levels, are also the responsibility of the MWE. They monitor drainage discharge, and soil salinity, and plan measures for the maintenance and improvement of soil conditions, including leaching, repair, and cleaning of collector-drainage network, rehabilitation, etc. Groundwater is not under the responsibility of the MWE, but of "Turkmengeologiya" State Corporation.

State Corporation "Turkmengeologyia"

The State Corporation is responsible for monitoring groundwater sources, in terms of both quantitative (levels, usage, stocks) and qualitative (physiochemical, chemical) characteristics. There are four hydrogeological bases (expeditions) that measure water quality on all operational groundwater wells: one each for Akhal, Dashoguz and Balkan provinces, and a shared one for Mary and Lebap provinces. They regularly conduct reduced chemical analyses on the quality of water in groundwater wells, and twice a year a full chemical analysis in the central laboratory of Turkmengeologiya, which is considered the best equipped in the country.

Ministry of Oil & Gas & Mineral Resources

The Ministry of Oil and Gas Industry and Mineral Resources ensures policy implementation in matters relating to the use of mineral resources, analytical work, and preparation of long-term plans and nationwide programs of mineral development. The state owned Turkmengas develops, produces, processes, transports, and sells gas, gas condensate, and liquefied gas. Turkmenoil is the state owned national oil company responsible for developing oil reserves, processing output, and selling oil products. Turkmenneftegasstroy is responsible for engineering and construction. Turkmengeology is responsible for surveys of oil and gas and other mineral resources.

Ministry of Agriculture (MOA)
The Ministry of Agriculture (MOA) is in charge of agricultural research and extension, land reclamation, and agricultural development at farm level, and the operation and maintenance of the irrigation network at farm level. The MOA manages the State Land Cadastre, conducts land monitoring, controls land use, and coordinates State expertise of projects related to land use and land ownership. The Service on Land Resources has also its local departments in provinces, districts and cities.

The Ministry of Municipal Affairs (MMA) is responsible for domestic water supply and wastewater treatment.

Ministry of Culture (MoC)
The Ministry of Culture (MoC), National Department of Protection, Research and Restoration of Historical and Cultural Sites is responsible for Cultural Heritage and Historical Sites. The Department has to give clearance if a site is suitable for any construction activity or if it belongs to one of the three categories:

1. Protection Zone (only archaeological studies)
2. Landscape Protection Zone (no digging, no construction activities) or
3. Limited Construction Zone (i.e. monuments close to urban areas).

State Commission on Clean Development Mechanism (CDM)
Turkmenistan has ratified the Kyoto Protocol to the United Nations Framework Convention on Climate Change in 1998. Turkmenistan has no quantitative obligations on the Kyoto Protocol and may engage in GHG emissions trading through the implementation of projects within the Clean Development Mechanism. To secure fulfilment of Turkmenistan's obligations ensuing from the UN environmental conventions and programmes, an inter-agency State Commission has been established in 2009 prescribing the creation of commission on CDM to secure active engagement of advanced technologies and foreign investments to the national economy through the implementation of environmentally safe and energy-saving technologies within the Kyoto Protocol CDM framework.

Other stakeholders include Local Administration (i.e. Municipality of Serarabat Etrap, Municipality of Gurbansultan / Dostluk Etrap), Civil Society Organisations (CSO) (i.e. Association for the Protection of the Environment) and the Women's Union of Serdarabat Etrap.

3.2 National Legal Framework

3.2.1 Environmental laws

Following main laws govern the protection of the environment in Turkmenistan.

Law/Code	Date	Key areas

Law/Code	Date	Key areas
On the Protection of Nature	11/12/1991	The basic law regulating environmental relations, defines the basic legal principles of environmental and natural resource management and environmental protection
"On Standardization and metrology	01/10/1993	Regulation of product requirements, providing security for people and the environment
On the protection and rational use of flora	12/28/1993	Regulates relations in the protection and use of natural vegetation
On the state environmental Review	15/06/1995	Legal and regulatory framework to ensure environmental safety
On Air Protection	12/20/1996	The legal regulation of activity of state bodies, enterprises, institutions, organizations, public associations and citizens in the area of air protection
On the protection and rational use of fauna	12/06/1997	Regulates relations in the protection, use and reproduction of the animal world
Assessment of the environmental impact of planned economic and other activities in Turkmenistan. Home Civil Service "Turkmenstandartlary".	2001	Represents the Turkmen State Standard (TDS 579-2001) to implement the EIA for the development of design and project documentation.
Code of Turkmenistan "On Water	10/25/2004	Regulates water relations, rational use of water for the needs of the population and economy, as well as protect the rights of enterprises, institutions, organizations, enterprises and citizens "daikhan" in the field of water relations

Law/Code	Date	Key areas
Code of Turkmenistan "On Earth"	10/25/2004	Regulates land relations, rational use of land, protects the rights of enterprises, institutions, organizations, and citizens "daikhan" farms in the area of land relations
Forest Code Turkmenistan	06.04.2011	Regulates relations in the use and protection of forests, contains general provisions on the functions, membership of forests and forest funds and regulates the use and restoration of forest resources
On specially protected natural areas	31/04/2012	Legal, environmental, economic and organizational basis for the creation, management and protection of unique natural complexes, which are of national wealth and national property for the benefit of present and future generations.

Table 3-1: National laws of Turkmenistan for the protection of environment

The Law of Turkmenistan On State Ecological Expertise, June 1995 is especially relevant:

The main aims and objectives of the State Ecological Expertise are: "Warning of possible adverse effects of facilities on the environment and its constituent components, the conditions of life and health; maintaining a dynamic and balanced natural balance, providing favorable environmental conditions during construction and operation of facilities (…) determine the level of environmental risk of proposed and existing business or other activity that may present or future, directly or indirectly have a negative impact on the environment, living conditions and public health; conformity assessment of the planned, projected economic and other requirements of environmental legislation; determination of the sufficiency and validity of measures for the protection of nature, the project provided for construction or renovation." (Law on SEE, 1995)

The general procedure for the assessment of environmental impact using EIAs and SEEs includes the following main stages:

- submission by a developer of a notice on the proposed type of activity to the Ministry of Nature Protection
- preparation of the EIA documentation

- organization of public participation procedures
- review of EIA documentation by the Ministry of Nature Protection, preparation of the review document, and conclusion of the SEE.

3.2.2 Other laws and policy documents

National Programme on the Strategy of Economic, Political, and Cultural Development of Turkmenistan until 2020

The National Programme on the Strategy of Economic, Political, and Cultural Development of Turkmenistan until 2020 and the National Environmental Action Plan until 2010 (from 2002), identify the following environmental priorities:

- water resources
- land resources
- air pollution and depletion of the ozone layer
- industrial pollution from the oil and gas and energy sectors
- biodiversity conservation
- protection of natural and cultural heritage
- issues of degradation of environmental media in Turkmenistan's Aral Sea area.

Land Code of Turkmenistan

The land code of Turkmenistan differentiates several categories of land that are summarized in the following:

Categories of Land:
In accordance with the target purpose the land fund of Turkmenistan is divided into the following categories:

a) lands of agriculture purpose
b) lands of forestry fund
c) lands of water fund
d) lands of state reserve
e) lands of population settlements (cities, residential settlements, rural settlements)
f) lands of industries, transport, communication, energy, defence and other sectors)
g) lands of nature protection purpose, health care, recreational, historic and cultural purposes

(Source: Land Code Chapter 2, Article 6)

Land acquisition procedure:

1. Official request from the Ministry of Energy (promoter of the project) to the governor (hakimlyk) including the master plan for the power plant and the surface required for the development.
2. Governor writes act and permission letter to promoter,

3. EPC Contractor finalizes design, MOE and IA submit final design to cabinet of ministers
4. Approval by cabinet of ministers

3.2.3 National standards

Air pollution:
National Standards exist for Air pollution Assessment within the "Atmospheric Pollution Control Guidelines".

Substances	Substance code	Maximum allowed concentration, mg/m^3 Maximum one-time	Maximum allowed concentration, mg/m^3 Average daily
Solid substances (dust)	01	0.5	0.15
Cement dust	89	0.3	0.1
SO_2	02	0.5	0.05
CO	04	5.0	3.0
NO_2	05	0.085**	0.04
Nitrogen oxide	06	0.4	0.06
Formaldehyde	22	0.035	0.003
Phenol	10	0.010	0.03
Ammonia	19	0.20	0.04
Chlorine, Cl	14	0.10	0.03
Hydrogen sulphide	08	0.008	-
Hydrogene fluoride	13	0.02	0.005

Note: Maximum allowed concentration is adopted in accordance with RD 52.04.186-89 of the "Atmospheric Pollution Control Guidelines"
** see also Table 3-5.

Table 3-2: National criteria for air pollution assessment

3.3 International Conventions and Agreements

The country operates a specially created state commission to ensure compliance with obligations under the Conventions and the UN program on environment, including:

- the Convention on Biological Diversity (1996) - supports the conservation and sustainable management of biodiversity resources
- the United Nations Convention to Combat Desertification (1995) - the purpose of this Convention is to reduce human impact on ecosystems of the desert, the restoration of the biological productivity of degraded lands
- the Vienna Convention for the Protection of the Ozone Layer and the Montreal Protocol on Substances that Deplete the Ozone Layer (1993) - aimed at protecting the ozone layer on a global scale
- the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (1996) - establishes a strict control

of transboundary movements of hazardous wastes and other wastes to protect human health and the environment

- the Aarhus Convention on public access to information on environmental issues (1999) - aimed at the development of human society to participate in the formulation and implementation of state environmental policies that promote social stability
- Framework Convention for the Protection of the Marine Environment of the Caspian Sea (2004) - defines the main directions of regulation of human impact on the ecosystem of the Caspian Sea, protection and restoration of the biological and other resources
- the Ramsar Convention on Wetlands (2009) - aimed at preserving ecosystems wetlands
- UN Framework Convention on Climate Change (1995) - aimed at stabilizing greenhouse gas concentrations
- Ashgabat Framework Convention for the Protection of the Environment for Sustainable Development in Central Asia (2006) - aimed at the integration and harmonization of efforts to manage natural resources.
- Interstate Coordination Water Management Commission (ICWC) regulating the water intake for Turkmenistan allocates 22.15 billion m^3 of water each year to the country.

3.4 International Standards

Environmental standards given by the World Bank Group (here: the International Finance Corporation IFC) but also the World Health Organization (WHO) and other relevant organizations are used in this study.

In the following, project relevant international standards/ limit values for effluents and discharges, air emissions and ambient air quality, and noise are given.

3.4.1 Effluents and discharges

Effluents from thermal power plants include thermal discharges, wastewater effluents, and sanitary wastewater. The IFC's EHS Guidelines for "Thermal Power Plants" (December 2008) gives the following effluent guidelines to be applicable at the relevant wastewater stream. They are applicable for direct discharges of treated effluents to surface waters for general use.

Parameter	Maximum Values (mg/l)
pH	6–9 pH units
TSS	50
Oil and grease	10
Temperature increase by thermal discharge from cooling system	• Site specific requirement to be established by the EA. • Elevated temperature areas due to discharge of once-through cooling water (e.g., 1° Celsius above, 2° Celsius above, 3° Celsius above ambient water temperature) should

Parameter	Maximum Values (mg/l)
	be minimized by adjusting intake and outfall design through the project specific EA depending on the sensitive aquatic ecosystems around the discharge point.

Note: Applicability of heavy metals should be determined in the EA. Guideline limits in the Table are from various references of effluent performance by thermal power plants.

Table 3-3: Effluent guidelines

The IFC' General EHS Guidelines for "Wastewater and Ambient Water Quality" (April 2007) gives indicated values for treated sanitary sewage discharges:

Indicated Values for Treated Sanitary Sewage Discharges [a]	
Pollutants	**Guideline Value (mg/l)**
pH	6–9 pH units
BOD	30
COD	125
Total nitrogen	10
Total phosphorus	2
Oil and grease	10
Total suspended solids	50
Total coli form bacteria	400[a] MPN[b] / 100 ml

a Not applicable to centralized, municipal, wastewater treatment systems which are included in EHS Guidelines for Water and Sanitation.
b MPN = Most Probable Number

Table 3-4: Indicative values for treated sanitary sewage discharges

3.4.2 Air emissions and ambient air quality

Ambient air guidelines are given in the IFC's General EHS Guidelines (April 2007). The following table also includes MACs (Soviet Union) as well as Interim Target 1 values.

Pollutant	Averaging period	MAC (Maximum Allowable Concentration) *	Ambient Air Quality Standards WHO [µg/m³]	Source
NO_2	Max (TKM)	85		SU
	1 hour		200 200 (IT1)	IFC, 2007
	1 year		40 40 (IT 1)	
PM_{10}	24 hours		150 (IT1) 100 (IT2) 75 (IT3) 50 (GL)	
	1 year		70 (IT1) 50 (IT2) 30 (IT3) 20 (GL)	

Pollutant	Averaging period	MAC (Maximum Allowable Concentration) *	Ambient Air Quality Standards WHO [µg/m³]	Source
$PM_{2.5}$	1 year		15-25.0 (USA/EU 35 (IT1)	
SO_2	Max (TKM)	500		
	10 minutes		500 (GL)	
	24 hours	40	125 (IT1) 50 (IT2) 20 (GL	
CO	Max (TKM)	5,000		
	Maximum daily 8 hr mean		10,000	European Directive 2008/50/EC of 21 May 2008

(Source: IFC, 2007; Directive 2008/50/CE; *MACs are still those taken over from Soviet Union at the beginning of 1990s)

Table 3-5: MAC, IFC and European Directive Air Quality Standards

The air quality standards of the former SU determine allowable limits for hazardous substances both in the industrial and residential areas. Various air quality standards were developed:

- The maximum allowable concentration of hazardous substances in the working area air (MAC_{wa}) is a concentration which, with a daily (except weekends) work of 8 hours (or other duration, but not longer than 41 hours a week), throughout the length of service should not cause a disease or any deviation in the state of health detected by modern research methods in the process of work or during remote periods of life of current or future generations.
- The maximum allowable concentration, maximum non-recurrent (MAC_{mnr}) is a concentration of a hazardous substance in the air of a locality which does not cause, when inhaled for 20 minutes, any reflex reactions in the human body.
- The maximum allowable concentration, daily average (MACda) is a concentration of a hazardous substance in the air of a locality which should not have any direct or indirect impact on a human being when inhaled for an indefinitely long period (years). The MAC_{da} is calculated for all population groups and for an indefinitely long period of impact and, therefore, it is the most stringent sanitary and hygiene standard setting concentration of a hazardous substance in ambient air (OECD, 2006).

The standards in general were derived based on the assumption of zero risk for human health. The resulting values are therefore often much more stringent than international AQS. The difference to international standards is in the application.

Emission guidelines with respect to relevant pollutants occurring from thermal power plants are provided in the EHS Guideline for "Thermal Power Plants" (December 2008).

Emissions Guidelines for Combustion Turbine (in mg/Nm³)		
Pollutant	**Natural Gas**	**Fuels other than Natural Gas**
NO_x	51	152
PM	N/A	50
SO_2	N/A	use of 0.5% or less S fuel

Dry Gas, Excess O_2 Content (%)

Table 3-6: WB & IFC Emission Standards for Thermal Power Plants

3.4.3 Noise

According to the IFC's General EHS Guidelines "Noise Management" (April 2007), noise impacts should not exceed the levels (measured out of doors) stipulated by the WHO in 1999 in their Guidelines for Community Noise, or result in a maximum increase in background levels of 3 dB at the nearest receptor location off-site.

Receptor	One Hour $L_{Aeq\ (dBA)}$	
	Daytime 7:00 – 22:00	**Night-time 22:00 – 7:00**
Residential; institutional; educational	55	45
Industrial; commercial	70	70

Table 3-7: International noise standards

Noise limits for various working environments as given in IFC's General EHS Guidelines "Occupational Health and Safety" (April 2007) can be found in the following table.

Location/ Activity	Equivalent level LAeq, 8h in dB(A)	Maximum LAmax, fast in dB(A)
Heavy Industry (no demand for oral communication)	85	110
Light industry (decreasing demand for oral communication)	50-65	110
Open offices, control rooms, service counters or similar	45-50	-
Individual offices (no disturbing noise)	40-45	-
Classrooms, lecture halls	35-40	-
Hospitals	30-35	40

Table 3-8: Noise limits for various working environments

3.4.4 PCB

According to US EPA, a transformer is 'a transformer that contains PCB' if the concentration of PCBs is higher than 500 ppm. Oil containing between 50 and 499 ppm PCBs is considered to be polluted with PCB and specific methods for disposal are necessary (e.g. specific incineration plants). According to EU Directive 75/439/EEC and amendments oil containing less than 50 ppm PCB can be burned in a regular incineration plant.

3.4.5 GHG

IFC Recommendations for reduction and control of greenhouse gases include:

- carbon financing
- enhancement of energy efficiency
- protection and enhancement of sinks and reservoirs of greenhouse gases
- promotion of sustainable forms of agriculture and forestry
- promotion, development and increased use of renewable forms of energy
- carbon capture and storage technologies
- limitation and / or reduction of methane emissions through recovery and use in waste management, as well as in the production, transport and distribution of energy (coal, oil, and gas).

3.4.6 Operational and community health and safety

IFC EHS Guidelines

The Environmental, Health, and Safety (EHS) Guidelines of the IFC are technical reference documents with general and industry-specific examples of Good International Industry Practice (GIIP).

The General EHS Guidelines contain a series of specific guidelines for different projects. They are designed to be used together with the relevant Industry Sector EHS Guidelines which provide guidance to users on EHS issues in specific industry sectors. The EHS Guidelines contain the performance levels and measures that are generally considered to be achievable in new facilities by existing technology at reasonable costs. When host country regulations differ from the levels and measures presented in the EHS Guidelines, projects are expected to achieve whichever is more stringent.

The specific IFC guidelines applicable to the proposed Project are the EHS Guidelines for "Thermal Power Plants" (December 2008). These specific sector guidelines have been used together with the General EHS Guidelines document as a basis for the present EIA.

According to the named specific sector guidelines, environmental issues in thermal power plant projects primarily include the following:

- air emissions
- energy efficiency and Greenhouse Gas emissions
- water consumption and aquatic habitat alteration
- effluents
- solid wastes
- hazardous materials and oil
- noise.

Occupational health and safety risks and mitigation measures of thermal power plants are similar to those at other large industrial facilities, and are addressed in Section 2.0 of the General EHS Guidelines. In addition, the following health and safety impacts are of particular concern during operation of thermal power plants:

- non-ionizing radiation (not relevant for OCGT)
- heat
- noise
- confined spaces
- electrical hazards
- fire and explosion hazards
- chemical hazards
- dust.

Many community health and safety impacts of thermal power plant projects are common to those of most infrastructure and industrial facilities and are discussed in Section 3.0 the General EHS Guidelines. In addition to these and other aspects given above, the following community health and safety impacts may be of particular concern for thermal power plant projects:

- Water Consumption
- Traffic Safety.

Performance indicators and monitoring programs are also given in the EHS Guidelines for “Thermal Power Plants”.

Community Health and safety measures are detailed in IFC EHS guidelines and include recommendations on:

- Water Quality and Availability
- Structural Safety of Project Infrastructure
- Life and Fire Safety
- Traffic Safety
- Transport of Hazardous Materials
- Disease Prevention
- Emergency Preparedness and Response.

3.5 Gap Analysis

The legal framework of Turkmenistan has not yet a law on waste, no law on energy efficiency or renewable energy. However, draft laws are currently under preparation.

For implementation of the Project, the legal framework (national or international) with the stricter standards will have to be applied.

4. Project Description

4.1 Technical Description

4.1.1 Concept and location

The plant is to be located near Zerger, in Serdarabad etrap/district in Lebap Province of Turkmenistan, around 15 km from central Turkmenabat. The coordinates of the site are 38°58'29.93"N and 63°28'7.88"E. The plant site is some distance from the Uzbekistan border (35 km to the NE). The Afghan border is about 260km to the SE. The topography of the site is essentially flat. There are no inhabitants within at least 7km of the plant site; a military installation lies 3 km to the South / SouthWest. The nearest population settlements are located to the North and NW at a distance more than 5km.

There are no endangered plants or animal species on the site. There are no protected areas around the proposed site.

The plant will be located in an arid area. The ambient temperature varies during the year from min. -25°C to max. +48°C. The annual mean temperature is +16.6°C and the relative humidity varies between 25% - 60%.

Turkmenistan is located in a seismically active zone and is considered part of the Eurasian Alpine-Himalayan mobile belt and has experienced numerous earthquakes throughout history. This will be taken into consideration in the design phase.

4.1.2 Infrastructure and interfaces

The selected site is located in close proximity to all required infrastructure. The electrical grid connection to the Turkmenenergo power grid will be via a new 110 kV / 220 kV substation located on the property of the power plant.

In a distance of about 6 km to the north, water can be taken from a canal called the GLK Collector via a buried steel pipeline. A gas pipeline with a design pressure of 55 bar adjoins the proposed site to the east.

A highway (M37) is located about 3.5 km to the SE. There is a road from the plant site to the M37.

The following table provides an overview about the ancillary infrastructure.

Ancillary Infrastructure	Length
Water pipeline	6.5km
Gas pipeline	7 km
Electrical Connection	50 m
220kV/110kV Substation	n.a.

Table 4-1: Ancillary Infrastructure

4.1.3 Gas turbine power plant and layout

A gas turbine consists of a compressor, a combustion chamber and a gas expansion turbine. The compressor increases pressure of ambient air, which is mixed with natural gas and combusted in the combustion chamber. The flue gas, high in temperature and pressure, is expanded in the subsequent turbine, usually generating power transferred to a connected generator via shaft.

In open cycle gas turbines (OCGT) hot flue gasses are emitted from the turbine.

In combined cycle power plants (CCPP) the hot exhaust gases are used in a downstream steam cycle in order to increase the degree of fuel utilization. This results in combined net efficiency of over 60% (at ISO conditions). Due to increased efficiency the specific fuel consumption as well as CO_2 emissions per generated kWh are reduced.

The configuration preferred by TE is an OCPP. Open cycle plants consist of one or multiple self-contained gas turbine units, each operating independently of each other.

For this project, several configurations can be considered, varying in the number of gas turbine units and taking into consideration possible efficiency increase by evaporative air inlet cooling. In theory, essentially any number of gas turbines can be used to match the desired power output.

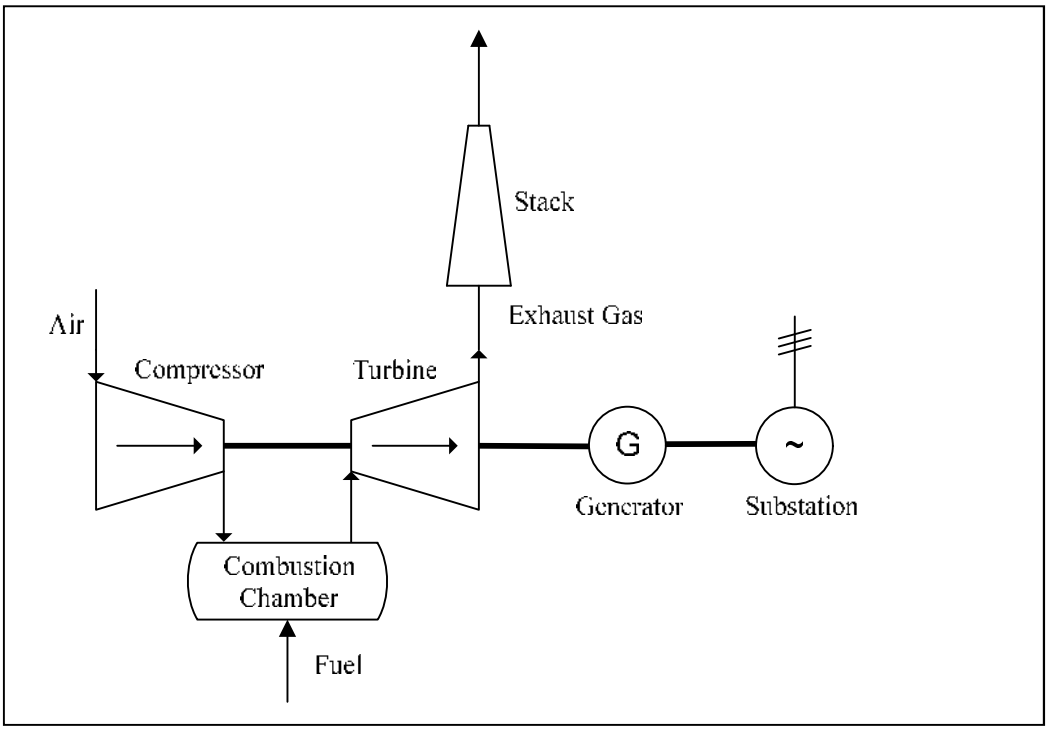


Figure 4-1: Schematic of an OCPP

However, extreme configurations of a single large gas turbine as well as an unreasonably large number of small gas turbines may lead to problems. In case of tripping or maintenance, a single unit would result in loss of the total installed power. On the other hand, efficiency is reduced in smaller gas turbines and investment cost per kWh is increased.

Therefore it is recommended to use a configuration of two or three gas turbine units. This allows using reliable and proven heavy duty gas turbines which offer a good mix of operational flexibility and high efficiency.

In case of trips with 200 MW gas turbine units, the effect on the electricity grid with a capacity of around 4 GW is small.

In principle, both configurations with 2 and 3 GTs are conceivable for this project. But since the configuration with three gas turbines needs more space for additional equipment, within this study the layout for this configuration has been considered. A 2 GT configuration would require less space and can easily be accommodated in the proposed plant site dimensions.

The gas turbine power rating is reduced due to high temperatures during summer. Thus, to guarantee power output of approximately 300 MW in summer, the installed power at ISO conditions is considerably larger. One option to compensate the adverse effect of high temperatures is the injection of liquid water into the inlet air flow. The water will evaporate using thermal energy of the air thereby lowering the air temperature. Installation of an evaporation cooler will be considered optionally.

According to Turkmenenergo´s requirements, the generators shall be connected as follows to a new 110/220 kV substation located within the power plants area:

In case of the two gas turbine configuration:
- One GT to the 220 kV System
- One GT to the 110 kV system

In case of the three gas turbine configuration:
- Two GTs to the 220 kV system
- One GT to the 110 kV system

For power evacuation, Turkmenenergo shall reroute and connect the existing 110 kV and 220 kV overhead lines to the new 110/220 kV substation.

All suitable E-Class turbines from various manufacturers provided by the Gas Turbine World Handbook are listed below:

Manufacturer	Model	Power Output at ISO conditions [kW]	Net Efficiency [%]

Alstom	GT11N2	113,600	33.3
Alstom	GT13E2	184,500	37.8
Ansaldo Energia	AE94.2K[1]	170,000	36.5
Bharat Heavy Industries	V94.2 [2]	157,000	34.4
General Eletric	9E	128,183	34.2
Mitsubishi Hitachi Power Systems	PG9171(E)	125,400	33.6
Mitsubishi Hitachi Power Systems	M701DA	144,090	34.8
Siemens	SGT5-2000E	166,000	35.0
Siemens	SGT5-3000E	198,800	36.9

Table 4-2: Market available gas turbines

Source: Gas Turbine World Handbook 2012

For the purpose of this study turbines from Alstom, General Electric, Mitsubishi Hitachi Power Systems and Siemens have been selected to analyze the aforementioned alternative configurations. The selected turbines are well suited to reach the desired power output. However, other turbines are also technically viable.

The following table shows the influence of site conditions on the power output of the selected turbines. Within the calculations annual mean temperature, annual max. temperature, site elevation and cooling concept have been considered.

