Initial Environmental Examination

September 2013

TAJ: Golovnaya 240 Megawatt Hydropower Plant Rehabilitation Project

This IEE is prepared by Corporate Solutions for Barki Tojik of the Republic of Tajikistan and for the Asian Development Bank (ADB)

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CONTENT

ABBREVIATIONS

ADB	Asian Development Bank
EHS	Environmental Health and Safety
EMP	Environmental Management Plan
GoT	Government of Tajikistan
IsDB	Islamic Development Bank
IEE	Initial Environmental Examination
PMU	Project Management Unit
SanPin	Sanitary Regulations and Standards

1. EXECUTIVE SUMMARY

The Government of Tajikistan (GoT) has requested assistance from ADB to fund the refurbishment of Golovnaya HPP which, with an installed capacity of 240MW, is the sixth largest power station in Tajikistan. It was commissioned in 1964 since when the only major renovation works undertaken was the replacement of one of three transformers in 2004 and one of six turbines/generators in 2012.

The power station is part of a cascade situated on the Vakhsh River approximately 11km from Kugan-Tube which is the nearest city and is almost adjacent to Sarband which is the closest town.

In accordance with the ADB's requirements a technical feasibility study and a financial management assessment have been undertaken, which are the subject of separate reports, whilst this report provides details of the Initial Environmental Examination (IEE).

The proposed refurbishment work to be undertaken at Golovnaya consists of replacing three of the remaining five old turbines and generators, rehabilitating the remaining two and replacing the remaining two old transformers. Ancillary work to upgrade the associated control room and reinforcing the left side of the river bank adjacent to the 220kV switchyard will also be undertaken. It is also intended that by working with the contractors who will provide "on the job" training the capacity of Barki Tojik (BT) personnel to operate the plant will be upgraded as will operational and safety practices.

Clearly there is a need to operate the plant during the period of refurbishment and it is therefore intended to replace the turbines/generators sequentially over a five year period expected to start in 2015. When completed it is expected that the work undertaken will extend the operational life of the plant by 50 years and will increase the installed capacity by 10 MW to 250 MW.

All of the refurbishment work will be undertaken within the existing boundaries of the plant which were established in 1957 and there is therefore no requirement for additional land. In addition we have confirmed with the Sarband Land Registration Office that the land use rights were transferred to the plant in 1957 and that at that time there were no displaced persons.

Findings from our examination of the physical environment are as follows:

- **Water/Hydrology and Climate Change** – no environmental impact is envisaged
- **Air Quality** – Limits for ambient emissions set out in Golovnaya's Environmental Passport issued by the Environmental Protection Agency in Sarband in 2010 will not be exceeded.
- **Noise** – There is a bypass around Sarband which traffic to and from the site will use and there is therefore little risk of increased noise pollution in the town. Ear protectors will be used by all personnel on site to prevent damage to hearing caused by the refurbishment works.
- **Waste** – the project will need to deal with the following three types of waste:
    - **Solid waste** – will need to be transported by the contractors to a waste disposal site in Sarband.
    - **Transformer and turbine oil** – will be relocated in suitable vehicles to other sites for future use by BT
    - **Scrap metal** – will be temporarily stored at Golovnaya but will be moved to alternative storage sites by BT.
- **Biological Environment** – no threatened or endangered plant or animal species are known at the site.

Our examination of the social and economic environment shows that the outcomes are largely positive. The contractor's staff will live in Sarband from which economic benefits to the local community are expected to accrue. In addition it is expected that a number of unskilled jobs will be created although clearly this depends on the contractor.

It is possible that power supply interruptions may occur as the generators/turbines are taken out of commission and that the water released through the irrigation canal could be interrupted when units 1 and 2 are being replaced. As far as possible these interruptions will be mitigated against by replacing the turbines/generators sequentially, one at a time.

The water supply from the reservoir to Sarband will not be affected.

Overall supervision of project implementation will be the responsibility of the central Project Management Unit (PMU) for Energy Projects operated under the GoT. There is a Social and Environmental Monitoring Unit within the PMU which will be responsible for ensuring the incorporation of an Environmental Management Plan (EMP) by the contractor. The project EMP has been developed as part of this IEE.

The PMU will be supported by the Implementation Consultant's Team which will be hired through the International Competitive Bidding Procedures of ADB for the selection of Consultants and which will include both an international and local Environmental Health and Safety (EHS) expert. The turnkey contractor will be responsible for incorporating and adopting all EMP recommendations in the detailed design and detailed scope of works.

Pursuant to the recommendations of the IEE, successful bidders will be required to submit an Environmental Health and Safety Plan to further detail and commit to the stipulations of the EMP on a site-specific basis. Contractors will be required to employ an environmental professional to prepare the EHS plan and retain this expert to oversee its implementation.