Manufacturer	Model	Corrected to 15 °C, site conditions		Corrected to 48 °C, site conditions	
		Gross Power [MW]	Gross Efficiency [%]	Gross Power [MW]	Gross Efficiency [%]
Alstom	GT13E2	200.23	37.8	164.66	36.1
General Electric	9E	124.78	33.9	97.91	31.8
Siemens	SGT5-2000E	166.6	35.0	131.1	32.8
Siemens	SGT5-2000E w. Evaporative Cooling	166.6	35.0	149.5	34.0
Siemens	SGT5-3000E	198.8	36.9	146.8	33.9
Mitsubishi Hitachi Power Systems	M701DA	141,2	33,7	109,5	31,6
Mitsubishi Hitachi Power Systems	M701DA w. Evaporative Cooling	144,3	33,9	123,1	32,7

Table 4-3: Corrected power output of selected gas turbines

Source: Manufacturer's information, Fichtner and TE internal calculation

[1] Designed by Siemens and license manufactured by All Ansaldo Energia
[2] Designed by General Electric and license manufactured by Bharat Heavy Industries

For all GTs listed in this table, Diesel can be used as back-up fuel, if the gas is interrupted.

Several configurations are suitable for the proposed task, depending on the ambient conditions at which the power output of 300 MW shall be reached. Based on the corrected power output calculations, the selected turbines are arranged as different configurations (2 gas turbines, 2 gas turbines with evaporative cooling, 3 gas turbines).

In Table 4-4 the alternative configurations for the selected gas turbines are shown, corrected for ambient conditions of 15 °C and 48 °C at site.

Manufacturer	Model	Units	Inlet Cooling	Power Output [MW] 15 °C, site conditions	Power Output [MW] 48 °C, site conditions
Alstom	GT13E2	2	no	400.46	329.32
General Electric	9E	3	no	374.34	293.73
Siemens	SGT5-2000E	3	yes	333.20	299.00
Siemens	SGT5-3000E	2	no	397.60	293.60
Mitsubishi Hitachi Power Systems	M701DA	3	no	432,60	328,50
Mitsubishi Hitachi Power Systems	M701DA	3	yes	432,90	369,30

Table 4-4: Corrected power output for 2GT and 3GT configurations for selected gas turbines

4.2 Methodology

For preparing the EIA study to this Project, Fichtner company was involved, later it was refined by Ministry of Energy of Turkmenistan and Turkmenenergo State Power Corporation. The following team was involved:

- International Environmental Expert
- International Social Safeguards Expert
- National Environmental Expert
- National Social Safeguards Expert.

As basis for the study intensive field surveys were conducted by the experts in May 2012 and May-August 2015. Additional information was obtained by consulting representatives of governmental organizations and non-governmental organizations (NGO). Additionally, an evaluation of possible ecological and social impacts was performed by interpretation of satellite maps and review of existing documentation.

The Air Dispersion Calculation was performed using the internationally recognized dispersion modeling software BREEZE AERMOD, version 7.5 (from March 2012), which predicts pollutant concentrations from continuous point, flare, area, line, volume and open pit sources. This steady-state plume model is a US-EPA Regulatory Model.

Due to the fact, that there is no official international consensus on an agreed approach for assessing the significance of impacts on the environment, Fichtner uses an own evaluation procedure. This transparent evaluation procedure is based upon Fichtner's extensive experience over the last fifteen years in performing Environmental and Social Impact Assessments (ESIA) and has proven to be a reliable method for assessing a project's impacts on the environment. It includes identification, prediction (e.g. duration, intensity, severity, status, reversibility of the impact) and evaluation of the significance of impacts based on legal requirements.

Impacts are distinguished as:

- negative impacts and positive impacts
- direct and indirect impacts
- short term and long term impacts.

Wherever possible, potential impacts are quantified as well as qualitatively assessed. The focus of the used evaluation procedure is to decide whether the Project is likely to cause significant adverse environmental effects resulting from the construction and operation. The sensitivity of the receptors is also assessed wherever possible and appropriate (i.e. a protected area would be assessed as highly sensitive, an industrial zone as less sensitive).

For the purpose of a transparent presentation and evaluation, a tabulated evaluation matrix is applied. On the basis of a point scale, the severity of the particular environmental impact together with its general trend - that is negative or positive - is described. The evaluation scale applied is as follows:

Extent of impact:

■ ■ ■	=	high negative
■ ■	=	medium negative
■	=	low negative
○	=	no impact
+	=	locally positive
++	=	regionally positive

For the judgment international standards like standards from the World Bank, World Health Organization (WHO) etc. are used supported by national standards of Turkmenistan. According to these standards the evaluation of impacts is done as follows:

Evaluation of impacts using International and National Standards:

Extent of impact	Reason
High negative	International and national standards are exceeded
Medium negative	Between international and national standards, international and national standards are barely met
Low negative	International and national standards are met

With the presented method it can be clarified which environmental impacts are most important and for which impacts mitigation measures must be applied in order to reduce negative effects on the environment.

5. Baseline Conditions

5.1 General Environment and Ecology

5.1.1 Project area

The Project area covers the potential area of influence of the Project which is the site of the planned power plant and its environment. It is situated next to the existing Lebap power plant, around 7 km from the settlement of Zerger and around 20 km from the town centre of Turkmenabat in Lebap province (velayat) of Turkmenistan. The selected location is 38°58’42.69’’N / 63°27’54.21 E. Depending on the detailed technical design, the impact on water resources (intake and outlet) and the impact of air emissions will extend beyond the selected perimeter and will also be analyzed. In relevant sections, areas beyond the area of influence will be mentioned (i.e. Amu Darya and Repetek Protected Areas).

The following maps and pictures provide an overview of the project location:

Figure 5-1: Overview Map

Figure 5-2: Overview Turkmenabat with planned project site

Figure 5-3: 1:50000 map with project location

Figure 5-4: Project location with 5 km radius

The project is located in Lebap Velayat (province), Serdarabat Etrap (municipality). The land belongs directly to the Municipality not to a subsidiary Gengeshlik (village) authority (as it is not inhabited land but at the southern border of Zerger industrial zone). The project area is located 3.1 km from the main road Turkmenabat-Mary next to next to the existing Lebap power plant. The city garbage disposal site and sewage ponds are the nearest structures from the site (1.9 km North).

There is a small military installation 3 km to the South of the power plant site. The nearest small population centers are located to the North and Northwest at a distance of more than 5 km.

Several industrial units and chemical industry plants (i.e. fertilizer production) are located in the vicinity (<10 km North-East)

The Hojaily Irrigation Canal is located in 3.5 km distance, the GLK (Main Left Bank) Drainage Collector in 6.5 km distance.

5.1.2 Geography and landscape

The topography of the Project area is characterized by a flat steppe / semi-arid desert landscape at the southern fringe of the industrial belt at the outskirts of Turkmenabat (Zerger, Komsomolsk). The area is situated between 188-192 altitude a.s.l.

The vegetation is not very dense and stretches for about 360 km^2 from Southeast to Southwest from the project site. The vegetation helps prevent sand deflation and further desertification.

The Amu Darya River, Turkmenistan's main resource of surface water flows in 21 km distance. The above mentioned irrigation channels are fed by the river.

Main features of the Project area are:

- Steppe and industrial areas at the fringe of the industrial belt of Turkmenabat.

Figure 5-5: Landscape at project site

- Irrigation Channel

Figure 5-6: Hojaily Irrigation Channel

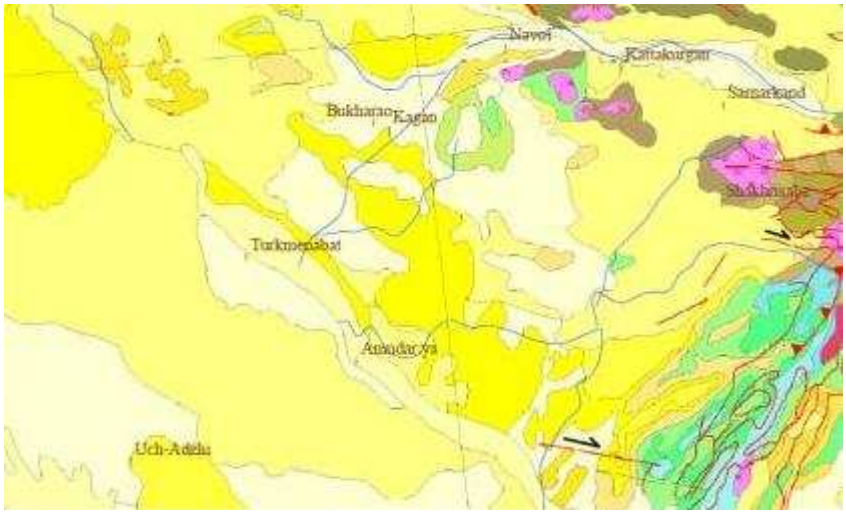
- Drainage Water Collector
  (used for irrigation further downstream)

Figure 5-7: Main Left Bank (GLK) Collector

5.1.3 Geology, seismic situation and soil

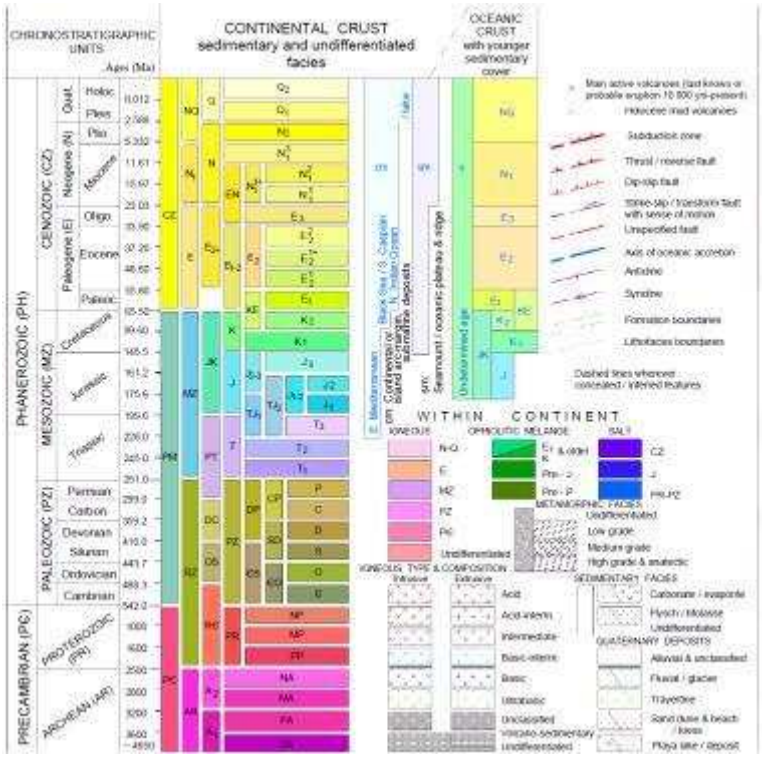
Generally, the surface of the sandy desert area of the region forms dissected ridge and hilly topography. Sand dunes are located at the southern periphery. Alluvial deposits of the river consist of sand and clay layers.

Sand deposits are covered from top to power irrigation sediments 0.5-2 m. On both banks of the Amu Darya River, residual outcrops composed of Tertiary and Cretaceous sediments can be traced. The width of the Amu-Darya sand dunes is up to 10-15 km.



Source: Map by: CGMW (2009)

Figure 5-8: Map of Soil



Source: Commission for the Geological Map of the World

Figure 5-9: Legend of Soil Map

Soil:
The topsoil in the project area is composed of shifting sands. It contains 50% sand-size particles with the rest consisting of impurities such as feldspar, mica, and cement of silica, iron or carbonates. Most of the soils from these rocks are coarse in texture, acid, deep, and low in nutrients.

According to geological data provided by the Turkmen administration (Mary Geological Expedition), soil under the territory of future new PP in Zerger has following characteristics:

On the 0.0 – 8.0 m deepness Grey-yellow small granulated sand.

On the 8.0 – 50.0 m deepness Grey-yellow middle granulated crumbly sand.

Seismic Situation:
Turkmenistan has a history of important seismic incidents.
The most damaging earthquake with a magnitude 7.3 Mw, occurred on 6 October 1948 near Ashgabat. The earthquake is considered to be the 6th deadliest earthquake in the history of humankind.

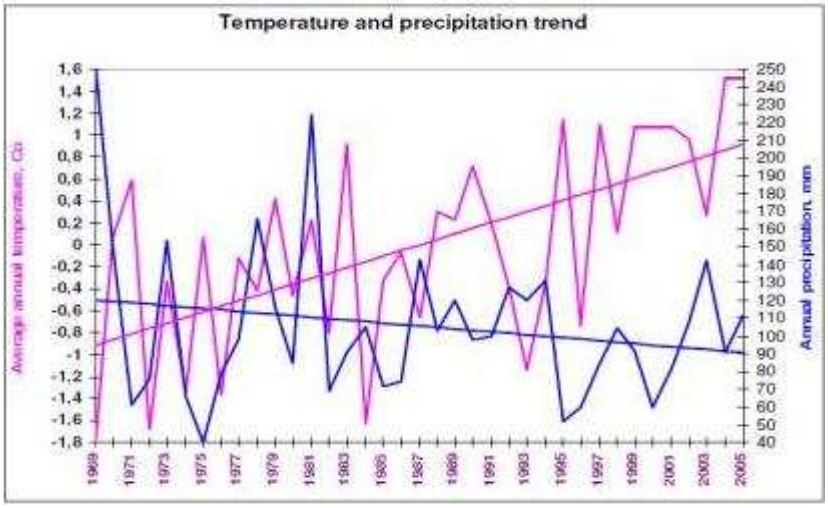
Source: http://www.cawater-info.net/amudarya/i/natural_disaster_e.gif

Figure 5-10: Map Natural Hazards in the Amudarya Basin

The map shows the whole basin of the Amu Darya River including Turkmenabat Area as a seismically active zone with potential for strong earth quakes with the potential of damage to infrastructure.

5.1.4 Climate and meteorology

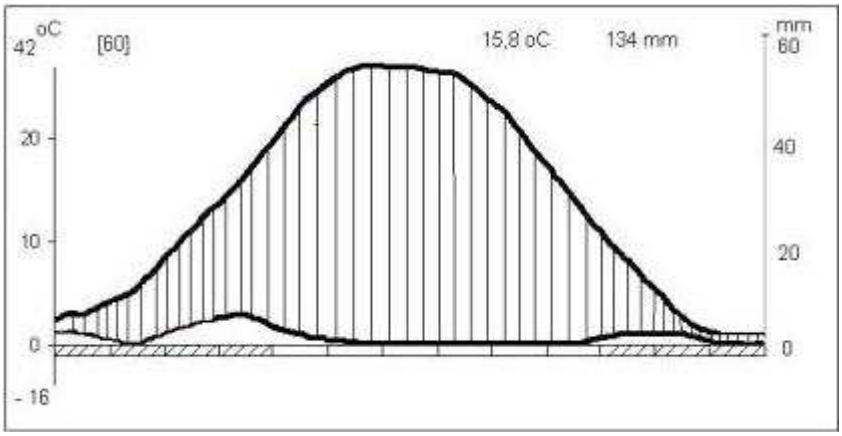
The latitudinal position of the territory of Turkmenistan is in the zone of non-tropical deserts, making the country rather vulnerable to climate changes. However, the main distinctive feature of Turkmenistan's climate is not hot sun and not excess heat but moisture deficiency. The mean annual temperature and precipitation trend for 35 years show that the mean annual temperature has increased by 1°C, while the amount of precipitation is gradually dropping down and for whole period has reduced approximately by 30 mm (Allaberdiyev 2006). These data were obtained from 48 meteorological stations which are observing weather, precipitation, air humidity and other climate parameters of Turkmenistan. Source: A. Ovezberdyyeva (2009).



Source: Trend of temperature and precipitation in Turkmenistan for 1969-2005 (Allaberdiyev 2006)

Figure 5-11: Temperature and precipitation trend

For Turkmenabat the average precipitation is 134 mm and an average temperature of 15.8°C. Highest temperatures are recorded during the summer months of July and August with a max of more than 40°C and a precipitation occurrence in spring and autumn. 50.1°C is the highest temperature recorded at Repetek Reserve (at 70km from the project site), recognized as the highest temperature ever recorded in the whole former Soviet Union.



Source: www.weatherbase.com

Figure 5-12: Climate diagram of Turkmenabat

Wind in the Project area:

Figure 5-13 presents the wind rose for the period between 2009 and 2011. It shows that the prevailing winds blow from the North, Northeast and Northwest. It is also visible that the wind speed is mainly between 3 and 8 m/sec, which is equivalent, in the Beaufort scale, to the levels between 3 (gentle breeze) and 4 (moderate breeze). In the three analyzed years, in only 1 day - 0.1%, the wind can be classified as strong gale (level 9).

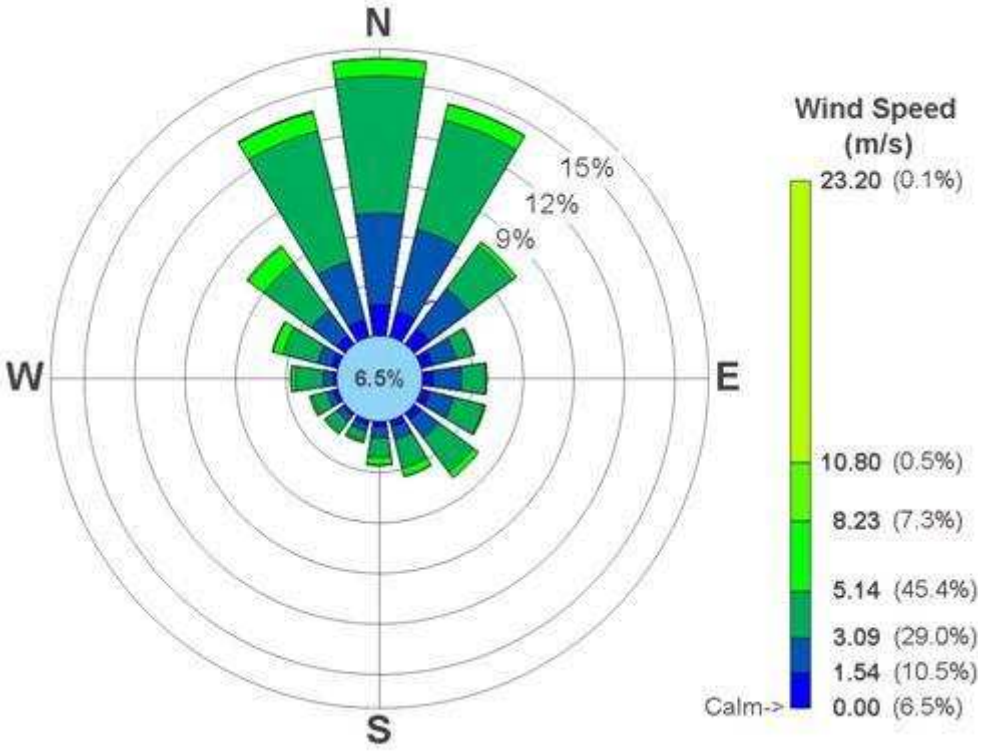


Figure 5-13: Windrose for the years 2009-2011 for Chardzhev meteorological station

Dust TSP / PM_{10}:

As the project site is located in a desert area, natural dust concentrations can be quite high, especially during windy conditions. (see also 5.1.6)

5.1.5 Climate Change

The impacts of climate change will be a temperature increase, the reduction of humidity and change in rainfall pattern, as well as reduction in available water resources. Climate change is one of the pillars of the Water Management Development Concept of Turkmenistan until 2030. GHG emissions are the major factor for human induced climate change.

The major sources of greenhouse gas emissions into the atmosphere in Turkmenistan are the oil and gas industry, the electricity subsector, and the transport sector. The tendency towards an increase in total GHG emissions in Turkmenistan is expected to continue, and is closely linked to the increase in the exploration and processing of hydrocarbons. Total GHG emissions in 2004 reached 60,569.92 Gg of CO_2-equivalent, nearly double the 1994 value of 34,901.31 Gg. (Source: Second National Communication to UNFCCC, 2010).

Under the United Nations Framework Convention on Climate Change (UNFCCC), Turkmenistan submitted the Second National Communication in November 2010. Turkmenistan participates in the Clean Development Mechanism, since 2009. There are plans to convert some of existing power plants into combined cycle, make electricity production more efficient.

5.1.6 Air emissions and ambient air quality

It should be considered that a high dust content in the ambient air is based on the geographical and meteorological context in the region. Today, the main contributors to air pollution are the industrial enterprises such as Chemical Plant, Cotton-Processing and Oil-Expeller plants, as well as motor transport. The share of the motor transport is 64 % of the total emissions in the city. (Source: Ovezberdyyeva (2009)

In the close vicinity of the Project's future installations there is an open air waste dump. Additionally, around 8 km from the Project area, there is an important chemical factory (fertilizer plant).

Air quality in the area:
The relevance of the impact of the emissions in an airshed depends on the existent air quality of the area.

Air quality data was received from the Ministry of Nature Protection of Turkmenistan, official air quality measurements data for Zerger. The data made available are presented in Table 5-1, along with the comparison to the respective air quality standards. Since the data respect annual means, the comparison with the standards is only possible when annual standards exist.

Substances	**Period of Observation**	**Concentration [µg/m^3]**	**TKM AQS [µg/m^3]**	**International Annual AQS [µg/m^3]**	
Hard substances	5 years	300	**TSP**	**PM_{10}**	**$PM_{2.5}$**

(Dust)			500	20 (IT1 70)	10 (IT 1 35)
Sulfur Dioxide (SO_2)	5 years	70	500	N.A.	
Nitrogen Dioxide (NO_2)	5 years	20	85	40	
Carbon Monoxide (CO)	5 years	1,000	N.A.	N.A.	

N.A.: Not Applicable (no annual standard exists)

Table 5-1: 5 year Air Quality data from Zerger and comparison with the annual Air Quality Standards

The data show that the present levels of dust in the area are above the annual air quality standards, unlike for NO_2. Although there are no annual standards for SO_2 and CO.

There is no information concerning the size of the dust monitored in Zerger. Thus, it is not possible to relate the monitored concentrations to any PM fraction (total suspended particulates (TSP), PM_{10}, $PM_{2.5}$ or others).

A comparison of TSP with PM 10 / PM2.5 and application of WHO standards is not appropriate. The Interim Target 1 for PM10 and PM2.5 will be more appropriate for Turkmenistan given its developing country status. If one compares with this standard, given the normal fraction of PM10 and PM 2.5 in TSP, the ambient standards may be complied with.

A monitoring campaign for NO_2, SO_2 and TSP was performed between 6th and 8th of August 2012 by the Centre of Ecological Monitoring of Turkmenistan. The measurements, performed for hourly and 10 minutes periods, were taken in three spots, namely:

- Spot 1: at the proposed project site
- Spot 2: at the side of the road M-37
- Spot 3: in Zerger settlement.

Pollutants	Concentration [µg/m3]	TKM AQS [µg/m3]	International AQS [µg/m3]
Spot 1 - At the proposed project site			
TSP - 1 hour	336	500	N.A
NO2 - 1 hour	55	N.A.	200
SO2 - 1 hour	76	500	N.A.
SO2 - 10 min	70	500	500
Spot 2 - At the side of the road M-37			
TSP - 1 hour	308	500	N.A
NO2 - 1 hour	58	N.A.	200

SO2 - 1 hour	75	500	N.A.
SO2 - 10 min	63	500	500
Spot 3 - In Zergyar settlement			
TSP - 1 hour	392	500	N.A
NO2 - 1 hour	88	N.A.	200
SO2 - 1 hour	103	500	N.A.
SO2 - 10 min	83	500	500

N.A. = Not Available

Table 5-2 presents the average of the results of the 3 days of the campaign. Since the measurements were made for hourly and 10 minute averages, the comparison with the air quality standards can only be made for NO_2 (1 hour standard) and SO_2 (10 min standard). It can be observed that the highest concentrations are found in the Zerger settlement and that the values in the two remaining points are very similar. These results are reasonable since it is in Zerger (spot 3) that the emission sources are concentrated while the project site (spot 1) and the road M-37 (spot 2) are located in the desert area. However, none of the measurements indicates an exceedance of the international AQS.

Pollutants	**Concentration [µg/m^3]**	**TKM AQS [µg/m^3]**	**International AQS [µg/m^3]**
Spot 1 - At the proposed project site			
TSP - 1 hour	336	500	N.A
NO_2 - 1 hour	55	N.A.	200
SO_2 - 1 hour	76	500	N.A.
SO_2 - 10 min	70	500	500
Spot 2 - At the side of the road M-37			
TSP - 1 hour	308	500	N.A
NO_2 - 1 hour	58	N.A.	200
SO_2 - 1 hour	75	500	N.A.
SO_2 - 10 min	63	500	500
Spot 3 - In Zergyar settlement			
TSP - 1 hour	392	500	N.A
NO_2 - 1 hour	88	N.A.	200
SO_2 - 1 hour	103	500	N.A.
SO_2 - 10 min	83	500	500

Compliant with the Standard Non Compliant with the Standard

N.A. = Not Available

Table 5-2: Summary of the results of the 3 day air quality monitoring campaign and comparison with the annual Air Quality Standards

5.1.7 Water resources

The project is located within the Amu Darya River Basin, one of the main (former) tributaries of the Aral Sea. Water from the Amu Darya was divided annually in the following way: Uzbekistan 29.6 km^3, Turkmenistan 22 km^3, Tajikistan 9.5 km^3, and Afghanistan 2 km^3.

Surface water:
The major source of surface water in Turkmenistan is the Amu Darya River. The length of the river is 744 km from Kelif Gauging Station to Tuya Muyunsky Reservoir. The Amu Darya used to be a major affluent of the Aral Sea. Turkmenistan actually diverts an agreed share of 22 km^3/a mostly via the Karakum Channel from the Amu Darya River. The major water user is agriculture with a share of 97.8% of the water consumption. Utilities use 1.1% of the surface water resources, Industry 1.06 and others 0.4%. The Amu Darya is not used for electrical power generation in Turkmenistan. The annual water intake of Lebap Province ranges from 3.5-5.5 billon m^3.

Water quality in Amu Darya River is classified as moderately polluted. More than 5.3 billion m^3 of collector drainage water are discharged into the river from irrigated land. The mineralization of Amu Darya river water reaches its maximum level at Darganata at about 2.2 g/liter. During the period of spring floods, the mineralization level comes down to 0.43-1.38 g/liter. The chemical composition of the water of Kara Kum Canal corresponds to the chemical composition of Amu Darya River. Turkmenabat is situated upstream on the Amu Darya from the major collector discharges, the salinity of the water is less, 0.76 g/liter according to the Ministry of Water Economy (MEW).

Water extraction from the Amu Darya Basin will not have an influence on the salinity of the groundwater.

Differentiation Channel and Collector:

Channel: A Channel is diverting water from Amu Darya River to irrigate fields, water is mostly transparent, salinity low (0.7g/l)

Collector: Collector is collecting run-off and drainage water from fields. The water is used further downstream for irrigation as long salinity content is not too high. Collectors discharges into Amu Darya River or as recently planned into the „Golden Lake“. Salt Content at level of Turkmenabat is 2-6 g/l, further downstream up to 30g/l.

There are two surface water sources near the project site, Hojaily Channel and main left bank collector (GLK-Collector). Hojaily Channel is located in 3.5 km distance, has a flow of 0.5-1.0 m^3/sec and a salinity of 0.7 g/l. The main left bank collector (GLK) is located at 6.5 km distance of the project

site, flow is 10-18 m³/s and salinity content is 1.5-3 g/l. Water level in Winter is lower than in Summer. The channels are not directly linked to each other. The indirect link is that the GLK Collector receives the infiltrated irrigation water from the Hojaily Channel after utilization.

Salinity of the collector-drainage flow coming into the Amudarya river at the site: G/S Kelif – Tyuyamuyun reservoir, g/l

Collector	Year	X	XI	XII	I	II	III	IV	V	VI	VII	VIII	IX	Average
Main left-bank collector	1990-1991				2,88	2,88	5,70	5,70	3,10	2,23	2,55	2,55	2,58	3,23
	1991-1992	2,70	2,70	3,20	3,20	3,30	2,35	2,45	2,45	2,71	2,08	1,80	1,78	2,54
	1992-1993	1,93	2,65	2,38	2,65	2,06	2,40	2,88	2,88	2,12	1,97	1,97	0,92	2,17
	1993-1994	2,01	2,34	2,24	3,15	2,07	2,37	2,60	2,42	2,21	2,27	1,61	2,85	2,32
	1994-1995	2,84	2,34	2,43	2,76	2,03	2,10	2,02	2,58	2,14	1,96	1,99	2,01	2,26
	1995-1996	2,38	2,33	2,54	2,24	2,29	2,09	2,18	2,22	2,53	1,73	1,76	2,07	2,18
	1996-1997	2,03	2,06	2,06	2,27	2,03	2,31	2,42	2,34	1,82	1,82	2,10	1,01	2,05
	1997-1998	1,99	2,10	2,35	2,18	1,87	2,13	2,14	2,50	1,93	1,78	1,81	1,79	2,06
	1998-1999	1,87	1,92	1,96	2,33	2,44	2,41	2,30	2,33	2,08	1,76	1,80	2,43	2,14
	1999-2000	2,27	2,58	1,86	2,04	2,16	2,20	2,26	2,20	2,12	1,98	1,95	1,87	2,13
	2000-2001	1,96	1,96	1,96	1,92	2,07	2,11	2,14	2,62	2,37	2,12	2,42	2,75	2,29
	2001-2002	2,54	1,81	1,87	1,97	1,86	1,81	1,87	2,08	2,14	2,32	1,94	1,25	1,94
	2002-2003	1,76	2,10	1,93	1,66	1,68	1,45	1,96	1,94	1,95	1,84	1,80	1,76	1,83
	2003-2004	1,76	2,26	2,28	2,20	1,98	2,01	2,00	2,00	1,93	1,89	1,80	1,97	1,97
	2004-2005	1,77	1,70	1,74	2,23	2,13	2,08	1,82	1,33	1,34	2,01	2,00	2,00	1,83
	2005-2006	2,10	1,58	1,68	2,30	2,12	2,20	2,20	2,57	2,01	2,60	2,05	1,70	2,17
	2006-2007	2,03	1,70	1,56	1,84	2,58	1,82	1,78	1,88	1,85	1,83	1,78	2,00	1,85
	2007-2008	2,12	2,00	1,92	1,79	2,02	2,50	2,44	2,33	2,21	2,07	1,92	1,85	2,09
	2008-2009	1,63	1,85	1,85	1,82	1,82	2,06	2,05	1,79	1,63	1,66	1,89	1,94	1,84
	2009-2010	1,63	1,68	1,76	1,56	1,69	1,87	1,80	1,36	1,24	1,33	1,47	1,48	1,58
	2010-2011	1,43	1,54	1,56	1,72	1,84	2,14							

Source: Database of BWO Amu Darya.

Table 5-3: Salinity of collector drainage flow BWO Amu Darya

Water of Main Left Bank (GLK) Collector is among the less salty collector waters at inflow at Tyuyamuyun Reservoir.

According to the Ministry of Water Economy (MWE) no plans of a construction of any irrigation and collectors close to the territory of the new Power Plant exist.

Groundwater

The groundwater at the substation has a high salt content and can be used for the fire extinguishing reservoir. Drinking water supply for the substation is brought with tank vehicle till water treatment facility start operating on the existing power plant.

The official communication from the State Corporation Turmengeologiya gives following results of the groundwater analysis at the site:

"Ground water in the first floodplain terrace is at the depth of 0.5 m -2 m. Average annual mean temperature varies from 13 – 17°C north to the south of the area. The nature level of the underground water on the territory is 5-8 meters, The salt content of the underground water is: on 7.8 m deepness – 21.02 g/dm³; on 28 m deepness – 26.04 g/dm³; on 50 m deepness – 28.54 g/dm³. The thickness of low-middle quarter (Q-p) water reservoir up to 50 meters. The chemical content of the underground waters is - chloride sulfate , sodium -magni (NaMg). The debt of water from the wells on the territory is - 2.5 l/sec, The coefficient of water activity – 4.4 m/g.g , water conducting coefficient Km -98.6 m²/g.g , the decreasing of the level of underground – 2.9 m., the nature level of water - 7.5 m." (Official communication Turmengeologyia Mary Expedition).

5.1.8 Waste

City Waste Dump:
The Turkmenabat City Waste Dump is located in 2km distance of the project area. There is no resident population in the area.

Sewage ponds of Turkmenabat City:
The sewage ponds of Turkmenabat city are located next to the City Waste Dump (North).

5.1.9 Forests

There are no forested areas in the Project area. The land to be allocated for the project is a desert land with sparse vegetation cover of Saxaul Haloxylonpersicum, Calligonum sp. and Astragalus sp. as the dominant species. The type of vegetation extends in southern direction of the project area for approximately 12 km, then getting gradually sparser and more concentrated on the north-eastern side of hillocks.

Figure 5-14: Trees in the project area

5.1.10 Flora and fauna / biodiversity

Generally, the ecology of Turkmenistan is characterized by both its high species and habitat diversity. The flora of Turkmenistan includes about 3,000 species of vascular plants belonging to 105 families. The main landscape of the Turkmenistan desert is defined by plant communities with dominant xerophytic low shrubs and halophytes, mixed with scattered saxaul (Haloxylon spp) communities, as well as sand-adapted shrubs and ephemerals. The vertebrate fauna of Turkmenistan includes almost 700 species: 103 species of mammals, 397 birds, 82 reptiles, 5 amphibians, and

108 fish. Among the 101 vertebrate species listed in the Red Data Book of Turkmenistan (1985) are 27 mammals, 35 birds, 30 reptiles, one amphibian, and eight fish species. The highest diversity is found in Mountain Areas as the Kopetdgh Mountains and the National Protected Areas.

The diverse and threatened large mammal fauna includes wild goats (bearded goat and markhor), wild sheep, wild ass, gazelles, leopard, hyena, jackal, and wild cats. The most common desert mammals are the long-eared hedgehog (Erinaceus auritus) and tolai hare (Lepus tolai); also common are long-quilled hedgehog (Piracohinus hypomelas), numerous rodents such as gerbils (Rhombomys, Meriones) and jerboas. Other characteristic desert mammals include honey badger (Mellivora capensis), an endemic sand shrew (Diplomesodon), ground squirrels (Spermophilopsis), and desert cat (Felis margarita).

In the deserts, reptiles are numerous, and the majority of species inhabiting these ecosystems are endemic to the Central Asian herpetofauna. These include Horsfield's tortoise (Agrionemys horsfieldi), lizards such as agamas (Phrynocephalus, Trapelus), and geckos (Gymnodactylus, Alsophylax, Cyrtopodion, Crossobamon, Teratoscincus). Snakes include sand boas (Eryx miliaris, E. tataricus), sand snakes (Psammophis lineolatum), gyurza viper (Vipera lebetina), and sand echis (Echis carinatus).

The bird fauna includes many dry country specialists: including Pander's ground jay (Podoces panderi), houbara bustard (Chlamydotis undulata), sandgrouse (Pterocles alcata, P. orientalis), desert sparrow (Passer simplex), and several eagles and falcons.

The native fish fauna includes nearly forty species in nine families, as well as a handful of strict endemic species. The regulation of the Amu Darya, manipulation of its flow for irrigated agriculture, and the introduction of East Asian fish (especially Chinese carps) in the 1960s led to radical changes in the river biota. Some fish species, whose life cycle was dependent on the river delta, almost disappeared.

The Red books of Turkmenistan, Uzbekistan, Kazakhstan and Tajikistan include the same species plus Fringebarbel sturgeon (Acipenser nudiventris) and Aral barbel (Luciobarbus brachycephalus). During the period 1960-1990 a number of fish species from outside the region were introduced in a number of irrigation water bodies of Central Asia. Pikeperch and bream were released into reservoirs and lakes of the rivers Zarafshan, Kashka-Darya and the middle courses of the Syr-Darya and Amu-Darya. Silver carp (Hypophthalmichthys molitrix), grass carp (Ctenopharyngodon idella), bighead carp (Aristichthys nobilis) and snakehead (Channa argus warpachowskii), introduced from the Far East, were stocked in fish farms in the Tashkent area and from there the hatchery-produced stocking material was regularly stocked into lakes and reservoirs. Many species spread throughout the basin via the connecting major canals. Some species started to breed in both the irrigation and drainage canals. (source feow.org)

The Project area borders an industrial zone in the North and extends into the desert in the South. In a radius of 5 km around the project site the landscape and vegetation does not change significantly (except existing infrastructure). The plant communities are dominated by the perennial Chenopodiaceae, large shrubs such as white and black saxaul (Haloxylon persicum, H. alba), sand acacia (Ammodendron), kandym (Calligonum), ephedra (Ephedra strobilacea), and ephemeral plants.

Figure 5-15: Vegetation at the project site

At the project site skylarks, crested lark, saxaul sparrows (Passer ammoderdri), wagtails, hoopoe and desert sparrows have been recorded. No threatened species as imperial eagle (Aquila heliaca) and saker falcon (Falco cherrug) have been identified.

In the irrigation channels and drainage collectors Silver carp (Hypophthalmichthys molitrix), grass carp (Ctenopharyngodon idella), bighead carp (Aristichthys nobilis), crested loach (Nemacheilus longicaudus), snakehead (Channa argus warpachowskii) pikeperch, bream and potentially channel catfish (Ictalurus punctatus) have been identified in consultation with local fishermen. No threatened or endemic species have been recorded in the Hojaily Canal or GLK collector.

Figure 5-16: Fishing in Main Left Bank (GLK) drainage collector 6.5 km from the site

5.1.11 Protected areas

The nearest Protected Areas are the UNESCO Biosphere Reserve of Repetek (at a distance of 70 km from the project site) and Amu Darya State Nature Reserve IUCN CAT IV (90 km). They are not considered to be part of the Project area. There are no wetlands in the Project area (except the sewage ponds of Turkmenabat City).

5.2 Socio-Economic Conditions

5.2.1 Population within the project area

In the structure of the population of Turkmenistan, women amounted to 50.2 percent (on 1 January 2015), and it is almost the same among both the urban and rural population. Turkmenistan is a country with an average level of urbanization - the proportion of urban population is 43.7 percent (2014).

Socio-economic indicators	2013	2014
Annual GDP growth rate (%)	10.2	10.3
Economic structure (as % of GDP)		
Agriculture	8.5	8.5
Industry	48.1	47.3
Construction	15.3	15.9
Transportation	5.4	5.6
Trade	6.7	7.1
Other services	16.0	15.6
Foreign trade		
Export (in million USD)	18 854.2	19 781.9
Import (in million USD)	16 090.0	16 637.7
Balance of trade (in million USD)	2 764.2	3 144.2
Financial flows		
Investments (in million USD)	18 187.7	19 290.6
Source: State committee for statistics of Turkmenistan		

Table 5-4: Socio-Economic Indicators of Turkmenistan

Project Area:
The project area is located in one of the municipalities of Turkmenabat (Serdarabat Etrap). Turkmenabat is the second biggest city of the country and capital of Lebap Velayat (province) with a population of 234,000 people. Turkmenabat is a major industrial city.

5.2.2 Education

Turkmenistan inherited a well-developed education system at independence. In 2007 the newly elected government announced large-scale reforms to the education sector. Expenditures on education have increased over recent years, with teachers' salaries raised, workload reduced and other improvements in school conditions and quality. Education is a strong priority under the National Program of Socio-Economic Development (NPSED) 2030.

The overall literacy rate is high (99.5%), with a negligible variation by gender, region or income group. Whole population has access to secondary education. The overall educational level of the population of 15 years and above is also high. A large number of young population study abroad.

A number of new higher education establishments are being built in the regions to meet demand, as well as an increased number of vocational schools.

On January 27, 2012 the President of Turkmenistan Gurbanguly Berdimuhamedov signed a decree setting the procedure for development and approval of state educational standards that is designed to play an important role in furthering the comprehensive reform of the national education system and improving the teaching methods.

5.2.3 Health

The government is implementing large-scale investments in health. These include building infrastructure and improving the quality of medical services throughout the country. The government is working closely with the WHO, UNICEF and other international organizations in the health sector. The Ministry of Health has a strong focus on the development of specialized facilities.

Most health services in Turkmenistan are provided by government-run health institutions and are subsidized. Free medical services are provided for targeted social groups. These groups receive certain medicines free or with 50 percent discounts. Subscribers to the voluntary medical insurance plan also get 50% discounts on medical services and purchases of medicines at state pharmacies. Monthly contributions to the scheme are low.

The population receives free basic education. Certain types of public health services and basic public utilities such as electricity, gas, water, heating and petroleum are provided free or at low cost. About 17 items of highly subsidized goods and services are supplied, including some foodstuffs, salt, public transportation, housing, and telephone services. Various types of social benefits are paid in cash to particular groups. These include: old age pensions; disability pensions; assistance for families with one breadwinner; allowances for temporarily disabled persons; maternity allowances; compensation to war victims, and; family benefits.

5.2.4 Land use pattern

Presently the land of the planned power plant construction site is officially unused. However, occasional use by local shepherds passing with their flock on the territory has been reported.

Municipality representatives and civil society associations confirmed this as being the only present land use. Due to the lack of fodder on the site the use is limited to occasional passages. This holds true for the terrain of gas pipeline connection, electrical connection, access road and water pipeline. The adjacent territory is large enough for shepherds to find other passages.

5.2.5 Agriculture

Irrigated agriculture is one of the main driving forces of the local economy. There is no practice of agriculture in the Project area (5 km radius round the site). Other areas (>5 km) nearer to the Amu Darya Valley, which are irrigated by canals and collectors are intensively cultivated with cotton, vegetables, fruits etc. The Project area is traversed by the main irrigation channels of the area.

The major irrigated crops are cereals (mainly wheat), cotton, and fodder. Cotton and vegetables are the most important export crops. As of today the

agronomic sector of the country is represented by around 500 daykhan (peasants) associations, where around 400 thousand farmers and private persons got for use about 83% (1,5 million hectares) of irrigated lands. Cotton growing (42% of the cultivation area) and grain crops (49.0%) are the basis of agriculture in the country, the other crops as melon and gourd cultivation, gardening, vegetable growing and viticulture occupying 4.0%. The share of perennial plantations (including gardens and vineyards) is 0.24%. The area of fruit and berry growing is 20.6 thousand hectares, vineyards – 28.1 thousand hectares."(Source: MNP, 2009).

5.2.6 Industrial development

The project area is located in the southern industrial belt of Turkmenabat, beyond settlement and agriculturally used areas (more than 5 km distance). There are no plans to extend the settlement area into the direction of the project site, but rather to intensify industrial development. A new unit for production of 500,000 tons of sulphuric acid will be added to Turkmenabat chemical plant. A new airport on the eastern side of the main road M37 (>6.5 km distance of the project site) is under construction.

A new Turkmenabat market was constructed in the area on the Gurbansultan Etrap territory on the eastern side of the main road M37 (more than 6 km distance from the project area).

5.2.7 Tourism

The project area and its surroundings (>5 km distance) are currently not used for tourism purpose. Being located in the industrial belt of Turkmenabat City the tourism potential of the area is assessed to be low.

The 10th century caravanserai Daya Hatyn (170 km) near Dargan and Astana Baba (180 km) near the town of Atamyrat, are the only prominent culture tourism sites that can be visited from Turkmenabat. Amudarya Nature Reserve (90 km) and Repetek Biosphere Reserve (70 km) are the closest nature tourism sites from Turkmenabat.

5.2.8 Historical and cultural sites

According to the Ministry of Culture of Turkmenistan, the project site is located in 3km distance of an important branch of the Silk Road linking today's Bukhara and Samarkand and Tehran via Ashgabat and Mary (see map below). The likelihood of historical remains is therefore described as high. Not historic artefacts and monuments are known or been found during construction of existing Lebap power plant.

Figure 5-17: Branches of the Silk road

There are no known cultural sites in the project area as confirmed with the Ministry of Culture / Institute of Archaeology. The official letter from the Ministry sent on 23rd June 2012 states that "the zone for the power plant with coordinates of – 38.58.30N/63.28.00.E is not important for Turkmenistan as a zone of historical-cultural issue." On the North-East side of Zerger is located archeological point - "Gobekli depe" (Hill Gobekli) with coordinates of 39.2.14.N/63.29.52.E and on the South-West of Zerger a "Kelte minar" (Small tower) with coordinates of 38.56.55.N/63.30.51.E.

5.2.9 Gender aspects

Gender indicators for Turkmenistan are remarkably positive. The high participation of women in the labour force of 62.4% is an evidence for the strong economic role women are playing these days. A positive trend is that younger women (26 to 35 years) are increasingly entering self-employed business with a share of 52.3% against 47.7% of men (cf. UNDP 2008). Another positive factor is that women profit in large numbers from state sector employment. There are also clearly positive figures regarding the participation of women in the socio-political life of the country (UNICEF 2003).

"The government has displayed commitment to gender equality by assenting to international conventions and adopting relevant national laws. Since independence both men and women in Turkmenistan have maintained high rates of literacy, education, and economic activity. Women have legal equality with men..."(ADB)

5.2.10 Ethnic minorities

Ethnic groups in Turkmenistan exist next to Turkmen majority population. Population structure is 85% Turkmen, 5% Uzbek, 4% Russian, 6% other.

Smaller ethnic groups, in order of size, are Tatar, Kazakh, Ukrainian, Azeri, and Armenian.

Due to the geographical location Turkmenabat has a considerable Uzbek population. The Uzbeks speak an eastern Turkic language and, like the Turkmen, are Sunni Muslims

The project area is not a settlement or land use area of Uzbek minority or other ethnic groups.

6. Analysis of Alternatives

This section examines alternatives to the proposed project site, technology, design, and operation - including the no project alternative -in terms of their potential environmental impacts; the feasibility of mitigating these impacts; their capital and recurrent costs; their suitability under local conditions; and their institutional, training, and monitoring requirements. It also states the basis for selecting the particular project design proposed and, justifies recommended emission levels and approaches to pollution prevention and abatement.

6.1 No Project Alternative

The “Zero-Alternative” describes the situation without the project: “No construction of a new power plant." This alternative would prevent the country to export substantial amounts of electricity to Afghanistan and reduce the benefits of the new 500 kV line, construction of which has already been finished. Turkmenistan has had a high growth rate of domestic electricity consumption in the past years and it is expressed state policy to increase exports of electricity to neighbouring countries. Regardless of whether the plant is considered as “dedicated export generator” or to be serving both domestic and export demand, the capacity is needed, according to expansion plans. Looking at the existing generation expansion plan, the alternatives to increase domestic generation capacity, i.e. modernization of existing open cycle power plants and construction of power plants in Mary and Vatan are already included in the expansion plan. As such these options are not substitutes for the new OCGT plant but rather additive to it.

6.2 Alternative Site

As an alternative to the Project site at Zerger a site at Atamyrat had been briefly considered and was recorded in earlier project documents. However, after MOE pursued this option in more detail, the alternative was rejected for technical reasons. The gas pressure was found to be not sufficient at the site. Therefore, lack of an adequate gas pipeline connection made the site unsuitable.

In other environmental regards, the region of a potential location in Atamyrat is similar to the one in Zerger. The biggest inconvenient of the alternative site in Atamyrat appears to be the lack of gas supply.

Figure 6-1: Alternative Site Atamyrat / Kerki

Selected Option:

The selected site at Zerger (38°58'30" N / 63°28'00" E) is an optimization of several factors:

- low ecological value and importance
- close distance to a gas pipeline with sufficient pressure
- close distance to the existing grid (including future previsions of grid expansion)
- water supply possibilities
- good accessibility via main road (M37) and
- proximity to train rails.

The site is located in an industrial zone where the existing industrial pollution level ("preload") is considerable. However, the power plant will figure among the cleaner infrastructure. If mitigation efforts are necessary to reduce the existing pollution levels, a first investment priority would be the proper management of the waste dump instead of selecting a different site with less preload for the Power Plant.

6.3 Technical Alternatives Power Plant

6.3.1 Alternative Technologies[3]

A gas turbine consists of a compressor, a combustion chamber and a gas expansion turbine. The compressor increases pressure of ambient air, which is mixed with natural gas and combusted in the combustion chamber. The

[3] Source: Fichtner (2012): CCPP, Pre-Feasibility Study

flue gas, high in temperature and pressure, is expanded in the subsequent turbine, usually generating power transferred to a connected generator via shaft.

In open cycle gas turbines (OCGT) hot flue gasses are emitted from the turbine. In combined cycle power plants (CCPP) the hot exhaust gases are used in a downstream steam cycle in order to increase the degree of fuel utilization. This results in combined net efficiency of over 60% (at ISO conditions). Due to increased efficiency the specific fuel consumption as well as CO_2 emissions per generated kWh are reduced.

The configuration preferred by TE is an OCPP. Open cycle plants consist of one or multiple self-contained gas turbine units, each operating independently of each other.

For this project, several configurations can be considered, varying in the number of gas turbine units and taking into consideration possible efficiency increase by evaporative air inlet cooling. In theory, essentially any number of gas turbines can be used to match the desired power output.

However, extreme configurations of a single large gas turbine as well as an unreasonably large number of small gas turbines may lead to problems. In case of tripping or maintenance, a single unit would result in loss of the total installed power. On the other hand, efficiency is reduced in smaller gas turbines and investment cost per kWh is increased.

Therefore it is recommended to use a configuration of two or three gas turbine units. This allows using reliable and proven heavy duty gas turbines which offer a good mix of operational flexibility and high efficiency.

In case of trips with 200 MW gas turbine units, the effect on the electricity grid with a capacity of around 4 GW is small. Nevertheless, the necessary electrical grid system studies are not part of the feasibility study.

In principle, both configurations with 2 and 3 GTs are conceivable for this project. But since the configuration with three gas turbines needs more space for additional equipment, within this study the layout for this configuration has been considered. A 2 GT configuration would require less space and can easily be accommodated in the proposed plant site dimensions.

The gas turbine power rating is reduced due to high temperatures during summer. Thus, to guarantee power output of approximately 300 MW in summer, the installed power at ISO conditions is considerably larger. One option to compensate the adverse effect of high temperatures is the injection of liquid water into the inlet air flow. The water will evaporate using thermal energy of the air thereby lowering the air temperature. Installation of an evaporation cooler will be considered optionally.

According to Turkmenenergo´s requirements, the generators shall be connected as follows to a new 110/220 kV substation located within the power plants area:

In case of the two gas turbine configuration:
- One GT to the 220 kV System
- One GT to the 110 kV system

In case of the three gas turbine configuration:
- Two GTs to the 220 kV system
- One GT to the 110 kV system

6.3.2 Power plant capacity

The power output, 300 MW_{el}, has been set by agreement with AFG and analysis of the power supply/demand situation done by TE. This study will investigate the aforementioned alternatives to reach this power goal:

Alternative 1: 2 Gas Turbines
Alternative 2: 2 Gas Turbines with evaporative cooling
Alternative 3: 3 Gas Turbines

All alternatives shall provide sufficient operational flexibility, reasonable efficiency and proven reliability.

6.3.3 General Considerations for the Layout

The general arrangement of this plant, orientation of the turbines and the filter house, the 110/220 kV substation, the dry cooling towers, gas receiving station, etc. has been decided on for the following reasons:

- prevailing wind direction is from the North
- minimize pipe work and ductwork
- existing infrastructure e.g. substation, road, rail spur, gas tie-in
- minimal impact on the occupied areas
- means of egress for employees
- accessibility to equipment for operations and maintenance activities
- easy rerouting of the existing 110 kV and 220 kV overhead lines.

The plant layout was prepared for a 3 GT configuration, as the area requirements for this configuration is larger than in a 2 GT configuration.

The new 110/220 kV substation will be located within the power plant area in front of the generators/ generator step up transformers to facilitate rerouting and connection of the existing 110 kV and 220 kV overhead lines. However, substation area shall be equipped with separate fencing.

The foreseen area for the configuration 3 GT is to be about 500 x 500 m (200,000 m^2). This already includes space for future installations to upgrade the existing plant to CCPP technology.

6.3.4 Water supply options

6.3.4.1 Selection of water source

Turkmenistan is in an arid region. Any water used in the new power plant will be sourced from local canals or collectors which in turn are sourced from the Amu Darya River. Water is scarce and is also required for irrigation and other uses by the general public.

The maximum water consumption for the power plant will be 60 m^3/h and 15 m^3/h for the additional gas turbines at site. Therefore a shared 6" water pipeline is sufficient.

Water can be extracted from one of the following possible water sources:

- Hojaily Channel, 0.5-1.0 m3/sec, 3.5 km distant, salinity = 0.7 g/l distance to Zerger Area approx. 7 km
- GLK Main collector, 10-18 m3/sec, 6.5 km distant, salinity = 1.5-3 g/l, distance to Zerger Area approx. 7 km

For transporting raw water from the canals to the power plant, a new water pipeline. It is assumed that:

- the area for this pipe way is available
- the right of way will be accepted by the authorities.

The location of the raw water intake from the canal with screen plant and the cooling water discharge must be so arranged as to prevent recirculation of blow down from the cooling tower to the raw water intake.

Tube wells

As a backup scenario well water may serve as the source of process water. If feasible, these shall be located as close as possible to the power plant where sufficient raw water in suitable quality is available. Raw water is pumped by several raw water pipes to the power plant area. A more detailed investigation shall be undertaken by the EPC Contractor.

For the arrangement of the raw water pipes from the wells to the power plant, several pipe runs will be needed. It is assumed that:

- the area for the pipe run is available
- the pipeline right of way will be accepted by the authorities.

The well water pumps needs an uninterruptible electricity supply. Therefore the electricity supply of the well pumps should come from the power plant area. The pumps shall be connected to the safe autonomous supply of the OCPP, so operation of well water pumps will not be directly affected by the local electric grid.

Well spacing shall be sufficient to reduce their mutual interference to a minimum.

Because of the risk of unexpected recovery times required for some wells, installation of additional wells with a capacity of about 100% of the total water demand of OCPP is recommended.

When upgrading the OCPP to a CCPP the water supply capacity has to be increased severely. The capacity required in the future shall be considered when installing a new pipe run.
Because water analyses of both water sources are only partly available, the Consultant recommends that proper water analyses and pumping tests as needed shall be conducted during the construction phase.

If considered further, the backup scenario, i.e. use of water from wells, must also be investigated by the EPC contractor and a budget for this included in the EPC contract.

6.3.4.2 Raw water pre-treatment

Water at site is required in three different forms

- potable water
- process water (for example for washing of the gas turbine, water injection during fuel oil operation and evaporative cooling, if applied)
- firefighting water

Of those three, the quality requirements of process water are the highest.

Drinking water treatment

Well water can be used as basis for the potable water treatment system. The well water used for potable water supply is filtered and, if necessary, iron is separated out in the pre-treatment plant.

Disinfecting agents like hypochlorite or chlorine are added to the filtered raw water before its transfer to the potable water storage tank, however, WHO drinking water guidelines have to be met.

Produced drinking water quality should be in accordance with WHO guidelines for drinking water quality.

Raw water pretreatment

The design of the raw water pretreatment should be done according to the used raw water source.

The process steps should enable the use of the treated raw water in the RO plant without any restrictions under all operating conditions

Demineralization (DM) plant
A demineralization plant is necessary if evaporative cooling is equipped, NOx reduction for fuel operation is installed and demineralized water with adequate quality will not be supplied by the chemical plant.

Demineralized water will also be required by the steam boiler of a CCPP so the capacity of the demineralization facilities shall be designed accordingly.

Demineralization is done in two process steps:

- reverse osmosis (RO)
- treatment in a mixed bed ion exchanger.

This design is based on the following aspects:

RO process is recommended as the first process step instead of ion exchange (cation/anion exchanger), as RO is more adequate for eliminating salt impurities in raw water like:

- organic matter from surface water
- colloidal silica.

This is better done by the membrane process than by ion exchange.

Additional demineralization of the permeate from the RO unit is necessary, as its conductivity is not in the quality range to be used as process water (evaporative cooling, water injection for NO_x reduction, etc.) (< 0.1 µS/cm) With this design, it will be possible to operate the demineralization plant with higher and varying salt concentrations in raw water also. This will be helpful if different raw water sources (e.g. from different wells) are used.

The pretreatment process of the RO plant must be properly operated. If this is not the case, the membranes will become clogged and have to be replaced. This will cause additional costs.

<u>1. RO plant</u>
The RO plant consists of two trains, each of 50% capacity for the demand.

During cleaning of the membranes, only one train shall be in operation, with any shortfalls in water to be taken from the permeate storage tank. The RO plant will be sized to meet the requirements of the demineralization plant.

Initial cleaning of the de-alkalized or softened raw water is done by passing it through prefilters before supplying it to the reverse osmosis membranes by means of a feed pump.

Both trains are equipped with all necessary dosing and storage systems for chemicals and membrane-cleaning equipment is provided for use by both.

One permeate storage tank is provided for a 24 h supply.

The RO plant shall be designed with a capacity of 2 x 50% of the demineralized water demand of the OCPP as stated above.

2. Mixed bed exchanger

The plant consists of two mixed bed exchangers, each of 100% capacity, with strong acid cation and strong base anion resins, demineralized water (DMW) tank and regeneration system.

Two 100% streams are provided, with one working and one on standby exchanger. All common items, such as pumps, pipes, valves and controllers shall be designed accordingly.

The regeneration system comprises the storage tanks and dosing pumps for NaOH and HCl.

As an alternative to mixed bed exchanger an electro-de-ionization should be evaluated.

The DM plant shall be of sufficient capacity to meet the requirements for NO_X abatement of the gas turbine exhausts or demineralized water demand for evaporative cooling. The mixed bed exchangers shall have a service run of at least 10 hours between regenerations. The output capacity of the DM plant shall be about 30 m^3/h.

The quality of the DM water produced shall meet the requirements as noted in Table 6-1.

Parameter	Unit	Value
Conductivity at 25°C	µS/cm	< 0.1
Silica as SiO_2	ppm	< 0.005
Sodium	ppm	< 0.01
Iron	ppm	< 0.01
Copper	ppm	< 0.001
DOC	ppm	< 0.2

Table 6-1: Proposed demin. water quality

One storage tank shall be provided to hold a 24 hours supply of demineralized water for fuel oil operation in winter. During normal operation with natural gas firing without evaporative cooling, no demineralized water is required.

Mode of operation of all treatment plants

The chemical waste treatment plant RO plant, mixed bed ion exchangers of the DM plant, shall be equipped with fully automatic control systems. For the DM plant, this shall enable the regeneration cycle of the mixed bed ion exchanger to be started and run fully automatically following starting by the operator. Standby trains shall be put into operation automatically.

Control and monitoring of the plant shall be from the Central Control Room with provision for manual intervention locally.

All instrumentation needed for safe and satisfactory operation and supervision of the plant shall be provided.

6.3.5 Wastewater evacuation options

If wastewater from the power plant cannot be used for irrigation, it will be discharged to the public systems.

The public systems used for waste water discharge should have enough capacity to accept the process waste water.

Two different wastewater systems shall be operated:

- wastewater from processes shall be treated prior to discharge to the public system
- sanitary wastewater shall be treated so that it may be used for irrigation, like rainwater runoff from buildings, but alternatively this water shall also be directed to the canal.

It is assumed that these limits of discharge shall be complied with at the discharge point after mixing of all wastewater streams and not at the place of wastewater discharge. During the design phase of the OCPP, some effluent parameters should be discussed and assessed in more detail:

- The wastewater resulting from the construction phase, has to be evaluated under the listed limits of discharge. Especially the TDS and concentration of heavy metals have to be considered.

The concept for the wastewater system, as shown in the process flow schematic of the wastewater system is as follows:

Wastewater from process plants shall be treated in each plant or building according to its composition, for example by an oil separator or by a neutralization plant. This wastewater shall be collected in a central process waste water basin, which then shall be pumped to the public system separated oil shall be collected and disposed of off-site.

All plant buildings shall have drain pits to collect floor wash water and other process discharges. These pits shall be connected to the network of

wastewater drains outside the buildings. Also transformer oil pits shall be connected to this network.

The regeneration flow from the demineralization plant and other chemical drains shall be discharged into a neutralization tank and chemicals added for neutralization. The neutralization tank shall be provided with an acid- and alkali-proof lining. A mixing nozzle or ejector system at the outlets of the recirculation pipes shall be provided for thorough mixing of the wastewater. Pipes, valves and fittings shall be of corrosion-proof material to withstand attack by sulphuric acid, caustic soda and the salts of both. The neutralized wastewater shall be discharged to the canal.

Sanitary wastewater from the plant shall be treated in a sewage treatment plant, consisting of a common septic tank for all buildings, and shall then be made available for irrigation or for discharge to the canal. The wastewater quantity for design purposes will be 150 l / person / day.

Rainwater shall also be collected and made available for irrigation. The rainwater system shall be designed to handle the maximum rainfall.

Firefighting water shall be discharged via a fire fighting water retention basin to the canal. The firefighting water retention basin shall only be used in case of firefighting.

Sludge from the CWTP shall be disposed of according to the local standards.

The power plant wastewater system shall be designed to also handle the wastewater and sewage from all buildings and installations.

The water has to be treated to avoid environmental pollution and to meet World Bank/IFC standards and local/national standards for Turkmenistan.

7. Anticipated Environmental Impacts and Mitigation Measures

7.1 Environmental and Social Impacts during Construction Phase

7.1.1 Impact on landscape and visual aspects

Being located in the industrial belt of Turkmenabat, the landscape of the Project area shows clear marks of past and present economic activity. The distance of the Project area is more than 3 km to built structures and the road M 37 (see following pictures).

Figure 7-1: Selected Project Site

Figure 7-2: Landscape at the Project site

The Open Cycle Gas Power Plant will not change the existing landscape since there is an existing Lebap power plant and its ancillary infrastructure. Due to the flat landscape, the visibility of the plant structures will be approximately 5 km. The sensitivity of the landscape is assessed to be "low", as it is not particularly scenic and does not present any tourist value. This additional visual impact next to the substation site is assessed to be low. No landscape mitigation measures are required.

Ancillary Infrastructure:
Regarding the ancillary infrastructure (access road, water pipeline, gas pipeline and electrical connection), the following assessment is made:

Access road:
The existing access road from road M 37 is 3.1 km long and asphalted, of good quality. The additional impact is low.

Water pipeline from GLK Collector:
A water pipeline needs to be built if the water used as process water (100 m^3/h) is taken from the GLK collector in 6.5 km distance. Pipeline length will be approximately 7 km. The water pipeline would need to cross Hojaily irrigation channel (with too little flow) and lead through unpopulated terrain near the sewage treatment plant and the waste disposal site (2.5 km distance). The impact is considered to be low. A pumping station would be required to bridge the elevation difference of 4 m. The water intake building at the collector would need to be equipped with fish screens to prevent fish getting caught at the intake. Due to the little quantity of water (28 l/sec) the impact is considered to be low.

Gas pipeline connection:
2 gas pipelines need to be built. Total length will be approximately 7 km. Additional impacts are expected to be low.

Electrical connection:
The electrical grid connection to the Turkmenenergo power grid will be via a new 110 kV / 220 kV-substation located on the property of the power plant. For the project a new 110 kV / 220 kV-substation located on the property of the power plant shall be build. The electrical connection to the national grid will be made from Chardzhev SS (distance 12 km), due to future dismantling of the present substation near the Project site. It is planned to use the existing 220 kV transmission line between both substations to connect the power plant. The new line to be constructed is expected to be between 50-100 m long. No additional impacts will occur.

Lay down areas and temporary workers camps:
During construction workers camps will be installed around the power plant area. The final decision on size will be made by the EPC contractor. Temporary lay down areas and other areas used during the construction process will need to be specified by the constructor. For the work camp sufficient land is available all around the construction site itself.

Workshops:
Maintenance and Workshop area shall be located within the power plant beside the process area.

All possible land for work camp near the selected construction site is currently barren state owned land so that even for a new settlement no land acquisition would have to be made.

Should the EPC Contractor choose the option to supply water from groundwater, specific well tests have to be undertaken and the EIA updated accordingly after finalizing the design.

Impact of/on	Sensitivity	Extent of Impact on/by	Duration of Impact	Direct/ Indirect
Power plant	■	■	Long term	Direct
Access road	■	■	Long term	Direct
Water pipeline	■	■	Long term	Direct
Gas pipeline	■	■	Long term	Direct
Electrical Connection	■■	O	Long term	Direct
workshops	■	■	Long Term	Direct
Lay down areas and Workers Camps	■	■	Short Term	Direct

In summary, the Project's visual impacts on the landscape are as follows:

Impact of/on	Sensitivity	Extent of Impact on/by	Duration of Impact	Direct/ Indirect
Landscape and Visual Aspects	■	■	Long term during construction	Direct

7.1.2 Impact on land use

The construction site of the power plant and the ancillary infrastructure will permanently close off a terrain of 15-20 ha for the power plant and temporarily another approximate 2.5 ha for the gas pipeline connection. The land is owned by the Serdarabat Etrap (Municipality) and there are no existing lease contracts or other permits for land use according to municipality officials.

To traces of an existing land use could be identified. During consultation it was revealed that occasionally shepherds would pass on the land with their flocks. The construction of the power plant will not be a hindrance for the occasional passage of shepherds, who can chose a passage a few 100 m further South. As potential shepherds have no need to pass on the land but can easily take a different route next to the site, the sensitivity as well as the Project impact are assessed to be low to nil. No mitigation measure is necessary.

Impact of/on	Sensitivity	Extent of Impact on/by	Duration of Impact	Direct/ Indirect
Land Use	■	■/O	Long term	Direct

7.1.3 Soil and erosion

Sand drifts and deflation of soil are a considerable issue for agriculture in the vicinity of infrastructure projects in Turkmenistan.
The Project will remove vegetation from an area of around 5-7 ha, depending on the design of the power plant and ancillary infrastructure (access road and pipelines). The Project area will partly be sealed with the planned constructions. Also, pipelines for gas and water supply will create newly exposed areas along the built infrastructure. With the prevailing strong winds erosion / deflation of soil will be increased. Due to soil structure and wind pattern the sensitivity of the soil in Project area is assessed to be high.

However, due to the characteristics and the location of the Project the magnitude of impact is assessed to be low due to the long distance to agriculturally used areas and the relatively small surface affected. The impact is therefore assessed to be medium. Therefore, sand deflation prevention measures shall be implemented.

Figure 7-3: Deflation prevention measures near M37 roadside

Measures to stabilize sand are commonly used for infrastructure projects. Similar measures (i.e. mechanical fixation with reed bundles) or replanting of salt tolerant bushes (i.e. Saxaul) shall be implemented for all areas where existing vegetation is removed and adjacent areas that are exposed to wind.

The importance of sand stabilization measures has been underlined by the Society for the Protection of Nature (CSO).

A remote sensing study conducted by GIZ (German International Cooperation) showed that sand deflation can be considerably reduced by the plantation of "Black Saxaul" trees and thereby acts as a very good anti-desertification measure. Even better sand / soil fixation was achieved by the sowing of Selin (Aristida karelini). The sand transport could be reduced by over 90 % in the surface near layers and dust transport even in a height of 150 cm could be reduced by approximately 50 %. (Source: GIZ 2007).

Sand deflation mitigation measures shall be implemented directly after the construction period. Construction areas not used for operation shall be replanted.

Turkmenenergo to prepare and implement in coordination with relevant local agencies (municipality, MNP) a plan for sand stabilization in the power plant area.

Impact of/on	Sensitivity	Extent of Impact on/by	Duration of Impact	Direct/ Indirect
Soil and Erosion	■■■	■■	Long term	Direct

7.1.4 Land acquisition and resettlement impact

The selected Project site is not inhabited, the nearest built structure in the vicinity is the substation and the next built structures are located in a distance of 1.9 km at the waste disposal site (North). An industrial site is located at 3.6 km (East). The closest farm is located in a distance of 5.5 km (North-West). Town / village settlements are located in a distance of 6.5 km (Zerger). There is no involuntary resettlement impact.

Figure 7-4: Built structures in the vicinity of the Project site

The land to be acquired for the Project is municipal (etrap) land and not village (gengeshlik) land, for which Serdarabat Etrap governor is in charge. Land acquisition procedure needs to be respected.

The sensitivity of the Project area related to land acquisition is low as land use is officially and practically inexistent. No negative livelihood impact will occur; no mitigation is required.

Impact of/on	Sensitivity	Extent of Impact on/by	Duration of Impact	Direct/ Indirect
Land Acquisition and Resettlement	■	O	-	-

7.1.5 Physical cultural resources

Despite being located in the vicinity of a route of the historical "Silk Road" (see Chapter 5.2.8), no known physical cultural resources could be identified at the selected Project site. This has been confirmed by the Ministry of Culture of Turkmenistan / National Department of Protection, Research and Restoration of Historical and Cultural Sites as well as during the site visit. The official letter from the Ministry sent on 23 June 2012 states that "the zone for the power plant with coordinates of – 38.58.30N/63.28.00.E is not important for Turkmenistan as a zone of historical-cultural issue." On the North-East side of Zerger is located archaeological point - "Gobekli depe" (Hill Gobekli) with coordinates of 39.2.14.N/63.29.52.E and on the South-West of Zerger a "Kelte minar" (Small tower) with coordinates of 38.56.55.N/63.30.51.E. The sites are not impacted by the construction of the power plant nor by ancillary infrastructure.

The likelihood of chance finds is extremely low. However, a chance find procedure will be proposed in the following to further reduce the potential impacts.

Impact of/on	Sensitivity	Extent of Impact on/by	Duration of Impact	Direct/ Indirect
Physical Cultural Resources	■	■	Long term	Direct

Standard "Chance Find Procedure":

a) stop the construction activities in the area of the chance find
b) delineate the discovered site or area
c) secure the site to prevent any damage or loss of removable objects. In cases of removable antiquities or sensitive remains, a night guard shall be present until the responsible local authorities and the equivalent take over
d) notify the supervisory Engineer who in turn will notify the responsible local authorities and the Ministry of Culture / National Department of

Protection, Research and Restoration of Historical and Cultural Sites immediately (within 24 hours or less)

e) responsible local authorities and the Ministry of Culture / National Department of Protection, Research and Restoration of Historical and Cultural Sites would be in charge of protecting and preserving the site before deciding on subsequent appropriate procedures. This would require a preliminary evaluation of the findings to be performed by the archaeologists of the Ministry of Culture / National Department of Protection, Research and Restoration of Historical and Cultural Sites (within 72 hours). The significance and importance of the findings should be assessed according to the various criteria relevant to cultural heritage; those include the aesthetic, historic, scientific or research, social and economic values
f) decisions on how to handle the finding shall be taken by the responsible authorities and the Ministry of Culture / National Department of Protection, Research and Restoration of Historical and Cultural Sites. This could include changes in the layout (such as when finding an irremovable remain of cultural or archaeological importance) conservation, preservation, restoration and salvage
g) implementation for the authority decision concerning the management of the finding shall be communicated in writing by the Ministry of Culture / National Department of Protection, Research and Restoration of Historical and Cultural Sites; and
h) construction work could resume only after permission is given from the responsible local authorities and the Ministry of Culture / National Department of Protection, Research and Restoration of Historical and Cultural Sites concerning safeguard of the heritage.

These procedures must be referred to as standard provisions in construction contracts, when applicable. During project supervision, the site engineer shall monitor the above regulations relating to the treatment of any chance find encountered are observed.

7.1.6 Biodiversity conservation and natural resource management

7.1.6.1 Flora and fauna

For the construction of the power plant vegetation will be removed from an area of 4 ha. Additionally, another 2-3 ha for pipeline constructions, temporary lay down areas and construction sites will be affected. This creates an impact on the existing vegetation and habitats. The Project area is not part of any protected area or sensitive ecosystem according to the Ministry of Nature Protection of Turkmenistan.

The local ecosystem with very similar characteristics in terms of vegetation, climate, altitude etc. extends for more than 360 km^2 before the vegetation gradually changes and vegetation becomes sparser. Due to the unavailability of data related to local migration pattern of birds and terrestrial fauna and the unavailability of data on bird collisions at existing transmission lines

there is no scientific evidence for the assessment, however due to the specificity of the Project location (industrial area) the impact is assessed to be low. There is reason to believe that fauna potentially affected by the construction of the power plant would shift the habitat by a few hundred meters (especially insects, reptiles and birds).

However, information on biodiversity remains incomplete.

On the present state of knowledge, noise and dust are not expected to impact flora and fauna at the construction site.

Impact of/on	Sensitivity	Extent of Impact on/by	Duration of Impact	Direct/ Indirect
Flora and Fauna	■■	■	Short term during construction (noise etc.), Long term due to removal of vegetation on the Project site	Direct

7.1.6.2 Protected areas and wetlands

The Project is located 70 and 90 km from the closest protected areas (PA) in the region. The area is not part of a wetland (Ramsar Convention) or coastal area and not likely to be declared as a protected area as it is located in the industrial belt of Turkmenabat. The sensitivity of a protected area in the vicinity would be high, but due to the long distance of existing PAs to the Project site the sensitivity is low and no potential impact is assessed. Therefore, no mitigation measures are necessary.

Impact of/on	Sensitivity	Extent of Impact on/by	Duration of Impact	Direct/ Indirect
Protected Areas and Wetlands	■	O	Short term	Direct

7.1.7 Traffic

The construction process will generate additional traffic, however due to the location of the Project site in the industrial belt of Turkmenabat and near the main road M 37, the additional impact will hardly be measurable. Warning signs shall be put at the entrance of the access road on M 37 to prevent accidents. The traffic on the access road will potentially impact the access to the existing power plant and substation site, but this impact is likely to be restricted to peak construction activity. However, the construction company must make sure not to block the access to the existing power plant and substation in case of hazards or urgent repairs.

The construction of the gas pipeline and the rail access will have to cross the main road and block or hinder traffic during the construction period. A suitable deviation of the road shall be proposed.

Mitigation measures:

- signing of construction site on M 37
- The access to the existing power plant and substation shall not be blocked during the construction work.
- Propose deviation for the time of gas pipeline construction.

Impact of/on	Sensitivity	Extent of Impact on/by	Duration of Impact	Direct/ Indirect
Traffic	■	■	Short term	Direct

7.1.8 Noise

The construction of the power plant is expected to generate a certain noise level generated by the construction machinery and all related activities. Generally, noise levels during construction are difficult to predict because the noise generating activities are not homogeneous in extend and duration largely affected by the number of operating machines. The construction machinery will work periodically and change depending on the construction works, the noise level around the construction site will be intermittent.

However, the possibility and corresponding risk with respect to an exceedance of allowed noise values as an occupational health aspect could be reduced by the mandatory use of personal protective equipment in noisy areas where noise limits could be exceeded. Noise concerns with respect to sensitive receptors outside the plant boundary are unlikely to occur because no permanent settlements are located in the area closed than 2 Km around the proposed plant side.

Impact of/on	Sensitivity	Extent of Impact on/by	Duration of Impact	Direct/ Indirect
Noise	■	■	Short term during construction	Direct

7.1.9 Air emissions and ambient air quality

During the construction period the Project will generate impacts on air quality through generated dust by construction activities and traffic as well as vehicle emissions.

Generated dust during the construction period can be reduced by spraying water on access roads and other construction sites.

Due to the characteristics of the area, the distance to settlements and a predominant wind direction from North-Northeast most of the dust and construction emissions will be blown into the desert and not impact settlement areas. Hence, the sensitivity of the site is assessed to be low and the generated impact on the air quality will be marginal.

As mitigation measures, construction vehicles shall be properly maintained and speed limits shall be respected in order to minimize generated emissions and dust.

Impact of/on	Sensitivity	Extent of Impact on/by	Duration of Impact	Direct/ Indirect
Air Emissions/ Ambient Air Quality	■	■	Short term during construction	Direct

7.1.10 Water supply

For the construction process a supply with water will be required.

Drinking water for workers is likely to be supplied by truck / water tank till water treatment facility start operating on the existing power plant. Health and safety aspects of drinking water supply need to be respected.

Water for construction purposes as well as for dust reduction (spraying) is expected to be brought by truck as long as the water supply pipeline is not operational. Due to its high salinity, groundwater consumption during construction will be reduced to safety measures (fire extinguishing reservoir). Potentially, the existing well at the substation site may be used for this purpose.

The impact on water resources resulting from water supply and consumption will be low during the construction period.

Impact of/on	Sensitivity	Extent of Impact on/by	Duration of Impact	Direct/ Indirect
Water Suppy a) Surface Water b) Groundwater	 ■ ■	 ■ ■	Short term during construction	Direct and indirect

7.1.11 Waste

7.1.11.1 Solid waste

Solid wastes generated during construction include excavated soil and rocks, concrete, asphalt, bricks, metals and glass, packaging materials like plastics and paper as well as domestic waste. Equipment and material containing asbestos will not be present.

Especially if they contain hazardous materials (see Chapter 7.1.12), solid wastes may pollute water (irrigation channels, groundwater) and contaminate soil in the Project area. They also mean a hazard to workers' health if they are stored, handled and disposed of in an improper way (e.g. by open burning of solid wastes, storing wastes outside designated areas, dumping wastes in the surroundings). Without applying mitigation measures impact of solid wastes on water, soil and worker's health are assessed to be medium regarding the construction phase.

Impact of/on	Sensitivity	Extent of Impact on/by	Duration of Impact	Direct/ Indirect
Solid Waste (generated by construction activities and by workers)	■■	■■	Short term during construction	Direct and indirect

To avoid such impacts, in general, principles of waste minimization shall be followed: (1) reduction of waste quantity, (2) recycling as much as possible, (3) proper dumping of remaining waste. Recyclable solid waste (e.g. old metals) shall be segregated and sold to local contractors.

All solid wastes containing hazardous materials shall be separated from other solid waste and treated adequately under compliance with international standards in order to avoid potential impacts. Fuels, chemicals and lubricants shall be stored in bounded areas with impervious ground. Non-hazardous solid waste shall be collected and disposed of by licensed waste contractors and land filled in an approved municipal waste disposal facility in compliance with local and international standards. Relevant international guidelines regarding adequate solid waste management are IFC's General EHS Guidelines "Waste Management" (April 2007) as well as IFC' EHS Guidelines on "Thermal Power Plants" (December 2008).

Periodic inspection is required to ensure the implementation of good management practices during construction. Also, an audit of the waste disposal procedure shall be done.

Mitigation measures include:

- Development of a Waste Management Plan within the EHS Management Plan considering following principles: (i) waste management hierarchy of avoidance-minimization-reuse-treatment-disposal; (ii) segregation of waste; (iii) minimization of construction waste by good technical planning; (iv) training of staff.
- Implementation of a Waste Management System.
- Staff training to increase awareness of waste minimization and appropriate waste disposal.
- Construction material as bags of cement etc. shall be stored in containers in order to avoid rinsing out.

If solid waste is stored, handled and treated adequately, the impact on water and soil resources of the Project area as well as on worker's health are assessed to be low.

7.1.11.2 Liquid waste

Liquid wastes generated during construction include wastewater (e.g. sewage) and other effluents from the construction activities.

Liquid wastes, especially if they contain hazardous substances (see Chapter 7.1.12) may pollute water (irrigation channels, groundwater) and soil of the Project area. This includes for example material storage run off and soil run off (storm water/ flood water) arising from rain and containing oil, grease, silt and/or other substances. If liquid wastes are stored, handled and disposed of improperly (e.g. storage in open canisters) they can also mean a hazard to workers' health.

Only low amounts of wastewater will be produced temporarily by workers at the construction sites. For impact avoidance/ mitigation, soil run off shall be controlled (periodic inspection) and adequate site drainage shall be performed.

If liquid waste is stored, handled and treated adequately, the impact on water and soil resources of the Project area as well as on worker's health are assessed to be low.

All liquid wastes containing hazardous substances shall be separated from other liquid waste and treated adequately in order to avoid potential impacts (e.g. storage in septic tanks). International guidelines shall be adopted for the management of liquid hazardous waste. Relevant international guidelines regarding adequate liquid waste management are IFC's General EHS Guidelines "Waste Management" and "Wastewater and Ambient Water Quality"(April 2007) as well as IFC' EHS Guidelines on "Thermal Power Plants" (December 2008).

Mitigation measures include:

- Temporary sewage treatment facilities shall be provided for the construction site and the worker's accommodation.
- All liquid materials and lubricants shall be stored in closed containers or barrels.
- Maintenance and re-fuelling of the construction equipment shall be done only on sealed and enclosed areas (careful handling and careful maintenance, especially of the fuel tanks).
- On site storage of fuel, engine oil and lubricants in locked tanks and on sealed and shadow roofed areas.
- All wastes generated through the use of fuel, engine oil and lubricants like drums and containers shall be collected and disposed of properly.

Impact of/on	Sensitivity	Extent of Impact on/by	Duration of Impact	Direct/ Indirect
Liquid Waste (generated by construction activities and by workers)	■■	■	Short term during construction	Direct and indirect

7.1.12 Hazardous materials

Hazardous materials (e.g. oil and fuel, paints and coatings, asphalt products, various types of wastes) may contaminate water (irrigation channels, groundwater) and soil of the Project area during construction. These materials can also be a health hazard, if stored, handled and disposed of improperly. This is the reason why storage and handling of hazardous materials shall be done in accordance with international standards and appropriate to their hazard characteristics. A pertinent reference for this is the IFC's Environmental Guidelines on "Hazardous Material Management". An Emergency Response Plan shall be developed for hazardous substances.

Due to the limited quantity of hazardous materials used during the construction period the impact on water and soil resources of the Project area as well as on worker's health are assessed to be low.

Mitigation Measures:
Hazardous materials as hydrocarbons, explosives and other, shall be stored, handled and treated respecting national and international guidelines. Specifications, which substances will be used and how they will be handled shall be made during finalization of the technical design and EHS - provisions.

Impact of/on	Sensitivity	Extent of Impact on/by	Duration of Impact	Direct/ Indirect
Hazardous Materials	■■	■	Short term limited to construction period	Direct and indirect

7.1.13 Natural disaster risks

Natural Hazards
Natural hazards during construction are related to possible earthquakes (seismic risk) that may lead to the damage of infrastructure, as well as dust storms that may disturb and delay the construction activities. Turkmenistan can be considered as a zone of high earthquake risk (see Chapter 5.1.3). The highest mean annual frequency of dust storms is observed in the spring in the sandy Central Karakum Desert (67 days).

Infrastructure needs to be constructed respecting earthquake safety standards. If this is respected, the extent of impact regarding natural hazards during construction is assessed to be low. An emergency plan shall be

elaborated within EHS provisions and staff trained in emergency response in the framework of the suggested EHS Training for all staff.

Impact of/on	Sensitivity	Extent of Impact on/by	Duration of Impact	Direct/ Indirect
Natural Disaster Risks	■ ■	■	Long term	Indirect

7.1.14 Ethnic minorities

The Project does not have any impacts on ethnic minorities. No settlements are concerned. Local population shall have a priority to be employed wherever possible.

Impact of/on	Sensitivity	Extent of Impact on/by	Duration of Impact	Direct/ Indirect
Ethnic Minorities	■■	■	Short term	Indirect

7.1.15 Gender issues

The construction process will not have any direct impact on gender relations.

However, women shall not be disadvantaged during contracting of local workforce. Health and safety measures shall include special provisions to take into account potential vulnerability situation of women (i.e. related to worker's camps, see below Health and Safety section).

Impact of/on	Sensitivity	Extent of Impact on/by	Duration of Impact	Direct/ Indirect
Gender Issues	■■	■	Short term	Indirect

7.1.16 Population influx / worker's accommodation

Due to the proximity of the city of Turkmenabat, the construction of worker's camps is not expected. Workers will find accommodation possibilities in the city area of Turkmenabat. The influx of external workers will not be as extreme as in more isolated areas. It is not expected that the Project will create a large influx of population during the construction period.

Nevertheless, provisions regarding health and safety and security will need to be implemented. Generally, alcohol consumption and other negative social phenomena are not assumed to be a concern in the area of the construction site, but prevention measures should be considered in general.

Mitigation measures include:

- awareness raising programme for workers shall be implemented
- put in place sufficient sanitation facilities for workers

- implementation of health and safety workshops for construction workers
- installation of warning signs "Danger of Electrocution" in risk areas
- City accommodation is priority. In the case that construction camps are necessary these will be located in agreement with relevant municipal authorities.

Impact of/on	Sensitivity	Extent of Impact on/by	Duration of Impact	Direct/ Indirect
Population Influx / Worker's Accommodation	■	■	Short term	Indirect

7.1.17 Workforce / generated employment

Whereas skilled workers will be recruited from Ashgabat or even foreign countries, unskilled labour may be recruited locally. The number of workers employed during the construction process is estimated to be 1200-1400 persons. Approximately 80% will be unskilled workers that may be recruited locally. The generated employment will be a tangible benefit for the local population.

Mitigation measures:

- local population shall have priority access to employment generated through the Project
- unskilled work-force shall be selected from proximity areas.

Impact of/on	Sensitivity	Extent of Impact on/by	Duration of Impact	Direct/ Indirect
Workforce / Generated Employment	■■	✦	Short term limited to construction period	Direct

7.1.18 Health and safety

7.1.18.1 Occupational health and safety

<u>Occupational Noise</u>
The plant construction will cause temporary noise emissions due to operation of the construction equipment and vehicle movements. According to the IFC's General EHS Guidelines, *'no employee should be exposed to a noise level greater than 85 dB(A) for a duration of more than 8 hours per day without hearing protection'*. In case this limit is exceeded workers shall wear ear plugs.

Together with further noise reducing measures (like the use of silencers), impacts of noise emissions on workers can be reduced to a low level.

<u>Dust Emissions</u>

The construction activities will cause dust resulting from vehicle movements and earthworks, which are limited in time. The impacts on workers might be locally considerable but can be reduced significantly by adequate measures. Such measures are e.g. reduced speeds and use of tarpaulins.

Spread of Diseases

Generally, the influx of construction workers from outside the communities contains a risk of spreading communicable diseases. To avoid a spread of serious diseases workers should be made aware of health implications and preventative measures. Information campaigns should be obligatory.

Adequate sanitation facilities must be provided at the construction site and in accommodation facilities.

Accident Risk and Safety Hazards

Potential impacts during the construction phase include increased safety risks for local inhabitants and workers related to increased road traffic particularly in view of large construction/ transport trucks. Accidents may be also due to a lack of work safety measures at the construction site. This particularly concerns the transportation of plant parts and machinery, the construction of the plant buildings and the use of harmful substances. Impacts include electric dangers during the time of connection of the Power Plant to the existing 220 kV grid.

To meet these safety risks, adequate safety protection measures and training for workers and drivers are necessary. With the provision of a high standard of health and safety management on site, the occupational health and safety risks for workers associated with construction of the power plant will be minimized so that they are not significant.

In order to meet the health and safety risks from noise and dust emissions, spread of diseases, alcohol and drug abuse, and potential accidents, an EHS Management System/ Plan shall be developed and implemented during construction, including an EHS Audit on the construction site and training of the workers.

Good local and international construction practice in, Health Safety and Environment (EHS) shall be applied at all times.

Measures include:

- implementation of EHS procedures as a condition of contract all contractors and subcontractors
- clear definition of the EHS roles and responsibilities of all construction companies and staff
- management, supervision, monitoring and record-keeping as set out in plant's operational manual
- pre-construction and operation assessment of the EHS risks and hazards

- completion and implementation of Fire Safety Plan prior to commissioning any part of the plant
- provision of appropriate training on EHS issues for all workers
- provision of health and safety information
- regular inspection, review and recording of EHS performance.

Impact of/on	Sensitivity	Extent of Impact on/by	Duration of Impact	Direct/ Indirect
Noise emissions	■■	■	Short term	direct
Dust emissions	■	■	Short term	direct
Spread of Diseases	■■	■	Short term	indirect
Accident Risk and Safety Hazards	■■	■	Short term	direct
Electric dangers	■■	■	Short term	direct

Turkmenenergo and EPC Contractor will take all steps to prevent accidents, injury, and disease arising from, associated with, or occurring during the course of work by (i) identifying and minimizing, so far as reasonably practicable, the causes of potential hazards to workers; (ii) providing preventive and protective measures, including modification, substitution, or elimination of hazardous conditions or substances; (iii) providing appropriate equipment to minimize risks and requiring and enforcing its use; (iv) training workers and providing them with appropriate incentives to use and comply with health and safety procedures and protective equipment; (v) documenting and reporting occupational accidents, diseases, and incidents; and (vi) having emergency prevention, preparedness, and response arrangements in place.

In summary, Project impacts on occupational health and safety during construction are assessed as follows:

Impact of/on	Sensitivity	Extent of Impact on/by	Duration of Impact	Direct/ Indirect
Occupational Health and Safety	■■	■	Short term during construction	Direct and indirect

7.1.18.2 Community health and safety

Despite being located relatively close to a major city, no settlements are located near the site. Air pollution and Water pollution will be prevented in the framework of EHS measures (see Occupational Health and Safety and Solid and Liquid Waste Management). Measures to prevent road accidents are detailed within the section on road traffic. Workers will most probably be accommodated in the city and not in separate camps near the site.

The impact on community health and safety is expected to be low.

Impact of/on	Sensitivity	Extent of Impact on/by	Duration of Impact	Direct/ Indirect
Community Health and Safety	■	■	Short term during construction	Indirect

7.1.18.3 Decommissioning of the existing substation

In the course of the construction of the new power plant, the existing substation will be demolished and a new substation within the boundary of the power plant will be constructed and operated.

The decommissioning of the existing substation will result in the generation of hazardous substances and recyclable materials.

Whereas scrap metal is a valuable resource and inert ceramics and other building materials are non-hazardous materials, transformer oil could be assessed to be of hazardous nature because it might contain PCBs. Scrap could be reused and other materials, such as ceramics, could be easily disposed of at controlled disposal sites or used for road- or other construction purposes.

The significant part of the decommissioning is the management of the transformer oil, because of its potential content of PCBs.

In former times, PCBs have been widely used as coolants and lubricants in transformers, capacitors, and other electrical equipment because PCBs possess good insulating properties and are fire retardant.

In general, the acute toxicity of PCB is small, but looking at the chronic effects a high toxic potential of PCBs has to be stated. Especially when burned, PCBs can be turned into highly toxic and carcinogenic furans (PCDF) and dioxins (PCDD). Therefore special care has to be put on this issue.

According to US EPA, a transformer is ‘a transformer that contains PCB’ if the concentration of PCBs is higher than 500 ppm. Oil containing between 50 and 499 ppm PCBs is considered to be polluted with PCB and specific methods for disposal are necessary (e.g. specific incineration plants). According to EU Directive 75/439/EEC and amendments oil containing less than 50 ppm PCB can be burned in a regular incineration plant.

The oil will be analysed and tested for PCB in a Turkmenenergo owned laboratory. If it contains PCB, it will be transferred to Turkmen Petrochemical Company at Turkmenabat for interim storage and later incineration if suitable incinerators that can burn the oil with the respective needed high temperatures are in place.

Transformer oil not containing PCBs will be stored at suitable storage areas of Turkmenenergo for further use in other substations.

The material management resulting from the decommissioning of the substation is assessed as follows:

Impact of/on	Sensitivity	Extent of Impact on/by	Duration of Impact	Direct/ Indirect
Decommissioning				
Scrap metal	■	+	Long term after operation	Direct and indirect
Ceramics	■	■	Long term after operation	Direct and indirect
Transformer oil	■■	■■	Long term after operation	Direct and indirect
Non-hazardous waste	■	■	Long term after operation	Direct and indirect

If recycling and waste management procedures are respected, the impact is assessed to be low.

Recycling and Waste Management procedures and provisions according to national and international standards will have to be planned for the decommissioning phase and foresee complete dismantling of the power plant.

7.2 Environmental and Social Impacts during Operation Phase

7.2.1 Electricity supply and electricity export

The Project is expected to increase stability of the electricity supply, especially if a raising demand is expected. This creates a locally positive impact of the Project. The export of electricity is expected to be regionally positive.

Good Coordination between both countries will remain essential during construction and operation phase.

Impact of/on	Sensitivity	Extent of Impact on/by	Duration of Impact	Direct/ Indirect
Electricity Supply Electricity Export	-	✦ ✦✦	Long term	Direct

7.2.2 Disaster risks and natural hazards

<u>Explosion Hazards</u>

The turbine is fuelled by flammable natural gas that is lighter than air. In case of a leak, the gas disperses quickly making ignition possible at the point of release. When released in an enclosed area an explosion or a flash fire cannot be excluded. In order to avoid an explosion, all the facilities and supply lines must conform to the standards and legal requirements. Furthermore, all the necessary safety measures for accident prevention must be installed.

Regarding the measures incorporated into the design of the plant to minimize its fire and explosion risk, the plant is not anticipated to pose a potential significant risk to other facilities in the vicinity of the site.

Natural Hazards

Natural hazards during operation are related to possible earthquakes (seismic risk) that may lead to the damage of plant buildings and other infrastructure.

It is anticipated that the power plant will be designed to conform to the relevant seismic criteria sufficient to withstand the level of seismic activity experienced in the area (see Chapter 5.1.3). Therefore, the risk during operation is assessed to be low.

Impact of/on	Sensitivity	Extent of Impact on/by	Duration of Impact	Direct/ Indirect
Disaster Risks and Natural Hazards	■■	■	Long term	Direct and indirect

7.2.3 Gas supply

Gas supply for the power plant is planned from a main pipeline with sufficient pressure located near the selected power plant site. The additional impact of a gas off-take station is assessed to be low.

Impact of/on	Sensitivity	Extent of Impact on/by	Duration of Impact	Direct/ Indirect
Gas Supply	■	■	Long term	Direct

Specific measures to minimize gas leaks need to be included in the provisions of the constructor and operator.

7.2.4 Noise

The planned Open Cycle Gas Turbine (OCGT) Power Plant conforms to the requirements of BAT with respect to noise. Harmful noise levels as an occupational health issue will be in the acceptable range of international standards. The noise level in the near zone (at a distance of 1 m from the source of noise, at the level of 1.2 m above the ground) will not exceed 85 dB (A), and in the far zone (distance of 120 m from the entire plant, at the height of 1.5 m above the ground level) will not exceed 65 dB(A).

During plant operation noise emissions will be caused by gas turbines, air compressors, pumps and emergency diesel engines. According to the IFC's General EHS Guidelines, *'no employee should be exposed to a noise level greater than 85 dB(A) for a duration of more than 8 hours per day without hearing protection'*. In case this limit is exceeded workers shall wear ear plugs. Together with further noise reducing measures (like preference of low noise equipment and use of noise silencers) and regular control of noise during operation impacts of noise emissions on workers can be reduced to a low level.

Environmental noise, harmful for any inhabitants living in the closer vicinity of the proposed plant, will not be an critical issue. The operation noise level at the site boundary will meet international standards (70 dB(A) during day and night) (see Chapter 3.4.3). Considering that there are no residential receptors within 2000 m of the construction site and that the allowed values are estimated at the plant boundary and noise levels are decreasing with the corresponding increase of the distance to the noise source, it is not expected that noise during operation will be a critical issue resulting in a significant impact.

The ventilation of the turbines are the biggest noise emitters (Lw in dB(A) of max. 85 dB (A) at the source). Given the distances to noise receptors in the Project area the sensitivity is low. The impact of noise can be considered as low.

Specific design mitigation measures to minimize noise impacts include:

- air compressors shall be equipped with silencers
- noisy outdoor equipment shall be designed to a noise limit of 85 dB (A) at 1 m distance.

In addition, plant workers will be provided with protective wear in plant areas with high noise levels. The power plant shall operate in accordance with internationally accepted health and safety measures.

Impact of/on	Sensitivity	Extent of Impact on/by	Duration of Impact	Direct/ Indirect
Noise	■	■	Long term	Direct

7.2.5 Ambient air quality impacts

In order to assess the impact on air quality derived from the activity of the future Zerger Open Cycle Gas Turbine Power Plant (400 MW OCGT PP) and the cumulative impacts of the future Zerger Gas Turbines (3 x 50 MW GTs), an Air Dispersion Calculation was performed using the internationally recognized modeling software BREEZE AERMOD. The expected ambient air concentrations of NO_2, CO, PM and SO_2 were modeled

and the comparison with national and international Air Quality Standards (AQS) allowed the perception of the contribution of the power plants for the degradation of the airshed in the area where they will be installed.

Some sensitive receptors were identified in the area, namely the site itself and the settlement areas situated Northwest, North and Northeast of the power plant.

A monitoring campaign for NO_2, SO_2 and TSP was performed between 6 and 8 August 2012 by the Center of Ecological Monitoring of Turkmenistan. The measurements, performed for hourly and 10 minutes periods, were taken in three spots, namely:

- Spot 1: at the proposed project site
- Spot 2: at the side of the road M-37
- Spot 3: in Zerger settlement.

Table 7-1 below presents the average of the results of the 3 days of the campaign. Since the measurements were made for hourly and 10 minute averages.

These monitoring data were used to assess the overall expected air quality values in the area, that is, the concentrations resulting from both installations‘ operation summed with the concentrations presently affecting the area. This exercise was only made for the pollutants for which annual, hourly and 10 minutes standards are defined (given the fact that the monitoring data were collected on these time basis).

Pollutants	**Concentration [µg/m^3]**	**TKM AQS [µg/m^3]**	**International AQS [µg/m^3]**
Spot 1 - At the proposed project site			
TSP - 1 hour	336	500	not available
NO_2 - 1 hour	55	85	200
SO_2 - 1 hour	76	500	not available
SO_2 - 10 min	70	500	500
Spot 2 - At the side of the road M-37			
TSP - 1 hour	308	500	not available
NO_2 - 1 hour	58	85	200
SO_2 - 1 hour	75	500	not available
SO_2 - 10 min	63	500	500
Spot 3 - In Zerger settlement			
TSP - 1 hour	392	500	not available
NO_2 - 1 hour	88	85	200
SO_2 - 1 hour	103	500	not available
SO_2 - 10 min	83	500	500

Compliance Non compliance

Table 7-1: Summary of the results of the 3 day air quality monitoring campaign and comparison with the annual Air Quality Standards

Results of the Air dispersion calculation:

The following table shows the modeled NO2 concentrations in Zerger settlement. NO2 has been identified as the most critical emission of the power plant.

	Considering only the projects' contribution				
	Maximum modeled NO_2 [µg/m³]		International AQS [µg/m³]		TKM AQS (MPC) [µg/m³]
Location	1 hr	Annual	1 hr	Annual	
Absolute max. point	83.3	2.1	200	40	85
Spot 1 At the site	83.3	2.1	200	40	85
Spot 2 = SR2 Road M-37 side	9.9	0.09	200	40	85
Spot 3 = SR3 Zergyar	10.3	0.04	200	40	85
SR1 Military camp	15.2	0.35	200	40	85

Table 7-2: Maximum simulated 1 hr and annual NO_2 concentrations and comparison with the air quality standards

Table 7-2 shows the expected maximum NO_2 ground level concentrations derived from the plants' operation are below the national and international standards in the whole assessment area. These values are expected to be found in a distance between 300 and 500 meters from the stacks. Lower maximum values are predicted to be found at the road M-37 side (spot 2, SR2).

Nevertheless, the maximum ambient NO_2 concentrations expected to be derived from the projects' operation reach, in the vicinity (300-500m) of the installations, more than 25% of the applicable AQS. This means that a future development directly at the projects' site shall be planned carefully.

The international NO_2 AQS is fulfilled in the whole extension of the project area, even when the baseline concentrations and cumulative impacts from the additional Gas Turbines are considered.

The contribution of the projects for the CO concentrations on the ambient air is expected to be very low, reaching less than 1% of the international AQS in the whole assessment area.

There is no information concerning the existent CO concentrations in the area. Therefore, the analysis of the overall predicted future air quality situation for the area could not be performed. On one hand, however, an exceedance to the international AQS is not expected, and according to the experience, high levels of CO are normally not found in open air areas. On the other hand, the contribution of the project for the CO concentrations is expected to be insignificant and not leading to raising these pollutant's levels above the international standard.

The simulation of the contribution of the projects for the particulates concentration in the area took into account only the fuel oil combustion in the OCGT PP, which is expected to occur 200 hours per year. This fact, associated with the usage of the BATs to guarantee the fulfilment of the international emission limit values, conducted to a very low importance of these pollutant's emissions in the assessment area.

The international and national AQS are expected to be fulfilled and the air quality impact derived from the PP's emissions represents insignificant percentages of these values.

Nevertheless, there are presently very high levels of PM registered in the area. This is most certainly due to natural reasons, like sand storms.

Also SO_2 emissions are expected to occur for 200 hours per year, when fuel oil is used in the OCGT PP. Therefore, the concentrations predicted are largely below the air quality standards.

When considering the baseline concentrations in order to obtain an overall prediction of the future air quality levels in the area, the 10 min international standard and the national standard are still expected to be fulfilled. This is predicted to happen despite the fact that the existent concentrations are much higher than the ones expected to be generated by the plant's operation.

An analysis in this context for the 24 hr means was not possible due to the lack of measurements in this specific time basis.

The following tables presents the summary results of the ADC for different situations 20012 and 2013 added to the baseline at the plant site and at the sensitive receptor level.

At the proposed project site					
Pollutant	**International AQS [µg/m³]**	**Greenfield site Baseline Air Quality [µg/m³]**	**Maximum Resulting Air Quality [µg/m³]**		
			Greenfield Baseline + CCGT	**Greenfield Baseline + 3 GT (= Baseline 2013)**	**Greenfield Baseline + 3 GT + OCGT**
NO_2 1 hr	200	55	131.2	103.5	138.3

NO_2 1 yr	40	N.A.	N.C.	N.C.	N.C.
CO 8 hr	10,000	N.A.	N.C.	N.C.	N.C.
PM 24 hr	25	N.A.	N.C.	N.C.	N.C.
PM 1 yr	10	N.A.	N.C.	N.C.	N.C.
SO_2 24 hr	20	N.A.	N.C.	N.C.	N.C.
SO_2 10 min	500	70	81.8	70 [1)]	84

Table 7-3: Maximum NO_2 and SO_2 concentrations and comparison with the air quality standards - considering the existing concentrations and the both PPs' contribution at the plant site (max ground level concentrations at 300-500m distance of the plant)

In Zerger Settlement					
Pollutant	**International AQS [µg/m³]**	**Greenfield site Baseline Air Quality [µg/m³]**	**Maximum Resulting Air Quality [µg/m³]**		
			Greenfield Baseline + CCGT	**Greenfield Baseline + 3 GT (= Baseline 2013)**	**Greenfield Baseline + 3 GT + OCGT**
NO_2 1 hr	200	88	93.6	93.4	98.3
NO_2 1 yr	40	20	22.1	20.0	22.1
CO 8 hr	10,000	N.A.	N.C.	N.C.	N.C.
PM 24 hr	25	N.A.	N.C.	N.C.	N.C.
O_2 24 hr	20	N.A.	N.C.	N.C.	N.C.
TSP 1 yr	10	300	300	300	300
SO_2 10 min	500	83	83.8	83 [1)]	85

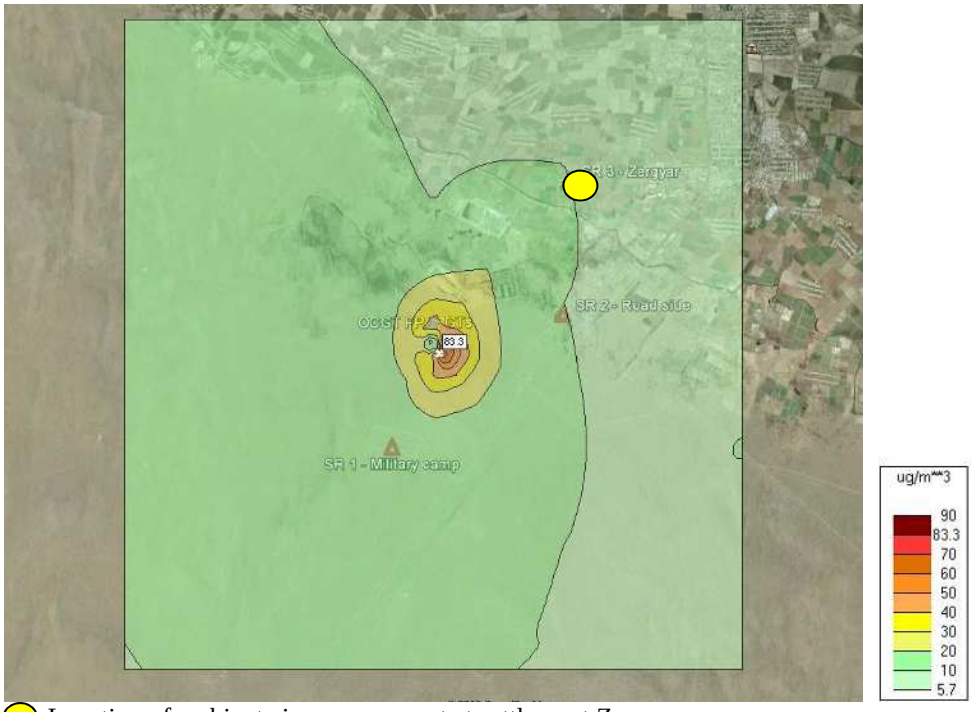
Table 7-4: Maximum NO_2 , TSP and SO_2 concentrations and comparison with the air quality standards - considering the existing concentrations and the both PPs' contribution at sensitive receptor level.

The results confirm the existence of high baseline levels of TSP in the area, although below the national AQS. The highest concentrations are found in the Zerger settlement and that the values in the two remaining points are very similar. These results are comprehensible since existing industrial emission sources are concentrated in Zerger (spot 3), while the project site (spot 1) and the road M-37 (spot 2) are located in the desert area.

The 1 hr baseline concentrations of NO_2 in Zerger settlement are below the international standard. The international NO_2 AQS is fulfilled in the whole extension of the project area, even when the baseline concentrations are considered. The project will have a small incremental impact on NO_2 levels

(2.5% of the NO_2 1-hr as referenced in World Bank EHS guidelines) at the nearest settlement in Zerger, which lies in a non-degraded airshed in terms of international standards for NO2. If national standards are applied, the incremental impact is still small (5.7% of the national standard.

The TSP concentrations are high, but a comparison of TSP with PM_{10} / $PM_{2.5}$ and application of WHO standards is not appropriate. The Interim Target 1 for PM_{10} and $PM_{2.5}$ will be more appropriate for Turkmenistan given its developing country status. If one compares with this standard, given the normal fraction of PM_{10} and PM $_{2.5}$ in TSP, the ambient standards may be complied with.



Location of ambient air measurement at settlement Zerger

Figure 7-5: Simulation of NO_2 emissions by the Powerplant.

Note: The graphical dispersion diagram is a simplified representation of the values calculated by the model for each quadrant (Grid 1: 40 m increment; Grid 2: 500 m increment). More detailed representations show that there are areas within the lines of equal concentration, which have higher or lower values than the indicated concentration of the area. In any case, the calculated concentrations (tables) at the designated points (receptors) are the correct values and these are given in the tables. The represented plume is only an approximation and a visualization of the overall concentration levels.

The simulation of NO_2 emission dispersion shows that settlement areas and other sensitive receptors are affected by very low concentrations of the plume of the power plant. Whereas the baseline level at Zerger settlement is 88 The plant does not contribute to an exceedance of international AQS in the settlement area.

The IFC guidelines state that the emissions from a single project should not contribute with more than 25% of the applicable ambient air quality

standards to allow additional, future sustainable development in the same airshed.

The results show that the increment in the NO_2 annual mean is less than 25% of the respective AQS in the whole assessment area, which goes in line with the IFC recommendations.

The model results reveal that it is not expected that the sensitive receptors are affected by high levels of pollutants originated by the projects' operation. Besides the fact that BATs will be used in order to fulfill international emission limit values, the predominant wind directions (from North) allow the dispersion of the pollution plume away from the residential areas.

The Project Implementation Consultant shall develop a proposal to assist the borrower in minimizing pollution from the existing polluting sources in the vicinity of the plant, especially the open dump site.

Impact of/on	Sensitivity	Extent of Impact on/by	Duration of Impact	Direct/ Indirect
Air Emissions/ Ambient Air Quality	■■	■■	Long term	Direct

7.2.6 Water supply

Water supply during operation is used for process water supply, drinking water supply and fire fighting system. The level of detail of technical planning at this stage is not sufficient to exactly quantify potential impacts.

Process Water Supply System
For the selected technological option OCGT, the required process water supply is minimized to max. 75 m³/h. This reduces the potential impact on water resources to a low level.

For transporting raw water from the canals to the power plant, a new pipeline with a length of 6.5 km will be necessary. As the pipeline is designed it leads across municipality lands without creating resettlement impacts. Environmental impacts are considered to be low.

The location of the raw water intake from the canal and the water discharge must be arranged in a way to prevent recirculation of water. The intake shall be equipped with a pumping station mechanical screen in order to prevent fish being caught in the water intake.

Water from GLK Collector has been selected as the preferable water source as the high salinity of the groundwater gives reason not to select this source for further use (about 10 times higher than the salinity of canal water).

Furthermore the information on ground water is very limited (Analysis and availability) and possible use must be checked in future project phases by

taking several analysis as well as checking the availability by long term pumping tests. Therefore, the primary process water source and basis for this EIA is recommended to be canal water from the GLK collector.

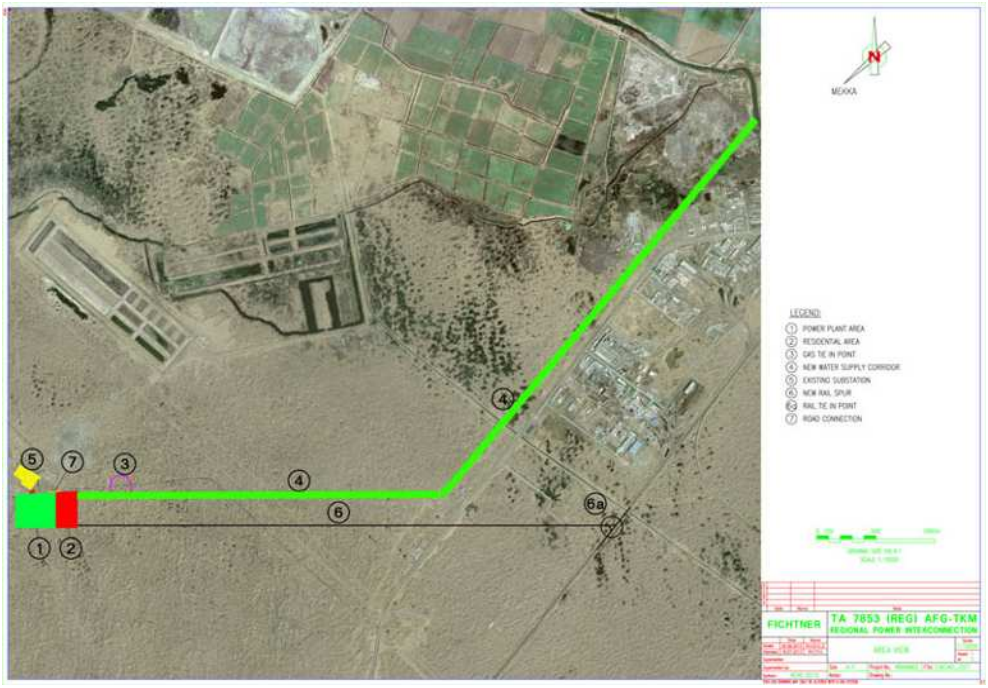


Figure 7-6: Process Water Supply Pipeline from GLK Collector

Drinking Water System

Drinking water will most likely be delivered by tank loads till water treatment facility start operating on the existing power plant and stored in a specific storage tank. Safety of drinking water in the storage tank should be regularly monitored.

Fire Fighting Water System

Water for the fire fighting system will be provided from a storage tank in order to have a regular and reliable water supply. The storage tank will be filled with saline ground water for.

It is recommended to provide two small pumps for maintaining permanent pressure in the fire mains, with automatic start-up in case of loss of pressure in the system. The water distribution circuit will be fitted with hydrants to connect hoses. The pumps will be installed at ground level.

Oil tanks will be provided with a foam fire extinguishing system consisting of a mixing foaming agent, with water delivered by the fire mains. To further enhance the reliability of the fire fighting system, a source of water supply from the overhead tank is also envisaged as a backup in the event of a power failure disabling the mains pumps.

Mitigation Measures include:

- monitoring of water supply from GLK Collector via pipeline or from groundwater well as per technical specifications by construction contractor
- fire fighting water supply, storage and pumping of water for firefighting needs to be assured
- implementation of storage and pumps
- accessibility and contingency planning
- regular drinking water supply and quality control of drinking water.

Impact of/on	Sensitivity	Extent of Impact on/by	Duration of Impact	Direct/ Indirect
Water Supply	■■	■■	Long term	Direct and indirect

7.2.7 Process wastewater

The process water will be taken from the water supply after desalination (e.g. via reverse osmosis). Demineralized water as boiler feed water will be produced from desalinated water by ion exchange (mixed bed) or by a electro-deionization system.

After utilization the desalinated and heated process water, a part stream ("blow down") will be rejected. The blow down, together with the concentrate of the reverse osmosis (RO) facility will be mixed and if needed further treated in a treatment facility. The treated wastewater is then mixed with the waste water of the other sources and then discharged to the retention pond

The different waste water streams must be treated in the waste water treatment plant. Surface water from unpolluted areas may be used directly for irrigation or sent directly to the canal.

The wastewater system shall be designed to also handle the wastewater from all processes, buildings and installations. This water has to be treated to avoid environmental pollution and to meet the waste water standard.

It is assumed that the limits of discharge shall be complied with at the discharge point after mixing of all wastewater streams. During the design phase of the waste water treatment plant, some effluent parameters should be discussed and assessed in more detail:

The wastewater resulting from the construction phase, especially from boiler cleaning and pickling, has to be evaluated under the listed limits of discharge. Especially the Total Dissolved Solids and concentration of heavy metals have to be considered.

The concept for the wastewater system is as follows:

Wastewater from process plants shall be treated in each plant or building according to its composition, for example by an oil separator or by a neutralization plant. This wastewater shall be collected in a central process wastewater basin, which then shall be pumped to the discharge point. Separated oil shall be collected and disposed of off-site (further treatment or incineration in external facilities).

A further basin will be provided to collect all water for irrigation (if direct irrigation will be possible in future).

All plant buildings shall have drain pits to collect floor wash water and other process discharges. These pits shall be connected to the network of wastewater drains outside the buildings.

Also transformer oil pits shall be connected to the oil separator system.

The regeneration flow from the demineralization plant and other chemical drains shall be discharged into a neutralization tank and chemicals added for neutralization. The neutralization tank shall be provided with an acid- and alkali-proof lining. A mixing nozzle or ejector system at the outlets of the recirculation pipes shall be provided for thorough mixing of the wastewater. Pipes, valves and fittings shall be of corrosion-proof material to withstand attack by sulphuric acid, caustic soda and the salts of both. The neutralized wastewater shall be discharged to the canal via the central waste water basin.

Sanitary wastewater from the plant shall be treated in a sewage treatment plant, consisting of a common septic tank for all buildings, and shall then be made available for irrigation or for discharge to the canal. The wastewater quantity for design purposes will be 150 l/ person / day.

Rainwater shall also be collected and made available for irrigation. The rainwater system shall be designed to handle the maximum rainfall.

Fire fighting water shall be discharged via a fire fighting water retention basin to the canal. The fire fighting water retention basin shall only be used in case of fire fighting.

For the reason of temperature adjustment a retention pond shall be constructed with the function of ensuring, by using a remaining amount of water, that the acceptable conditions of the water discharge (applicable for irrigation purposes or discharge to the channel) are kept. The temperature of the rejected water shall not alter the temperature of the collector in the case of rejection. The temperature of the collector reaches maximum 26-28 °C in summer.

There is no increase of temperature and no significant increase in salinity of the discharge water compared with the supply water from the drainage canal.

The discharge system has enough capacity to accept the wastewater, from the power plant.

Since the process is not handling any hazardous chemicals, storm water will simply be directed offsite without treatment.

The water has to be treated to avoid environmental pollution and to meet the World Bank standards and local/national standards for Turkmenistan which will be part of the plant specifications.

Impact of/on	Sensitivity	Extent of Impact on/by	Duration of Impact	Direct/ Indirect
Process Wastewater	■■	■ / ■■	Long term	direct

7.2.8 Solid and liquid waste

Solid Waste
Solid wastes generated during plant operation include mixed utility waste, absorbents, and filtering materials, cleaning tissues and protective clothing as well as slurry from water treatment. Generally the quantities generated during operation of the power plant will be limited.

Oil storage
Oil polluted wastewater will be treated by oil separators. The wastewater system of the power plant shall be designed to also handle the waste water and sewage from all buildings and installations. Oil from separator will be stored accordingly together with other used oil.

Grease
Grease will be stored accordingly in order to avoid water or soil pollution. If it needs to be disposed of a suitable disposal site needs to be selected.

Especially if solid waste contains hazardous materials (see Chapter 7.1.12), they may pollute surface and groundwater and contaminate soil in the Project area. These wastes also mean a hazard to workers' health if they are stored, handled and disposed of in an improper way. Without applying mitigation measures impact of solid wastes on water, soil and worker's health are assessed to be medium regarding the operation phase.

Impact of/on	Sensitivity	Extent of Impact on/by	Duration of Impact	Direct/ Indirect
Solid Waste	■	■■	Long term	direct

To avoid such impacts, solid wastes shall be separated in hazardous and non-hazardous wastes. Hazardous wastes shall be treated adequately under compliance with international standards. Non-hazardous wastes shall be collected and disposed of by waste disposal contractors and land filled in an approved municipal waste disposal facility. Relevant international guidelines regarding adequate solid waste management are IFC's General

EHS Guidelines "Waste Management" (April 2007) as well as IFC' EHS Guidelines on "Thermal Power Plants" (December 2008).

Best industry practices shall be adopted for the management of solid hazardous waste on site and monitoring is required to ensure the implementation of good management practices during operation. Also, an audit of the disposal procedure shall be done.

If solid waste is stored, handled and treated adequately, the impact on water and soil resources of the Project area as well as on worker's health are assessed to be low.

Liquid Waste

Liquid wastes generated during construction include wastewater (e.g. sewage) and other effluents from the construction activities.

Liquid wastes, especially if they contain hazardous substances (see Chapter 7.1.12) may pollute water (irrigation channels, groundwater) and soil of the Project area. This includes for example material storage run off and soil run off (storm water/ flood water) arising from rain and containing oil, grease, silt and/or other substances. If liquid wastes are stored, handled and disposed of improperly (e.g. storage in open canisters) they can also mean a hazard to workers' health. Without applying mitigation measures impact of liquid wastes on water, soil and worker's health are assessed to be medium regarding the operation phase.

Impact of/on	Sensitivity	Extent of Impact on/by	Duration of Impact	Direct/ Indirect
Liquid Waste	■	■■	Long term	Direct

Therefore, all liquid wastes containing hazardous substances shall be separated from other liquid waste and treated adequately in order to avoid potential impacts (e.g. storage in septic tanks). International guidelines shall be adopted for the management of liquid hazardous waste. Relevant international guidelines regarding adequate liquid waste management are IFC's General EHS Guidelines "Waste Management" and "Wastewater and Ambient Water Quality"(April 2007) as well as IFC' EHS Guidelines on "Thermal Power Plants" (December 2008).

If liquid waste is stored, handled and treated adequately, the impact on water and soil resources of the Project area as well as on worker's health are assessed to be low.

In general, principles of waste minimization shall be followed: (1) reduction of waste quantity, (2) recycling as much as possible, (3) proper dumping of remaining waste.

For impact avoidance/ mitigation, run off shall be controlled (periodic inspection) and adequate site drainage shall be performed. Regular vehicle maintenance and sewage treatment shall be enforced.

7.2.9 Occupational health and safety

Occupational Noise

During plant operation noise emissions will be caused by gas turbines, air compressors, pumps and emergency diesel engines. According to the IFC's General EHS Guidelines, *'no employee should be exposed to a noise level greater than 85 dB(A) for a duration of more than 8 hours per day without hearing protection'*. In case this limit is exceeded workers shall wear ear plugs. Together with further noise reducing measures (like preference of low noise equipment and use of noise silencers) and regular control of noise during operation impacts of noise emissions on workers can be reduced to a low level. Buildings for worker accommodations will have to be built in sufficient distance and noise insulated according to best practice to match international guidelines.

Spread of Diseases

Spreading of different communicable diseases is also a topic during the operation phase. To avoid a spread of serious diseases workers should be made aware of health implications and preventative measures. Information campaigns to all workers should be obligatory.

Accident Risks and Safety Hazards

Potential accident risks and safety hazards during the operation phase are e.g. related to equipment failures, leaking or spilling of hazardous substances, fires, explosions and electric dangers. Accidents and injuries may be also due to a lack of work safety measures. This particularly concerns the use of harmful substances and waste management.

To meet these safety risks, adequate safety protection measures (e.g. establishment of safety and security notices for hazardous materials, provision of protective equipment), record of accidents, injuries and incidents, spills, fires and other emergencies and training for workers are necessary. With the provision of a high standard of health and safety management, the occupational health and safety risks for workers associated with plant operation will be minimized so that they are not significant.

In order to meet the health and safety risks from noise emissions, drug abuse, potential accidents and safety hazards, an EHS Management System/ Plan shall be developed and implemented during operation, including regular EHS Audits and training of the workers. Instructions on emergency measures necessary to safeguard employees shall be prepared.

Fire Fighting

Water for firefighting is taken from the raw water/firefighting storage tanks. These tanks shall be designed so that the storage capacity required for firefighting is always maintained, which means it cannot be used for other purposes. Fire water will be stored in the on-site 5,000 m^3 storage tank. This storage capacity will be sufficient to provide the maximum automatic

system demand plus 1.9 m^3 per minute (as recommended by NFPA 850) for a 2-hour period.

The fire water pumping system will consist of a primary motor-driven pump, a diesel-driven backup pump with independent fuel supply, and a pressure-maintaining jockey pump.

The firefighting water system shall comprise the following major components:

- Firefighting water pump station with 2 x100 % electrically driven pumps connected to a power supply fed by an emergency diesel set as emergency power supply
- underground main piping system (ring system) with:
    - isolating valves for sectionalizing
    - connection lines to the various buildings
    - outdoor hydrants of underground types for connection to main pipe
    - indoor water hose reels for various buildings
    - foam/water hydrant facilities for fuel oil tank area and for other areas, if applicable according to the bidders' requirements.

Further firefighting, protection and detection systems comprise:

- spray water systems, such as for oil-filled transformers, lube oil facilities, etc.
- CO_2 systems for electrical facilities, if applicable according to the bidders' requirements
- mobile fire protection equipment
- firefighting control system
- fire alarm and detection system

Impact of/on	Sensitivity	Extent of Impact on/by	Duration of Impact	Direct/ Indirect
Noise Emissions	■■	■	Long term	direct
Spread of Diseases	■■	o	Long term	indirect
Accident Risks and Safety Hazards	■■	■	Long term	direct

Operational and Community Health Safety Plans:

A detailed Operational Health and Safety as well as a Community Health and Safety Plan, according to IFC EHS standards, shall be established during the construction phase, before commencing operation.

The Operational Health and Safety Plan (OHSP) should:

a) identify and minimize, so far as reasonably practicable, the causes of potential hazards to workers, including communicable diseases
b) provide preventive and protective measures, including modification, substitution, or elimination of hazardous conditions or substances
c) provide for the provision of appropriate personal protective equipment (PPE) to minimize risks, including ear protection, hard hats and safety boots
d) provide procedures for limiting exposure to high noise or heat working environments
e) provide training for workers, and establish appropriate incentives to use and comply with health and safety procedures and utilize PPE
f) include procedures for documenting and reporting occupational accidents, diseases, and incidents; and (vii) include emergency prevention, preparedness, and response arrangements in place.

The Community Health and Safety Plan (CHSP) should include emergency response procedures developed in close collaboration and consultation with potentially affected communities and local authorities, and should address the following aspects of emergency response and preparedness:

a) procedures to identify and minimize, so far as reasonably practicable, the causes of potential Project related hazards to local communities, including communicable diseases such as HIV/AIDs and vector borne diseases
b) specific emergency response procedures
c) trained emergency response teams
d) emergency contacts and communication.

Detailed plans will be established by the EPC Contractor.

In summary, if the HS plans are implemented, the Project's impacts on occupational health and safety are assessed as follows:

Impact of/on	Sensitivity	Extent of Impact on/by	Duration of Impact	Direct/ Indirect
Occupational Health and Safety	■■	■	Long term during operation	Direct

7.2.10 Emission of greenhouse gases / climate change

The impacts of climate change will be a temperature increase, the reduction of humidity and change in rainfall pattern, as well as reduction in available water resources. Climate change is one of the pillars of the Water Management Development Concept of Turkmenistan until 2030.

Gas has been selected as the fuel for the power plant. Compared to other fossil fuel generating technologies, gas fired have a relatively low emissions of carbon dioxide (CO_2) around 3.34 % of flue gas.

For power generation processes, CO_2 is the key GHG emission of concern. Additional emissions from power plant operation are expected to be 1,036,455 tons CO_2 annually.

Item	Parameter	Unit
Efficiency of OCGT	35%	%
Specific CO_2 emissions of OCGT	576	kg CO_2/MWh = t/GWh
Annual CO_2 emissions of OCGT	1,036,455	tons CO_2
CO_2 emission savings	172.7	kg CO_2/MWh = t/GWh

Mitigation measures:
In order to mitigate the additional GHG emission from the power plant operation considerable effort would need to be put in the implementation of CDM development projects. A first step to mitigate Climate Change impacts would be to reduce emissions by converting the power plant into combined cycle in the future.

Impact of/on	Sensitivity	Extent of Impact on/by	Duration of Impact	Direct/ Indirect
Climate change	■■	■■	Long term during operation	Direct and indirect

7.3 Decommissioning

Decommissioning of the Power Plant:
In order not to create an industrial ruin after the life-span of the power plant and cause pollution of the environment by solid and liquid waste and potentially hazardous materials, the power plant will have to be completely dismantled after its life-span of minimum 25-30 years. The materials will have to be recycled and waste will have to be disposed of according to national and international standards. Without applying such measures impacts during decommissioning are expected to be of significance.

Decommissioning of Substation
In the course of the construction of the new power plant, the existing substation will be demolished and a new substation within the boundary of the power plant will be constructed and operated. (see impacts during construction period).

The decommissioning of the substation will result in the generation of hazardous substances and recyclable materials. Transformer oil could be assessed to be of hazardous nature because it could contain PCBs, scrap could be reused and other materials, such as ceramics, could be easily disposed of at controlled disposal sites or used for road- or other construction purposes.

The significant part of the decommissioning is the management of the transformer oil. The oil will be analysed and tested for PCB in a Turkmenenergo owned laboratory. If it contains PCB, it will be transferred to Turkmen Petrochemical Company at Turkmenabat for interim storage and later incineration if suitable incinerators that can burn the oil with the respective needed high temperatures are in place.

Transformer oil not containing PCBs will be stored at suitable storage areas of Turkmenenergo for further use in other substations.

The material management resulting from the decommissioning of the substation is assessed as follows:

Impact of/on	Sensitivity	Extent of Impact on/by	Duration of Impact	Direct/ Indirect
Decommissioning				
Scrap metal	■	+	Long term after operation	Direct and indirect
Ceramics	■	■	Long term after operation	Direct and indirect
Transformer oil	■■	■■	Long term after operation	Direct and indirect
Non-hazardous waste	■	■	Long term after operation	Direct and indirect

If recycling and waste management procedures are respected, the impact is assessed to be low.

Recycling and Waste Management procedures and provisions according to national and international standards will have to be planned for the decommissioning phase and foresee complete dismantling of the power plant as well as the new substation (at the end of life span).

7.4 Cumulative Impacts and Downstream Impacts

Cumulative impacts are impacts that are added to other impacts and may form negative synergies. Given, that the Project life is more than 25 years, potential impact areas of the Project are the following:

Water use

The potential impacts are not assessed in detail because the power plant is planned as an air-cooled system, which by design reduces water consumption to a level of creating negligible cumulative and downstream impacts.

Air pollution

The emissions from the Power Plant are likely to be insignificant. For the time being it is not possible to predict the future situation exactly as the planning for various infrastructure projects is still in infant stage.

The air dispersion calculations predict that cumulative impacts on the sensitive receptors (e.g. settlements in the plant vicinity) will be unlikely to arise. The area affected by the highest concentrations of emissions of the Power Plant is an industrial area occupied by a land fill and large sewage ponds and therefore considered to be unfit for future settlement extension. Other industrial developments are planned to be allocated on the other side of the main road M37.

The existing NO_2 levels (Table 3) are added to the modeled results to obtain the total concentrations expected to be found in the project area when the plants are operating simultaneously. The results are shown in the following table:

At the proposed project site					
Pollutant	**International AQS [µg/m³]**	**Greenfield site Baseline Air Quality [µg/m³]**	**Maximum Resulting Air Quality [µg/m³]**		
			Greenfield Baseline + CCGT	**Greenfield Baseline + 3 GT (= Baseline 2013)**	**Greenfield Baseline + 3 GT + OCGT**
NO_2 1 hr	200	55	131.2	103.5	138.3
NO_2 1 yr	40	N.A.	N.C.	N.C.	N.C.
CO 8 hr	10,000	N.A.	N.C.	N.C.	N.C.
PM 24 hr	25	N.A.	N.C.	N.C.	N.C.
PM 1 yr	10	N.A.	N.C.	N.C.	N.C.
SO_2 24 hr	20	N.A.	N.C.	N.C.	N.C.
SO_2 10 min	500	70	81.8	70 [1)]	84

Table 7-5: Maximum NO_2 and SO_2 concentrations and comparison with the air quality standards - considering the existing concentrations and the both PPs' contribution

In Zerger Settlement					
Pollutant	**International AQS [µg/m³]**	**Greenfield site Baseline Air Quality [µg/m³]**	**Maximum Resulting Air Quality [µg/m³]**		
			Greenfield Baseline + CCGT	**Greenfield Baseline + 3 GT (= Baseline 2013)**	**Greenfield Baseline + 3 GT + OCGT**
NO_2 1 hr	200	88	93.6	93.4	98.3
NO_2 1 yr	40	20	22.1	20.0	22.1
CO 8 hr	10,000	N.A.	N.C.	N.C.	N.C.
PM 24 hr	25	N.A.	N.C.	N.C.	N.C.
O_2 24 hr	20	N.A.	N.C.	N.C.	N.C.
TSP 1 yr	10	300	300	300	300
SO_2 10 min	500	83	83.8	83 [1)]	85

When considering the existent concentrations of NO_2, in the area (baseline), and summing them to the model results (the concentrations derived from

both plants' operation, both having 40 m stacks), the WHO air quality standard for NO_2 is fulfilled at the project site and in Zerger settlement.

Transmission Line Connection to Afghanistan

As the electricity generated by the Power Plant shall be exported to Afghanistan, the transmission line construction in Afghanistan is necessary. Both parts of the Project have a transboundary linkage requiring international coordination and agreement at various levels.

The transboundary impact of the electricity export to Afghanistan is regionally positive.

Impact of/on	Sensitivity	Extent of Impact on/by	Duration of Impact	Direct/ Indirect
Cumulative Impacts	■■■	■■ and ✦✦	Long term	Indirect

8. Summary Assessment of Impacts

Impact of/on	Sensitivity	Extent of Impact before mitigation	Extent of Impact after mitigation	Duration of Impact	Direct/ Indirect Impact	Comment
Landscape and Visual Aspects	■	■	■	Long term during construction	Direct	The construction will be visible from the main road M 37 creating a visual impact for passing vehicles. Being located in the industrial belt of Turkmenabat next to an existing power plant site and various high-voltage transmission lines the landscape is assessed to be not sensitive; there is no present tourist value. The additional visual impact of the power plant and the ancillary infrastructure is assessed to be low. No mitigation required.
Land Use	■	■/O	O	Long term	Direct	The land is owned by the Serdarabat Etrap (Municipality) and there are no existing lease contracts or other permits for land use according to municipality officials. During the site visit no traces of an existing land use could be identified. No mitigation required as shepherds can easily choose another passage.
Soil and Erosion	■■■	■■	■	Long term	Direct	Removal of vegetation shall be minimised. Borders of access roads will be rehabilitated and replanted. Measures to stabilize sand and prevent deflation shall be implemented for all areas where existing vegetation is removed and adjacent areas that are exposed to wind.
Land Acquisition and Resettlement	■	O	O	-	-	Land use is officially and practically inexistent. No resettlement necessary; no mitigation required.
Physical Cultural Resources	■	■	O	Long term	Direct	As confirmed by the Ministry of Culture, there are no cultural sites or historic monuments in the Project area. In case of chance finds, the construction has to be stopped immediately and the Department of Protection of Monuments and Historical Sites has to be informed to agree on further steps. Chance find procedure has to be implemented.

Impact of/on	Sensitivity	Extent of Impact before mitigation	Extent of Impact after mitigation	Duration of Impact	Direct/ Indirect Impact	Comment
Flora and Fauna	■■	■	■	Short term during construction (noise etc.), Long term due to removal of vegetation on the Project site	Direct	Due to the specificity of the Project location (industrial area) the impact is assessed to be low. Noise and dust are not expected to impact flora and fauna at the construction site. Vegetation shall be replanted on unused areas to provide prevention of sand deflation and habitats for birds, reptiles and insects.
Protected Areas and Wetlands	■	O	O	Short term	Direct	The closest protected areas are Repetek Biosphere Reserve (70 km distance) and Amu Darya Nature Reserve (90 km distance). The sensitivity of a protected area is generally assessed to be high, but as no protected area, wetland or sensitive ecosystem is located at the Project site no impact during construction of the Project will occur; no mitigation is necessary.
Traffic	■	■	O	Short term	Direct	Additional traffic on the M 37 is expected. The construction of the gas pipeline will have to cross the main road and block or hinder traffic during the construction period. Following mitigation measures shall be implemented: Signing of the construction site on the M 37 to prevent accidents; access to the existing power plant shall not be blocked during the construction work, a deviation on the M 37 for the time of gas pipeline construction shall be proposed.
Noise	■	■	■	Short term during construction	Direct	Due to the limited time of the construction period and the remoteness of the site, the annoyance of the population by noise generated during construction activities will be low. A proper EHS Management Plan will address the issue ‘noise’ regarding workers. All workers will be fitted with personal protective equipment (PPE)as ear plugs etc.
Air Emissions/ Ambient Air Quality	■	■	■	Short term during construction	Direct	Due to the characteristics of the area, the distance to settlements and a predominant wind direction from North-Northeast most of the dust and construction emissions will be blown into the desert and will not impact settlement areas. The sensitivity of the site is assessed to be low and the generated impact on the air quality will be marginal. For impact mitigation, construction vehicles shall be properly maintained and speed limits shall be respected in order to minimize generated emissions and dust.

Impact of/on	Sensitivity	Extent of Impact before mitigation	Extent of Impact after mitigation	Duration of Impact	Direct/ Indirect Impact	Comment
Water Supply Surface Water Groundwater	■ ■	■ ■	■ ■	Short term during construction	Direct and indirect	Drinking water supply for workers will be done by truck/ water tank till water treatment facility start operating on the existing power plant. Health and safety aspects of drinking water supply need to be respected. Water for construction purposes as well as for dust reduction (spraying) will be brought by truck as long as the water supply pipeline is not operational. Due to its high salinity, groundwater consumption during construction will be limited. The impact on water resources resulting from water supply and consumption will be low during the construction period
Solid Waste (generated by construction activities and by workers)	■■	■■	■	Short term during construction	Direct and indirect	Without applying mitigation measures impact of solid wastes on water, soil and worker's health are assessed to be medium. All solid wastes containing hazardous materials shall be separated from other solid waste and treated adequately under compliance with international standards in order to avoid potential impacts. Fuels, chemicals and lubricants shall be stored in bounded areas with impervious ground. Non-hazardous solid waste shall be collected and disposed of by licensed waste contractors and land filled in an approved municipal waste disposal facility in compliance with local and international standards. Relevant international guidelines regarding adequate solid waste management shall be respected
Liquid Waste (generated by construction activities and by workers)	■■	■	■	Short term during construction	Direct and indirect	Only low amounts of wastewater will be produced temporarily by workers at the construction site. For impact avoidance/ mitigation, soil run off shall be controlled (periodic inspection) and adequate site drainage shall be performed. If liquid waste is stored, handled and treated adequately, the impact on water and soil resources of the Project area as well as on worker's health are assessed to be low. Respect of international safeguards and guidelines shall be obligatory.
Hazardous Materials	■■	■	■	Short term limited to construction period	Direct and indirect	Due to the limited quantity of hazardous materials used during the construction period the impact on water and soil resources of the Project area as well as on worker's health are assessed to be low. Hazardous materials as hydrocarbons, explosives and others, shall be stored, handled and treated respecting national and international guidelines.
Natural Disaster Risks	■■	■	O	Long term	Indirect	Natural hazards during construction are related to possible earthquakes (seismic risk) that may lead to the damage of infrastructure, as well as dust storms that may disturb and delay the construction activities. Infrastructure needs to be constructed respecting earthquake safety standards.

Impact of/on	Sensitivity	Extent of Impact before mitigation	Extent of Impact after mitigation	Duration of Impact	Direct/ Indirect Impact	Comment
Ethnic Minorities	■■	■	O	Short term	Indirect	The Project does not have impacts on ethnic minorities. No settlements are concerned. Local population shall have a priority.
Gender Issues	■■	■	O	Short term	Indirect	Women shall not be disadvantaged.
Population Influx / Worker's Accommodation	■	■	■	Short term	Indirect	It is not expected that the Project will create a large influx of population during the construction period. Provisions regarding health, safety and security will need to be implemented. Especially, conflicts other negative social phenomena shall be prevented.
Workforce / Generated Employment	■■	✦	✦	Short term limited to construction period	Direct	During the construction period local workforce will be employed for the construction works. This will contribute to monetary income.
Occupational Health and Safety	■■	■■	O/■	Short term during construction	Direct and indirect	In order to meet the health and safety risks from noise and dust emissions, spread of diseases and potential accidents, an EHS Management System/ Plan shall be developed and implemented during construction, including an EHS Audit on the construction site and training of the workers. Good local and international construction practice in, Environment, Health & Safety (EHS) shall be applied at all times.
Community Health and Safety	■	■	■	Short term during construction	Indirect	The impact on community health and safety is expected to be low.
Decommissioning of the existing substation	■■	■■	■	Short term during construction	Indirect	Recycling and waste management procedures and provisions according to national and international standards will have to be planned for the decommissioning of the existing substation, especially related to analysis and treatment of oil containing equipment.

Extent of impact:

■■■ = high negative
■■ = medium negative
■ = low negative
O = nil
✦ = locally positive
✦✦ = regionally positive

Extent of sensitivity

■■■ = high
■■ = medium
■ = low

Table 8-1: Impacts during construction phase (under consideration of the proposed mitigation measures)

Impact of/on	Sensitivity	Extent of Impact before mitigation	Extent of Impact after mitigation	Duration of Impact	Direct/ Indirect Impact	Comment
Electricity Supply, Electricity Export	-	✦ / ✦✦	✦ / ✦✦	Long term	Direct	An increased stability of the electricity supply will be reached, especially if a raising demand is expected, which creates a locally positive impact of the Project. The export of electricity is expected to be regionally positive.

Impact of/on	Sensitivity	Extent of Impact before mitigation	Extent of Impact after mitigation	Duration of Impact	Direct/ Indirect Impact	Comment
Disaster Risks and Natural Hazards	■■	■	O	Long term	Direct and indirect	It is anticipated that the power plant will be designed to conform to the relevant seismic criteria sufficient to withstand the level of seismic activity experienced in the area.
Gas Supply	■	■	O	Long term	Direct	Specific measures to minimize possible gas leaks need to be included in provisions of the constructor and operator.
Noise	■	■	O/■	Long term	Direct	Design mitigation measures to minimize noise impacts include: air compressors shall be equipped with silencers; noisy outdoor equipment shall be designed to a noise limit of 85 dB(A) at 1 m distance. In addition, plant workers will be provided with protective wear in areas with high noise levels. The power plant shall operate in accordance with internationally accepted health and safety measures.
Air Emissions/ Ambient Air Quality	■■	■	■	Long term	Direct	The future plant will have a limited influence on the air quality in the Project area especially on the sensitive receptors in the vicinity. The results of the air dispersion modelling show that the expected levels of pollutants resulting from the operation of the power plant will be considerably below national and international Air Quality Standards.
Water Supply	■■	■■	■	Long term	Direct and indirect	Mitigation measures include: monitoring of water supply from GLK Collector; fire fighting water supply, storage and pumping of water for fire fighting needs to be assured; implementation of storage and pumps; accessibility and contingency planning; regular drinking water supply and quality control of drinking water.
Process Wastewater	■■	■ / ■■	■	Long term	Direct	The treated waste water will be rejected to the GLK channel or used for irrigation nearby. The quantities are not expected to change the temperature and quality of the water significantly. Since the process is not handling any hazardous chemicals, storm water will simply be directed offsite without treatment. Oil polluted waste water will be treated by oil separators.
Solid and Liquid Waste	■	■■	■	Long term	Direct	Solid wastes generated during plant operation include mixed utility waste, absorbents, filtering materials, cleaning tissues and protective clothing as well as slurry from water treatment. Liquid wastes generated during construction include wastewater (e.g. sewage) and other effluents from the construction activities. Liquid wastes, especially if they contain hazardous substances may pollute water and soil of the Project area. Generally the quantities generated during operation of the power plant will be limited. If solid and liquid waste is stored, handled and treated according to international safeguards, the impact on water and soil resources of the Project area as well as on worker's health are assessed to be low. An audit of the disposal procedure shall be done.

Impact of/on	Sensitivity	Extent of Impact before mitigation	Extent of Impact after mitigation	Duration of Impact	Direct/ Indirect Impact	Comment
Occupational Health and Safety	■■	■	o	Long term during operation	Direct	In order to prevent the health and safety risks from noise emissions, potential accidents and safety hazards, an EHS Management System/ Plan shall be developed and implemented during operation, including regular EHS Audits and training of the workers. Instructions on emergency measures necessary to safeguard employees shall be prepared.
Emission of Greenhouse Gases/ Climate Change	■■	■■	■■	Long term during operation	Direct and indirect	In order to mitigate the additional GHG emission from the power plant operation considerable effort would need to be put in the implementation of CDM development projects. Provision for annual GHG quantification and monitoring need to be included. A further step to reduce Climate Change impact would be to convert power plant into combined cycle in future.

Extent of impact:

■■■ = high negative
■■ = medium negative
■ = low negative
o = nil
✦ = locally positive
✦✦ = regionally positive

Extent of sensitivity

■■■ = high
■■ = medium
■ = low

Table 8-2: Impacts during operation phase (under consideration of the proposed mitigation measures)

Impact of/on	Sensitivity	Extent of Impact before mitigation	Extent of Impact after mitigation	Duration of Impact	Direct/ Indirect Impact	Comment
Decommissioning						Recycling and waste management procedures and provisions according to national and international standards will have to be planned for the decommissioning phase and foresee complete dismantling of the power plant and the substation.
Scrap metal	■	+	■	Long term after operation	Direct and indirect	Steel will be sold as scrap metal and recycled.
Ceramics	■	■■	■	Long term after operation	Direct and indirect	Ceramic waste may be re-used as material for land levelling (e.g. road or other construction)
Transformer oil	■■	■■■	■■	Long term after operation	Direct and indirect	Oil containing equipment (e.g. transformers) shall be analysed on content of PCB. If the oil is PCB free it might be burnt, otherwise it will need to be recycled or disposed off according to international standards.
Non-hazardous waste	■	■	■	Long term after operation	Direct and indirect	Non-hazardous waste shall be disposed in a proper disposal site / land fill.

Table 8-3: Impacts during decommissioning phase (under consideration of the proposed mitigation measures)

Impact of/on	Sensitivity	Extent of Impact before mitigation	Extent of Impact after mitigation	Duration of Impact	Direct/ Indirect Impact	Comment
Cumulative and Downstream Impacts	■■■	■■ ✦✦	■/■■ ✦✦	Long term	Direct / Indirect	A potential industrial development in Turkmenabat and the development of other sources of emissions / air pollution will need to be controlled by national institutions responsible for environmental monitoring (MNP). A recently constructed additional power plant at the same site will lead to generation of cumulative impacts on the ambient air quality. With the stack height of 15m international standards of NO_2 will be exceeded at the project site, when the 400 MW OCGT will be constructed. Changing the stack height of the existing GTs from 15 to 40 m will lead to a reduction in the contribution of these units for the air quality degradation at the project site area below the international limits values. The transboundary impact of the electricity export to Afghanistan is assessed as regionally positive.

Extent of impact:

■■■ = high negative
■■ = medium negative
■ = low negative
O = nil
✦ = locally positive
✦✦ = regionally positive

Extent of sensitivity

■■■ = high
■■ = medium
■ = low

Table 8-4: Impacts of cumulative and downstream impacts (under consideration of the proposed mitigation measures)

In summary, the results of the environmental assessment demonstrate that the Project will have mostly low impacts on the environment if the proposed EMP is implemented and all proposed mitigation measures are accomplished.

A few impact areas have to be highlighted:

Impacts of Ancillary Infrastructure
Impacts of ancillary infrastructure are assessed to be low. The distances to be bridged by additional infrastructure (access roads, pipelines) are smaller than in alternative areas. A new substation will be built on the territory of the Power Plant. A 220 kV transmission line to substation Chardzhev (National Grid) does already exist (max. 50 m of new electrical connection is needed).

Decommissioning of the existing Substation
In the course of the construction of the new power plant, the existing substation will be demolished and a new substation within the boundary of the power plant will be constructed and operated. The decommissioning of the existing substation will result in the generation of hazardous substances and recyclable materials. Whereas scrap metal is a valuable resource and inert ceramics and other building materials are non-hazardous materials to be reused, transformer oil could be of hazardous nature because it might contain PCBs. The oil will be analyzed and tested for PCB in a Turkmenenergo owned laboratory. If it contains PCB, it will be transferred to Turkmen Petrochemical Company at Turkmenabat for interim storage and later incineration (where suitable high temperature incinerators are to be in place).

Air Emissions and Air Quality:
The future plant will have a very limited influence on the air quality in the area. The results of the air dispersion modeling show that the emissions of the power plant will only have an insignificant impact on sensitive receptors (e.g. settlements). The future plant will have a limited impact on the air quality in the area. An ambient air quality measurement and an air dispersion calculation was carried out in order to assess the existing preloads, and the cumulative impact of the power plant emissions added to the power plant. Also potential future developments were taken into account.

The results of the air dispersion modelling show that, considering only the operation of the power plant, the expected levels of pollutants in the area will be well below the considered (international) Air Quality Standards. However, due to existing pre-loads the standards for PM are exceeded in some areas.

The simulation of NO_2 emission dispersion (cumulative impact of existing pollution and emissions of the power plant) shows that some settlement areas and other sensitive receptors are affected by the plume of the power plant, but with very small concentrations and small increment.

However, for a more comprehensive assessment of existing preloads the EIA shall be updated with a continuous air baseline measurement (summer and winter data) during the construction period in order to monitor existing emission sources and on this basis decide if an investment in reduction of existing air-pollution is necessary.

Water supply and Discharge:
As a result of the selected technology, the water consumption of the plant is minimized. The recommendation from the EIA is to use collector water, because of its 10-times inferior salinity. If for technical/ economic reasons the groundwater option is envisaged, this would create the necessity to carry out a suitable groundwater analysis and modelling. A small pumping station will be installed to facilitate the transport of water through a feed pipe. Power connection is nearby and the pumping station will be located near the road for accessibility. All wastewater from the power plant will be discharged back into the GLK Collector after proper treatment and cooling. The treated wastewater stream to the GLK collector is calculated at a rate of about 70 m^3/h (19 l/sec.). Water losses are estimated to be inferior to 10% and water quality will not change significantly. A discharge of 19 l/sec into the GLK collector (flow 15,000-18,000 l/sec) is expected to have an insignificant impact especially after treatment and cooling in retention ponds.
Wastewater will be treated before being used for irrigation or before rejection to the collector.

Noise
During plant operation noise emissions will be caused by gas turbines, air compressors, pumps and emergency diesel engines. Specific design mitigation measures to minimize noise impacts include air compressors to be equipped with silencers and noisy outdoor equipment to be conform to a noise limit of 85 dB (A) at 1 m distance.

Climate Change Impact
A further step to reduce Climate Change impact would be to convert power plant into combined cycle in future.
All other impacts (i.e. traffic, dust, waste, flora and fauna, health & safety etc.) are assessed to be low or insignificant if the proposed mitigation measures are applied. They can be readily mitigated with compliance to good construction and operation practices.

Main proposed mitigation measures are:

- compliance with good Construction Practices
- vegetation shall be replanted and sand deflation (“sand drift”) prevention measures shall be implemented
- avoidance of air pollution and water pollution during construction
- implementation of a waste management system
- implementation of EHS Management System as per international standards (IFC EHS guidelines).

9. Public Consultations and Disclosure

Meaningful consultation is a process that

a) begins early in the project preparation stage and is carried out on an ongoing basis throughout the project cycle
   (i) provides timely disclosure of relevant and adequate information that is understandable and readily accessible to affected people
   (ii) is undertaken in free atmosphere
   (iii) is gender inclusive and responsive, and tailored to the needs of disadvantaged and vulnerable groups; and
   (iv) consultation will be carried out in a manner commensurate with the impacts on affected communities.

For the present EIA at feasibility level, public consultations have been conducted in a manner commensurate with the impacts on affected communities.

Project stakeholders, national and local administration as well as civil society organisations where consulted to the extent possible in order give their feed-back and recommendations on the selection of the project site, potential impacts on resident population and existing land use, expectations related to the project. Local population (i.e. Fishermen) have been consulted if a risk of any impact has been analysed (i.e. Water-Pipeline). There are no local residents in the vicinity of the project site. No settlements will be affected by the project impacts.

Consultations were held with:

- Regional Energy Utility
- Municipality level institutions of ministries.
- Environmental organisations,
- Local authorities,
- Local fishermen,
- Women representatives

Summary:
Associations as well as view the project area as having no significant impact on flora, fauna, biodiversity as the ecosystem would not be important and distance to existing Protected Areas big.

All interviewed stakeholders confirmed the Project location as suitable and impacts on local population and the local ecosystem as largely inexistent. The land acquisition of 15-20 ha of terrain plus additional ancillary infrastructure at the planned Project site was mentioned to be uncritical by all interviewees. The project will not have direct impacts on the local population. The air emissions are uncritical as the results of the air dispersion modelling show, the water emissions will not have a critically different quality when compared to the quality of the intake water and

temperature of the canal will not be increased due to retention ponds to be constructed to cool down process water. There are no houses in the vicinity of 5km. The only work places within the impact area of the power plant are the workers at the waste disposal site, the operational team at the existing power plant Lebap as well as the employees of the Project: construction workers during construction works and the operational staff during operation phase of the plant.

10. Grievance Redress Mechanism

In the course of the construction process, people affected by the project may suffer from accidental negative impacts. This might happen for various reasons: the contractor does not adhere to sound construction principles, health hazards were incidentally produced, working conditions are found unacceptable, unexpected downstream impacts / environmental pollution were incidentally produced, misunderstandings have arisen and so forth.

In case of accidental environmental pollution the local / national environmental authority will have to be directly informed and legal procedures started.

Distribution of leaflets as well as putting up information boards are an effective way of distributing information including contact addresses and telephone numbers to be contacted.

A professional attitude to accept complaints in a friendly manner and offering all possible help is a crucial qualification for the staff charged with grievance collection.

11. Environmental Management Plan

11.1 Mitigation Measures

11.1.1 Mitigation measures for the construction phase

Issue / Potential Impact	Mitigation Action	Responsibility	Date for Implementation
Institutional Capacities to address environmental issues	• Appoint a responsible person for Environmental issues within Turkmenenergo • Basic induction training for all employees on good construction and site management practice.	MOE, Turkmenenergo	Design phase
Landscape and Visual Aspects	• No mitigation measures required for access road construction, water and gas pipeline connection, electricity connection	Turkmenenergo	During Design and Construction phases
Land Use)	• Land acquisition from Serdarabat Etrap following national procedures • No mitigation measure related to compensation of land use necessary	MOE, Turkmenenergo	Before Construction
Soil and Erosion	• Minimization of cutting of vegetation and removal of topsoil at construction sites. • Replanting of grass/shrubs at construction sites and road sides • Sand Deflation Prevention Plantation • Turkmenenergo to prepare and implement in coordination with relevant local agencies a plan for sand stabilization in the power plant area	EPC Contractor, Turkmenenergo	Before starting construction and during construction period
Land Acquisition and Resettlement	• Land acquisition from municipality (Etrap). No existing land use. No resettlement.	MOE	Before construction
Physical Cultural Resources	• Implementation of Chance Find procedure	EPC Contractor	During construction period
Flora and Fauna	• Determination of necessary laydown areas together with the site manager to prevent the cutting of vegetation. • Instruction of the employees not to disturb animals. • Vegetation shall be replanted on unused areas to provide prevention of sand deflation and habitat for birds, reptiles and insects.	EPC Contractor	During construction period

Issue / Potential Impact	Mitigation Action	Responsibility	Date for Implementation
Protected Areas and Wetlands	• No mitigation measure. No impact on Protected Areas or wetlands.	n.a.	n.a.
Traffic	• Signing of construction site on M37 • The access to the eüisting power plant shall not be blocked during the construction work. • Propose deviation for the time of gas pipeline construction • Optimisation of transportation management to avoid needless truck movements; avoidance of truck movements during night-time.	EPC Contractor, Turkmenenergo	During construction period
Noise	• Utilization of low sound power mechanical equipment like bulldozer, air compressor, concrete pumps, excavator, concrete mixer etc. whenever possible. • enforcement of vehicle speed limits; • strict controls of vehicle routing; • diesel engine construction plant equipment to be fitted with silencers; • limited noisy construction activities at night; • prohibition of light vehicle movements at night; • use of protective hearing equipment for workers. • Regular maintenance and service of building machinery and other during construction works.	EPC Contractor	During design and construction phase
Air Quality	• EIA shall be updated with a winter baseline air measurement for TSP/ PM_{10}, SO_2, CO, NO_2 levels at 4 sites (On site, at military Camp South, Zerger settlement area (North), New Planned Market Area (East), wind data. Air dispersion modelling for Winter baseline • If existing pollutant levels are exceeding international standards (too high to permit operating the power plant), mitigation measures to reduce air pollution from other sources should be envisaged. • Construction vehicles shall be properly maintained and speed limits shall be respected in order to minimize generated emissions and dust. • Further air quality assessments in Zerger are needed	EPC Contractor; Turkmenenergo; MNP	During design phase and construction phase
Water Supply	• Drinking water supply for workers will be made by truck / water tank till water treatment facility start operating on the existing power plant. Health and Safety aspects of drinking water supply need to be respected. • Construction of water pipeline from GLK collector	EPC Contractor, Turkmenenergo; MoWR	Prior start of construction and during construction phase

Issue / Potential Impact	Mitigation Action	Responsibility	Date for Implementation
Solid and Liquid Waste (generated by construction activities)	• Development of a Waste Management Plan within the EHS Management Plan considering following principles: (i) waste management hierarchy of avoidance-minimisation-reuse-treatment-disposal; (ii) segregation of waste; (iii) minimisation of construction waste by good technical planning; (iv) training of staff. • Implementation of a Waste Management System. • Maintenance and re-fuelling of the construction equipment shall be done only on sealed and enclosed areas (careful handling and careful maintenance, especially of the fuel tanks). • On site storage of fuel, engine oil and lubricants in locked tanks and on sealed and shadow roofed areas. • All wastes generated through the use of fuel, engine oil and lubricants like drums and containers shall be collected and disposed of properly. • Staff training to increase awareness of waste minimisation and appropriate waste disposal. • All liquid materials and lubricants shall be stored in closed containers or barrels. • Construction material as bags of cement etc. shall be stored in containers in order to avoid rinsing out. • Temporary sewage treatment facilities shall be provided for the construction site and the labour camp.	EPC Contractor, Turkmenenergo	During construction phase
Hazardous Materials	• Insignificant amount of hazardous materials will be used • Hazardous materials as hydrocarbons, explosives and other, shall be stored, handled and treated respecting national and international guidelines.	EPC Contractor	During Construction
Disaster Risks and Major Accidents Hazards	• Elaboration of an emergency plan and staff training for emergency response • Fire Prevention and Emergency Plan to be elaborated and implemented • Fire extinguishers to be installed • “Fire Water” tank/pond to be constructed and filled. • Regular training for emergency situations	EPC Contractor, Turkmenenergo,	At the beginning of Construction
Ethnic Minorities	• No impact on ethnic minorities.	EPC Contractor	During construction
Gender Aspects	• No impact on gender relations.	EPC Contractor	During construction
Population Influx / Worker’s camps	• Implementation of provisions regarding health and safety and security (EHS Management plan) • Conflicts shall be prevented. • Awareness raising programme for workers related to STD’s / conflict prevention	EPC Contractor, Turkmenenergo	During construction

Issue / Potential Impact	Mitigation Action	Responsibility	Date for Implementation
Local Workforce	• Local population shall have priority access to employment generated through the project. • Unskilled work-force shall be selected from proximity areas • Health insurance for all workers • Put in place sufficient sanitation facilities for workers. • Implementation of health and safety workshops for construction workers. • Installation of warning signs “Danger of Electrocution” in risk areas • Priority for city accommodation. In the case that construction camps are necessary these will be located in agreement with relevant municipal authorities.	EPC Contractor	During construction
Health and Safety	• Development of a EHS Policy for the construction phase. • Development of a detailed EHS Management Plan for the construction phase (shall include a Waste Management Plan). • implementation of EHS procedures as a condition of contract all contractors and subcontractors; • clear definition of the EHS roles and responsibilities of all construction companies and staff; • management and supervision; • pre-construction and operation assessment of the EHS risks and hazards; • completion and implementation of Fire Safety Plan prior to commissioning any part of the plant; • provision of appropriate training on EHS issues for all workers; • provision of health and safety information; • regular inspection, review and recording of EHS performance	EPC Contractor, Turkmenenergo	Before and during construction process
Decommissioning of existing substation	• Recycling and waste management procedures and provisions according to national and international standards will have to be planned for the decommissioning of the existing substation • Analysis of transformer oil (PCB) and treatment according to results • Metal scrap could be reused, recycled or sold under condition that no PCB or other contamination is found in analysis • Ceramics, could be easily disposed of at controlled disposal sites or used for road- or other construction purposes.	EPC Contractor, Turkmenenergo	Before and during construction process
Grievance Mechanism	• Implementation of possibilities to lodge complaints • Assignment of staff for grievance mechanism (incl. telephone number and office in Turkmenabat) • Implementation of Grievance reporting system • Response to complaints within 15 days and successful grievance settlement	EPC Contractor, Turkmenenergo, Municipality, NGOs	During Construction process

11.1.2 Mitigation measures for the operation phase

Issue / Potential Impact	Mitigation Action	Responsibility	Date for Implementation
Electricity Supply Electricity Export	• Good Coordination between both countries will remain essential during construction and operation phase.	MOE, Turkmenenergo	During construction and operation phase
Natural Disaster Risks	• The design of the power plant will be adapted to the seismic risk level in the Project area. • TE to implement in the operation phase an emergency response plan	EPC Contractor, Turkmenenergo	During operation
Gas Supply	• Specific measures to minimize gas leaks need to be included in the provisions of the constructor and operator • Install measurement device at connection point • Oil absorbers to be installed below tanks	EPC Contractor, Turkmenenergo	During construction and operation phase
Noise	• Specific design mitigation measures to minimize noise impacts include air compressors shall be equipped with silencers; • Noisy outdoor equipment shall be designed to a noise limit of 85 dB (A) at 1 m. • Plant workers will be provided with protective wear in plant areas with high noise levels. • Power plant shall operate in accordance with internationally accepted health and safety standards • According to World Bank Standards (World Bank & IFC General EHS Guideline, April 2007) a max. noise level of 45 dB(A) during night time for residential areas shall not be exceeded. • This value will be reached by using BAT (Best Available Technology) with incorporating noise reduction measures such as e.g. silencers for stacks, for the air inlet area, gas turbine compartment, noise reducing measures for piping etc. wherever needed.	EPC Contractor, Turkmenenergo	During operation
Air emissions	• Air emissions from the power plant are not exceeding international standards and are not affecting sensitive areas. • Adequate mitigation measures to reduce air pollution from other sources shall be implemented • The power plant needs to meet international emission standards irrespective of the pollution from other sources. • Turkmenenergo in cooperation with the environmental authorities to implement a long term ambient air pollution monitoring program for the project area • Annual GHG quantification and monitoring to be made	EPC Contractor / Turkmenenergo / MNP	During operation
Water Supply	• Construction of Water pipeline from project site to GLK collector according to good practices • Fire Fighting Water Supply, storage and pumping of Water for Fire Fighting needs to be assured. Implementation of storage and pumps. Accessibility, Contingency Planning. • To mitigate the risk of fish, water plants and debris entering the water pipe, the intake need to be protected by a small mesh size metal screen. • Regular drinking water supply for plant and workers` accommodations	EPC Contractor; Turkmenenergo	During operation

Issue / Potential Impact	Mitigation Action	Responsibility	Date for Implementation
Evacuation of Process Waste Water	• The treated waste water will be discharged to the sewage ponds of Turkmenabat or used for irrigation. Since the process is not handling any hazardous chemicals, storm water will simply be directed offsite without treatment. • Process wastewater treatment standards consistent with applicable Industry Sector EHS Guidelines; • Compliance with national or local standards for sanitary wastewater discharges or, in their absence, the international guideline values applicable to sanitary wastewater discharges; • Oil polluted waste water will be treated by oil separators. • EPC contractor to implement a wastewater management plan	EPC Contractor, Turkmenenergo	During operation
Solid and Liquid Waste	• Reduction of waste quantity, • Recycling as much as possible, • Proper dumping of remaining waste. • Run off shall be controlled and adequate site drainage shall be performed. • Regular vehicle maintenance and sewage treatment shall be enforced. • EPC contractor to implement a wastewater management plan	EPC Contractor, Turkmenenergo	During operation
Operational Health and Safety	• EHS Management System/ Plan shall be developed and implemented during operation to prevent health and safety risks from noise emissions, potential accidents and safety hazards, i.e. fire safety • Regular training of the workers. • Instructions on emergency measures necessary to protect employees shall be prepared. • EPC contractor to prepare and implement a occupational health and safety plan • The Operational Health and Safety Plan (OHSP) should: • identify and minimize, so far as reasonably practicable, the causes of potential hazards to workers, including communicable diseases; • provide preventive and protective measures, including modification, substitution, or elimination of hazardous conditions or substances; • provide for the provision of appropriate personal protective equipment (PPE) to minimize risks, including ear protection, hard hats and safety boots; • provide procedures for limiting exposure to high noise or heat working environments; • provide training for workers, and establish appropriate incentives to use and comply with health and safety procedures and utilize PPE; • include procedures for documenting and reporting occupational accidents, diseases, and incidents; and (vii) include emergency prevention, preparedness, and response arrangements in place • TE to implement in the operation phase an emergency response plan	EPC Contractor, Turkmenenergo	During operation

Issue / Potential Impact	Mitigation Action	Responsibility	Date for Implementation
Community Health and Safety	• EPC contractor to prepare a Community Health and Safety Plan. • The Community Health and Safety Plan (CHSP) should include emergency response procedures developed in close collaboration and consultation with potentially affected communities and local authorities, and should address the following aspects of emergency response and preparedness: • procedures to identify and minimize, so far as reasonably practicable, the causes of potential Project related hazards to local communities, including communicable diseases and vector borne diseases; • specific emergency response procedures; • trained emergency response teams; • emergency contacts and communication	EPC Contractor, Turkmenenergo	During operation
Climate Change	• In order to mitigate the additional GHG emission from the power plant operation considerable effort would need to be put in the implementation of CDM development projects. • An additional study should be made to assess possibilities and costs. • A first step to mitigate Climate Change impacts would be to reduce emissions by converting the power plant into combined cycle in the future	MOE / MNP / ADB	During Operation
Decommissioning	• Recycling and Waste Management procedures and provisions according to national and international standards will have to be planned for the decommissioning phase and foresee complete dismantling of the power plant after termination of operations at the end of the power plant's life-span. • Decommissioning of the new substation will have to be done at the end of its life span. (see decommissioning of existing substation during construction phase)	Turkmenenergo	After Life-Span of Power Plant (> 30 years)
Cumulative and Downstream Impacts	• The potential downstream impacts on water resources of the power plant are avoided by the choice of the Open Cycle technology of the power plant and minimization of water use.	MNP/ Turkmenenergo /Constructor	During Design / Construction and Operation

11.2 Monitoring Measures

11.2.1 Monitoring measures for the construction phase

Internal environmental monitoring will be conducted by EHS team of EPC contractor. External Environmental monitoring will be performed during construction phase. Monitoring results will be included in the project quarterly progress reports, semi-annual environmental reports during the construction phase and annual reports after commissioning.

Issue / Potential Impact	Monitoring Action	Monitoring Indicators / Quality Standards	Location	Measurements	Frequency	Supervisor / Monitoring Responsibility	Date for Implementation
General	Monitoring of compliance with mitigation measures presented in the EMP and with the requirements of the construction phase EHS plans	General compliance with mitigation measures presented in the EMP Visual inspection of project site, and all offsite areas where works are being undertaken (access roads, etc)	All active work areas	Visual Inspection of all active work areas	Daily Monitoring	EHS Team of EPC Contractor, responsible person of TE	During Construction period
Institutional Capacities to address environmental issues	Appoint a responsible person for Environmental issues within Turkmenenergo Basic training and effectively conducted training programs for persons employed to operate the monitoring activities. Preparation of content reports, yearly Environmental Quality reports and quarterly monitoring reports	Number of effectively conducted training programs, content of trainings, Environmental Quality reports Quarterly monitoring reports Check employees if they have received training	Turkmenenergo,	Capacity Development review of Turkmenenergo, Records of Trainings	Quarterly, yearly	MOE, TE	Design phase,
Landscape and Visual Aspects	Monitoring of good construction principles Monitoring of Construction site and ancillary infrastructure sites	Visual control of construction site	Construction Site and ancillary Infrastructure construction sites	Visual inspection	Quarterly, included in EHS audit	MNP, TE	During Design and Construction phases
Land Use)	Monitoring of Land Acquisition Procedures	Land acquisition procedure, records	Municipality of Serdarabat	Land Acquisition procedure records	Quarterly, Included in EHS audit	MOE, TE	Before Construction
Soil and Erosion	Monitoring of Implementation of Erosion / Sand Deflation Mitigation Plan Re-Planting activities Construction site audit Soil quality analysis at construction site	Number of constructed Sand deflation barriers, number of planted trees, bushes Soil quality measurement: pH, salinity, NH4+, total P, Zn, Cd, As, Cr, Hg, Cu, Pb, Oil & grease, selected pesticides, PAHs	2 sampling points around project site boundary, and 1 sediment sampling point at GLK Collector planned water intake	Number of constructed sand deflation barriers, Record of planted trees and bushes, Sampling and Analysis by Turkmengeologiya State Corporation	Annual monitoring	MNP, Centre for Ecological Monitoring, jointly with EPC Contractor and TE	Before starting construction and during construction period
Land Acquisition and Resettlement	Records of Land acquisition procedure,	Records of Land acquisition procedure, President's decree	Municipality of Serdarabat	Records of Land acquisition procedure	Once at beginning of construction	MOE, TE, Municipality of velayat	Before construction
Physical Cultural Resources	Visual Inspection, Interviews with construction workers Control of implementation of Chance Find Procedure	Visual Inspection of construction site if no physical cultural objects are found by chance, Interviews with construction workers, Control of implementation of chance find procedure	Construction Site and ancillary Infrastructure construction sites	Visual Inspection Records of chance find procedure	Quarterly	MOC, TE and EPC Contractor	During construction period
Flora and Fauna	Monitoring of replanting activities to restore eco-system functions at temporary construction sites after use	Visual control of replanting activities, Number of structures to be replanted, records of activities	Construction Site and ancillary Infrastructure construction sites All project related construction sites	Visual control	Yearly monitoring	Turkmenenergo / MNP	During construction period
Protected Areas and Wetlands	No monitoring action necessary	none	None	none	none	n.a.	n.a.

Issue / Potential Impact	Monitoring Action	Monitoring Indicators / Quality Standards	Location	Measurements	Frequency	Supervisor / Monitoring Responsibility	Date for Implementation
Traffic	Record of vehicle movements Construction site audit reports	Visual control of traffic, Control of implementation of traffic signs and proper deviations Record of vehicle movements, Construction site audit reports	Main road M37	Visual Control; Analysis of records	Quarterly	Turkmenenergo	During construction period
Noise	Visual control of implementation of noise reduction measures Regular noise measurements Construction Site EHS audit	Visual control of implementation of noise protection , Noise measurements at sensitive receptors (workers accommodations), nearest settlements regular inspection visits by EHS department staff; Construction Site EHS audit; International Standard (IFC): 70dBA max / 85 dBA short term heavy industry activities	Construction Site	Visual control of implementation of noise reduction measures Regular noise measurements	Quarterly	TE, EPC Contractor, MNP	During design and construction phase
Air Quality	Monitoring of TSP/ PM10,SO2, CO, NO2 levels and comparison to national and international limits Monitoring and record keeping of other ambient air pollution sources The monitors will be rotated among the four sampling points on a weekly basis such that there is at least one week of continuous monitoring at every sampling point every month.	TSP/ PM10,SO2, CO, NO2 Standards: TSP 1 h max: 500 [µg/m³] SO2 1h max: 500 [µg/m³] CO 8h max:10000 [µg/m³] NO2 1h max: 85 [µg/m³] (more details in ADC Annex 14.4.) Increase by plant not more than 25% of international AQS.	Monitoring at 4 sampling points (at project site, Zerger Municipality, Road side M37. Military Camp 3km South)	Mobile air pollution monitors	Daily, rotation between 4 points, for each point a week of measurements every month	Sampling and Analysis by existing staff of CEM-MNP, Surveillance by TE	During design phase and construction phase
Water Supply	Construction Site Audit Groundwater monitoring (quarterly) Surface water monitoring at GLK Collector (monthly) Monitoring of implementation of Fish meshes at intake pipeline	Construction Site Audit Groundwater Monitoring Zn, Cd, As, Pb, Hg, Cr, Cu, Mn; total fecal coliform; NH4+, total nitrates and total phosphates; TDS, TSS Conductivity, pH, DO, salinity, of two wells at project site GLK Collector quality: Parameters Oil & grease; Zn, Cd, As, Pb, Hg, Cr, Cu, Mn; total fecal coliform; NH4+, total nitrates and total phosphates; TDS, TSS, Conductivity, pH, DO, temperature, salinity at planned water intake IFC Standards to be respected, see Chapter 3.5.1.)	2 Ground-water sampling stations at wells around project site, 1 surface water sampling point at GLK Collector Water supply Intake,	Sampling and laboratory water analysis	Monthly	MoWR, MNP, EHS Team of EPC Contractor	Prior start of construction and during construction phase
Solid and Liquid Waste (generated by construction activities)	Monitoring of implementation of Waste Management Plan Construction Site Audit	Waste Management Plan, Visual Inspection of implementation of waste management measures	Construction site	Visual Inspection, As defined in Waste Management Plan	Quarterly	TE and EPC Contractor jointly with MNP	During construction phase
Hazardous Materials	Implementation of Hazardous Waste Management Plan	Visual Control; monitoring of Hazardous Substances Management Plan	Construction Site	Visual Control As defined in Hazardous Waste Management Plan	Quarterly	EPC Contractor/ Turkmenenergo	During Construction
Disaster Risks and Major Accidents Hazards	Regular monitoring and training for emergency situations	Emergency planning included in Construction plan	Construction Site	As defined in emergency response plan	Quarterly	EPC Contractor, Turkmenenergo	At the beginning of Construction
Ethnic Minorities	Complaints, reports of Grievance Mechanism	Number of registered complaints, reports of Grievance Mechanism	Municipality of Serdarabat	Grievance Mechanism	Yearly	EPC Contractor, TE	During construction

Issue / Potential Impact	Monitoring Action	Monitoring Indicators / Quality Standards	Location	Measurements	Frequency	Supervisor / Monitoring Responsibility	Date for Implementation
Gender Aspects	Complaints, reports of Grievance Mechanism	Number of registered complaints, reports of Grievance Mechanism	Municipality of Serdarabat, CSO	Grievance Mechanism	Yearly	Women's Union, EPC Contractor, TE	During construction
Population Influx / Worker's camps	Development of EHS Management Plan Monitoring as defined in EHS Plan	Development of EHS Management Plan; Review of EHS Management Plan Control of implementation of EHS Management Plan	Municipality of Serdarabat, CSO	EHS Management Plan	Yearly	EPC Contractor, Turkmenenergo,	During construction
Local Workforce	Visual Control, Audit Survey, Interviews with local population	Percentage of involvement of local population as workforce	Municipality of Serdarabat,	Visual Control, Audit Survey, Interviews with local population	Quarterly	EPC Contractor, Turkmenenergo and Women's Union	During construction
Health and Safety	Visual inspection Compliance with Community EHS plan Documentation of EHS Management Plan Monitoring and record-keeping;	Visual inspection, Documentation of EHS Management Plan	Construction Site		Quarterly	EPC Contractor, Turkmenenergo	Before and during construction process
Decommissioning of existing substation	Visual inspection, Documentation of EHS Management Plan Documentation of recycling / discharge procedures PCB Analysis Monitoring of appropriate disposal procedures	Results of PCB Analysis Quantities of material recycled, quantities of materials discharged and Standard for PCB content: Oil containing below 50 ppm PCB can be burned in regular incineration plant above 50ppm special disposal is required.	Substation Site	EHS Audit; International Guideline Sampling to be done by existing staff of substation and Turkmenenergo	Monthly during decommissioning	EPC Contractor, Turkmenenergo	Before and during construction process

A monthly ambient air pollution monitoring program shall be implemented during the entire construction period to monitor air quality at the project site. Together with the monitoring parameters, a log / records, identifying the sources of pollution at the time of measurement shall be maintained and included in the reports. This will enable the project to identify at which sources (e.g. waste dump) mitigation measures shall be programmed. Existing air pollution can best be mitigated at the source of emission. Before developing an offset, the standard (averaging period) should be further clarified and the requirements being enforced by the environmental authorities should be ascertained. Further air quality assessments in Zerger are also needed. The offset related mitigation in the EMP may be revised to reflect these measures during the construction phase

The remaining impacts during the construction period are easily mitigated by standard construction and supervision procedures. The effective implementation of the chosen design and the internal monitoring and external supervision of the construction process are the core areas of the monitoring measures. During construction semi-annual monitoring reports will have to be submitted.

EHS Audit

In addition, construction site audits shall be performed by Turkmenenergo and EPC Contractor to ensure that all requirements as stipulated in this EMP to the Project are fulfilled. An Environment, Health & Safety (EHS) Construction Site Audit shall be performed three times a year during a period of 3 years.

Air quality monitoring

During Construction baseline air quality survey of NO_2, SO_2, CO and TSP/PM shall be initiated six months ahead of commissioning using air quality monitors and continue during 6 months. Monitoring Indicators are dust levels (TSP/PM10, NO_2, SO_2, CO levels. A quarterly reporting of monitoring results shall be done during construction process.

Water Monitoring

Surface water: visual control of downstream water quality (turbidity) during pipeline construction, regular measurements of upstream / downstream basic parameters (pH, temperature, conductivity and if feasible light and heavy metals, pesticides).

Groundwater: selection of existing wells for analysis of basic parameters (pH, temperature, salinity, if feasible heavy metals) and 1-2 measurements during construction period and after completion.

Erosion control / Sand Deflation prevention

Implementation of erosion prevention structures shall be made by an experienced company and terminated at the end of the construction process. Implementation shall be monitored after construction period. Monitoring shall be done by Construction Site Audit Expert and include visual control and record keeping of construction process and number of structures.

Indicators are number and location of anti sand deflation structures and successful replanting of vegetation.

Waste management monitoring
Waste management shall be monitored by visual control and record keeping of proper waste disposal, including recycling during construction period.

Noise Emission Monitoring
Noise emissions during construction process shall be monitored by controlling implementation of good construction principles.

Good construction principles related to noise emissions include:

- diesel engine construction plant equipment to be fitted with silencers
- enforcement of vehicle speed limits
- limited noisy construction activities at night
- use of protective hearing equipment for workers.

Implementation of good construction practices shall be the responsibility of all contractors on site. Noise complaints (indicator) shall be registered and followed up rigorously.

11.2.2 Monitoring measures for the operation phase

Environmental monitoring during operation phase will be performed by the plant operator / Turkmenenergo. Monitoring results will be included in annual environmental reports during the construction phase and in annual reports after commissioning.

Issue / Potential Impact	Monitoring Action	Monitoring Indicators / Standards	Location	Measurements	Frequency	Supervisor/ Monitoring Responsibility	Date for Implementation
Electricity Supply Electricity Export	• Good Coordination between both countries will remain essential during construction and operation phase.	Number of inter government meetings, bilateral agreements	n.a.	n.a.	Yearly	MOE, TE,	During construction and operation phase
Natural Disaster Risks	• Control of the power plant design	Construction design; Seismic risk resistant construction standards; Construction Audit	Power plant site	Control of Powerplant design, Visual control of implementation	Yearly	EPC Contractor, TE	During operation
Gas Supply / Fuel oil supply	• Control of the power plant design • Quantification of gas losses from connection point to power plant • Input monitoring (e.g. gas quality, sulphur content of fuel)	Quantification of gas losses from connection point to power plant, Construction design	Power plant Site	Identification of losses; Gas quality, sulphur content of fuel;	Yearly	TE, MNP	During construction and operation phase
Noise	• Visual inspection of noise reduction measures; • Noise level measurement	Implementation of Noise Protection Measures Noise level Measurement Max. noise level of 45 dB(A) during night time for residential areas	Power plant Site	Noise Monitor	Monthly	Turkmenenergo, MNP	During operation

Issue / Potential Impact	Monitoring Action	Monitoring Indicators / Standards	Location	Measurements	Frequency	Supervisor/ Monitoring Responsibility	Date for Implementation
Air emissions	• Implementation of Stack Emission Monitoring System; • Monitoring of Emission Concentrations TSP/ PM10,SO2, CO, NO2 and comparison to national and international limits • Monthly monitoring of ambient air quality NOx, SO2, TSP/PM10 at 4 locations • Automatic monitoring of stack emissions	TSP/ PM10,SO2, CO, NO2 levels within national and international limits Standards: TSP 1 h max: 500 [µg/m³] SO2 1h max: 500 [µg/m³] CO 8h max:10000 [µg/m³] NO2 1h max: 85 [µg/m³] Increase by plant not more than 25% of international AQS.	Monitoring at 4 sampling points (at project site, at Zerger Municipality, at Road side M37, at Military Camp 3km South); Automatic monitoring at each stack;	Mobile ambient air quality analyzer Automatic stack emission monitoring system	Monthly Continous	Turkmenenergo / Sampling and Analysis by existing staff of Centre for Ecological Monitoring CEM-MNP	During operation

Issue / Potential Impact	Monitoring Action	Monitoring Indicators / Standards	Location	Measurements	Frequency	Supervisor/ Monitoring Responsibility	Date for Implementation
Water Supply	• Monitoring of water supply from GLK Collector via pipeline or from groundwater well as per technical specifications by construction contractor. • Monitoring of water quality at GLK collector pipeline intake • Quality control of groundwater at the project site • Quality control of drinking water • Water management monitoring plan to be developed by PIC • Monitoring of safety of drinking water in the storage tank • Monitoring of Fire Water availability	Water within limit values to be used for irrigation, monthly measurements of salinity, temperature, pollution with hydrocarbons	One sampling point at GLK Collector intake, 2 Groundwater Sampling stations at wells around project site,	Sampling and Laboratory Water Analysis	Monthly	Turkmenenergo Sampling and Analysis by existing staff of MWR, oversight by MNP Municipality of Serdarabat	During operation

Issue / Potential Impact	Monitoring Action	Monitoring Indicators / Standards	Location	Measurements	Frequency	Supervisor/ Monitoring Responsibility	Date for Implementation
Evacuation of Process Waste Water	• Control of process waste water treatment and control of discharge • Monitoring of cooling ponds • Water management monitoring plan to be developed by PIC	Waste Water within limit values to be used for irrigation, Periodic inspections, monthly measurements of salinity, temperature, pollution with hydrocarbons, Comparison of Inflow and Outflow IFC Guidelines: Temperature increase of receiving water not more than 3°C; ph 6-9; BOD mg/l 30; COD mg/l 125; total Nitrogen mg/l 10; total phosphorous mg/l 2; Oil and grease mg/l 10; Total suspended solids mg /l 50; total coliform bacteria MPN/100ml: 400	Sampling point at water discharge into GLK Collector	Water quality Analysis; Temperature measurement	Monthly	Turkmenenergo / MNP / MWR	During operation
Solid and Liquid Waste	• Control of Run-off • Visual Control after heavy rain fall • Visual inspection of waste treatment infrastructure and compliance with Waste Management Plans	Functioning of drainage system Functioning of oil separators, appropriate treatment and storage of solid and liquid wastes Periodic visual inspection,	Power plant Site	Visual inspection Standard Waste water measurements	Yearly	Turkmenenergo/ MNP	During operation
Workers and Community Health and Safety	• Implementation of OHSP and CHSP • Check of Operations Manual, • Interview with workers / medical reports	Regular inspections, Check Operations Manual, Interview with workers / medical reports/	Power plant Site, Neighboring Communities	Regular inspections As defined in OHSP and CHSP during construction phase	Quarterly	Turkmenenergo EMD staff	During operation

Issue / Potential Impact	Monitoring Action	Monitoring Indicators / Standards	Location	Measurements	Frequency	Supervisor/ Monitoring Responsibility	Date for Implementation
Decommissioning	• Control of Recycling and Waste Management procedures • Provisions for decommissioning of power plant, substation and ancillary infrastructure in power plant accounts	Provisions for decommissioning in power plant accounts, Inclusion of decommissioning phase in planning documents	Power plant site	As defined in plans for decommissioning phase	Yearly	Turkmenenergo	After Life-Span of Power Plant (> 30 years)

TE to implement a long term environmental monitoring program for the power plant during the operational phase, including air, wastewater and noise emission monitoring

TE in cooperation with the environmental authorities to implement a long term ambient air pollution monitoring program for the project area.

Operation phase environmental monitoring will include regular plant inspections to verify compliance with EMP requirements and with relevant laws and regulations.

Monitoring of Air Emissions

A regular stack emission monitoring program needs to be implemented for NO_2, CO, PM_{10} and SO_2. Measurement places should be selected according to sensitivity of impacted areas i.e. at the power plant site, a suitable location approx. 3 km in the South, in Zerger settlement (6.5 km North); New Market Area (6.5 km Northeast). Contingency procedures for the case of exceeding values shall be established in the operations manual and monitored by Turkmenenergo (internal monitoring) and MNP (external monitoring).

Automatic measurement system to be installed and records of sources of emissions to be kept.

Continuous ambient air monitoring of NOx, SO_2, and PM_{10}.

Continuous emissions monitoring system for monitoring of stack emissions (NOx, SO_2, PM_{10}, CO) during the operation phase.

TE in cooperation with the environmental authorities to implement a long term ambient air pollution monitoring program for the project area

Water Management Monitoring

A regular water quality monitoring program needs to be implemented including the quality of all water prior to discharge. Discharge of water shall conform to national as well as international standards. Details of the monitoring program need to be established in the operations manual and monitored by Turkmenenergo (internal monitoring) and MWE (external monitoring).

The water quality monitoring program will include:

- Annual sampling and laboratory analysis of groundwater at two wells.
- Monthly monitoring of surface water at water intake and outflow.
- Monthly sampling and monitoring of all plant wastewater discharges.

- Continuous monitoring of the temperature of the cooling water at the intake and discharge outlet.

EPC contractor to implement a wastewater management plan in accordance with national and international standards.

Sampling and Analysis done by the Ministry of Water Resources, Analysis Department, where laboratory facilities are available.

Solid Waste Monitoring

Waste generated on site and collected for disposal will be referenced, weighed and recorded. Environmental audits will be undertaken which will assess the quality and suitability of on- and off-site waste disposal and recycling according to national and international standards. The EHS audit will include solid waste monitoring. For operation phase Solid Waste Management Monitoring will need to be detailed in the operations manual and monitored by Turkmenenergo (internal monitoring) and MNP (external monitoring).

Liquid Waste Monitoring

Sewage will be treated according to international standards on site and disposed in existing sewage ponds or if quality permits in irrigation channels. Oil, hydrocarbons and other hazardous liquids shall be separated and recorded before disposal by experienced companies and according to international standards. The environmental audit will include monitoring of liquid waste management. For operation phase Liquid Waste Management Monitoring will need to be detailed in the operations manual and monitored by Turkmenenergo (internal monitoring) and MNP (external monitoring).

Noise Monitoring

During operation phase, noise audit measurements are to be carried out at noise sources and at the fence of the power plant as well as at noise receptors around the plant in order to guarantee that the plant will operate in accordance with international health and safety standards. For operation phase Noise Monitoring will need to be detailed in the operations manual and monitored by Turkmenenergo (internal monitoring) and MNP (external monitoring).

According to World Bank Standards (World Bank & IFC General EHS Guideline, April 2007) a max. noise level of 45 dB(A) during night time for residential areas shall not be exceeded.

This value will be reached by using BAT (Best Available Technology) with incorporating noise reduction measures such as e.g. silencers for stacks, for the air inlet area, gas turbine compartment, noise reducing measures for piping etc. wherever needed.

Health and Safety Monitoring

- Occupational Health and Safety monitoring and Community Health and safety monitoring shall be done according to the recommendations of IFC EHS guideline (see also Chapter 3.4).

Soil Monitoring:

- Soil monitoring at the power plant site boundary to ensure that the Project is not contaminating adjacent areas.

During operation phase, annual monitoring reports will have to be submitted.

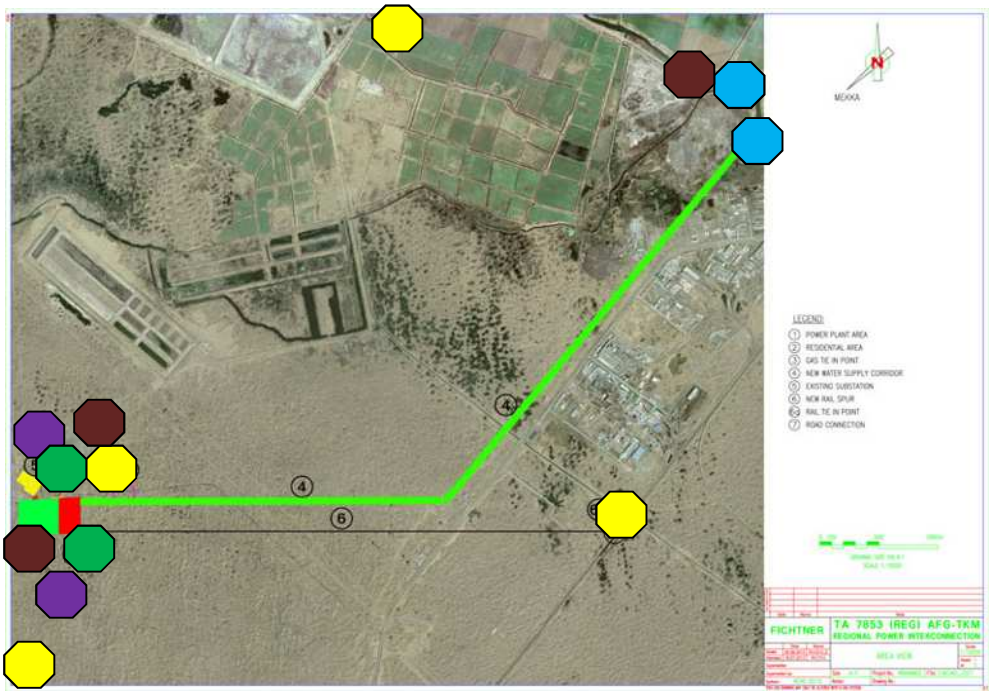
If the monitoring has identified a weakness or deficiency in the implementation of the EMP that has already been addressed, the report should explain the manner by which the issue was resolved.

If the monitoring has identified a weakness or deficiency in the implementation of the EMP that has not yet been addressed, a corrective action plan should be developed. The corrective action plan should describe actions necessary to address each area of concern; prioritize these actions; identify responsibilities for implementation of each corrective action; identify a time-line for their implementation; and, present a schedule for communicating the results of plan implementation.

During operation phase, annual reports documenting the monitoring results will be prepared by the plant operator based on the monitoring results, and submitted to MNP.

If the monitoring has identified a weakness or deficiency in the implementation of the EMP that has already been addressed, the report should explain the manner by which the issue was resolved. If the monitoring has identified a weakness or deficiency in the implementation of the EMP that has not yet been addressed, a corrective action plan should be developed.

The following figure presents suggestions for monitoring points:



Legend: Monitoring points during construction and operation phases for ground water (violet), surface water (blue), noise (green), soil (brown) and ambient air quality (yellow) measurements

Figure 11-1: Proposed monitoring locations

12. Conclusion and Recommendation

It can be concluded that the planned 400 MW Open Cycle Natural Gas Power Plant in Zerger (Serdarabat Etrap) can be constructed and operated without having significant adverse impacts on the social and ecological environment on the project site and its surroundings, if all proposed mitigation measures are implemented.

The choice of the location is assessed to be suitable as it is located in an industrial area without competing land use and with no resettlement requirements. Neither the Power Plant nor the ancillary infrastructure created by the project will generate any resettlement impacts. Local residents are not affected by the project. The closest settlements are located in a distance of more than 6.5 km. The disturbance of Flora and Fauna is assessed to be low and Protected Areas or Wetlands will not be affected. There are no historical monuments or cultural heritage sites in the Project area.

Impacts of ancillary infrastructure are assessed to be low. The distances to be bridged by additional infrastructure (access roads, pipelines) are smaller than in alternative areas. A new substation will be built on the territory of the Power Plant. A 220 kV transmission line to substation Chardzhev (National Grid) does already exist (max. 50 m of new electrical connection is needed).

In the course of the construction of the new power plant, the existing substation will be demolished and a new substation within the boundary of the power plant will be constructed and operated. The decommissioning of the existing substation will result in the generation of hazardous substances and recyclable materials. Whereas scrap metal is a valuable resource and inert ceramics and other building materials are non-hazardous materials to be reused, transformer oil could be of hazardous nature because it might contain PCBs. The oil will be analysed and tested for PCB in a Turkmenenergo owned laboratory. If it contains PCB, it will be transferred to Turkmen Petrochemical Company at Turkmenabat for interim storage and later incineration (where suitable high temperature incinerators are in place).

The results of the air dispersion modeling show that the emissions of the power plant will only have a limited impact on sensitive receptors (e.g. settlements). An ambient air quality measurement and an air dispersion calculation was carried out in order to assess the existing preloads, and the cumulative impact of the power plant emissions added to the power plant.

The results of the air dispersion modelling show that the expected levels of pollutants in the area will be well below the considered international Air Quality Standards.

The operation of the 3 existing GTs with 15m stack height is expected to have a negative impact on the 1 hr NO_2 concentrations and would cause an

exceedance of the international air quality standards for NO_2 /1 hr in the vicinity of the plant.

Changing the stacks' height of the 3 existing GTs from 15 to 40 m will lead to a reduction in the contribution of these units for the air quality degradation in the area within the international standards.

The simulation of NO_2 emission dispersion (cumulative impact of existing pollution and emissions of the power plant) shows that all settlement areas and other sensitive receptors are only marginally affected by the plume of the power plant. The plants contribution to NO_2 concentrations in the settlement area (or other sensitive receptors) is low. In the absence of national 1 hr Air Quality Standards for NO_2, the international standards are taken as a reference. These standards are met, with both power plants operating on the background of the baseline air pollution (pre-loads).

However, for a more comprehensive assessment of existing preloads the EIA shall be updated with a continuous air baseline measurement (summer and winter data) during the construction period in order to monitor existing emission sources and on this basis decide if an investment in reduction of existing air-pollution is necessary.

As a result of the selected technology (OCGT), the water consumption of the plant is minimized. The recommendation from the EIA is to use collector water, because of its 10-times inferior salinity. If for technical / economical reasons the groundwater option is envisaged, this would create the necessity to carry out a suitable long-term groundwater analysis and modelling. A small pumping station will be installed to facilitate the transport of water through a feed pipe. Power connection is nearby and the pumping station will be located near the road for accessibility. All wastewater from the power plant will be discharged back into the GLK Collector after proper treatment and cooling. The treated wastewater stream to the GLK collector is calculated at a rate of about 75 m^3/h (19 l/sec). Water losses are estimated to be below 10% and water quality will not change significantly. A discharge of 19 l/sec into the GLK collector (flow 15,000-18,000 l/sec) is expected to have an insignificant impact especially after treatment and cooling in retention ponds.

During plant operation noise emissions will be caused by gas turbines, air compressors, pumps and emergency diesel engines. Specific design mitigation measures to minimize noise impacts include air compressors to be equipped with silencers and noisy outdoor equipment to be conform to a noise limit of 85 dB (A) at 1 m distance. In addition, plant workers will be provided with protective wear in plant areas with high noise levels. The power plant shall operate in accordance with internationally accepted health and safety measures. Buildings shall be noise protected. According to World Bank Standards (World Bank & IFC General EHS Guideline, April 2007) a max. noise level of 45 dB(A) during night time for residential areas shall not be exceeded.

This value will be reached by using BAT (Best Available Technology) with incorporating noise reduction measures such as e.g. silencers for stacks, for the air inlet area, gas turbine compartment, noise reducing measures for piping etc. wherever needed.

All other impacts (i.e. Traffic, Dust, Health & Safety, Cultural Heritage Sites etc.) are assessed to be low or insignificant and/or can be readily mitigated with compliance to good construction and operation practices.

For power generation processes, CO_2 is the key GHG emission of concern. Additional emissions from power plant operation are expected to be 1,036,000 t/ CO_2 per year.

A further step to reduce Climate Change impact would be to increase efficiency of the PP with the upgrade of OCGT to the more efficient CCGT in future.

Extensive supervision activities are necessary because the detailed design features are not known yet. The determination of the technical details is the responsibility of the constructor (EPC contractor) and could therefore not be covered by this EIA/EMP.
The entire construction process shall be supervised by Turkmenenergo expert. The implementation of the EMP shall be part of the obligations of the EPC contractor, as well as the construction companies and the plant operator.

It is recommended to train the staff to cover Environment, Health and Safety aspects as well as monitoring during construction and operation of the power plant and thus ensure efficient implementation of the EMP.

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