As can be seen from the EMP only a few low negative impacts will occur, mainly during the construction phase. Positive social effects of the construction stage can be expected due to the envisaged creation of additional workplaces for unskilled workers, and the capacity development of the staff at Golovnaya. During the operational phase, the positive impacts are obvious and consist of a better sector performance. Providing the stipulated mitigation measures are implemented the positive social effect of this project is well-known whereas the negative impacts on the environmental side are very low. The findings of the IEE are clear and sufficient to meet the aim of ADB's safeguard policy, and there is no need to undertake any further assessment in the form of an EIA.

2. INTRODUCTION

The (GoT) has requested the ADB to provide technical assistance to undertake a feasibility study for the refurbishment of the Golovnaya Hydro Power Plant which is situated on the Vakhsh River. The Executive Agency for the Project is the Open Joint Stock Holding Company Barki Tojik which has been mandated by the GoT to own, operate and maintain all power generation, transmission and distribution enterprises within the country.

The ADB requires all investment projects to undergo an analysis of the anticipated environmental impacts, and the project is only approved, if these impacts are mitigated adequately.

Under the ADB rules the proposed project classifies as a category B project and therefore this IEE is sufficient for the review of the environmental aspects. This report has been prepared as part of the project preparation and is based on the technical feasibility report findings and recommendations.

The report describes the scope of the proposed project, the potential positive and negative environmental impacts together with proposed mitigation measures. For the rehabilitation project, most of the potential impacts are relatively low and the mitigation measures are part of the regular civil works practice. However, certain activities are new to the sector and require particular attention and control, such as removal of asbestos paper from the windings of rotor ad proper disposal of removed asbestos paper.

Comprehensive descriptions of baseline conditions of the project environment, potential impacts and mitigation measures are presented in the IEE's Section 2, Part B. Project description, Part C. Description of the project environment, and in Part D. Screening of potential environmental impacts and mitigation measures. Mitigation actions for construction and operation stages, as well as the requirements ans costs of environmental monitoring are summarized in Part G: Environmental Management Plan. Annex 1 of the IEE gives detailed information about the status of the land of the Golovnaya HPP, Annex 2 shows the list of participants of the Public Consultaions on the Project, Annex 3 of the IEE provides more detailed information on the selected hazardous materials, often associated with this type of projects (polychlorinated biphenyls (PCBs), sulfurgexafluoride gas (SF6) and asbestos).

Together with the project detailed design documents this IEE will be submitted to the State Agency for Environmental Protection for review and approval.

3. ASSESSMENT OF POLICY, LEGAL FRAMEWORK AND INSTITUTIONAL CAPACITY

3.1 REPUBLIC OF TAJIKISTAN

The environmental protection policy in Tajikistan is in place. The legal basis is formed by the Parliament and by the President, while the implementation of the state's functions over the control of nature protection and rational use of resources lies with the State Agency for Environmental Protection, Protection of Forests and Specially Protected Areas.

The responsibility for formulation of the environmental legislation and policy is with the Parliament. The implementation of the policy and control over environmental protection on behalf of the State is undertaken by the State Agency for Environmental Protection, Protection of Forests and Specially Protected areas. The agency is also responsible for protection of the environment, control of economic activities prom the point of view of environmental pollution, rational use of natural resources, including licensing in the field of industrial safety, industrial activities and mining.

There are several laws, dealing with the issue of environmental protection:

The Law on Environmental Protection, #223, 196;

The Law on Environmental Expertise (law on the state environmental review) , #3, 2011; The law on State environmental review requires all projects, irrespective of the source of financing, to be approved by the State Agency for Environmental Protection. The assessment is conducted at the detailed design stage and responsibility for obtaining such approval is with the detailed design consultant. The purpose of the state review is to ensure that the project will not create any harm to the environment and all the potential risks are properly mitigated. Public consultations through public hearings and dialogue in the media are envisaged as part of the State review.

The Law on the Protection of Air; #123, 2005

The Law on Environmental Audit, 2011

The Law on Ecological Monitoring, 2011;

The Law on Ecological Information, 2011;

The State Agency for Environmental Protection is financed from the state budget and has branch offices in every rayon center. Environmental expertise is provided by the Agency for every investment project at the stage of detailed design, followed by the inspection of construction and operation activities. While the legal basis and policy documents are there, the actual control and monitoring activities are still behind international standards. Due to the lack of resources most of the inspection activities are undertaken on the basis of visual assessment with no laboratory tests undertaken. In relation to the proposed project examples are: asbestos manufacturing and its use are not restricted in the country. Asbestos pipes and corrugated roofing material are available on the market, being imported from Russia and China. The local cement factory in Dushanbe is resuming its corrugated asbestos line in September 2013. There are no regulations on handling SF6 gas possibly due to the fact that it is new to the sector.

BT is responsibility for environmental protection in the energy sector. The Company has one employee, Inspector on Environmental Protection, whose role is to support each enterprise to get all the licenses and permits from the State.

3.2 ADB

The environmental policy of the ADB is based on ADB's safeguards policy and a long-term development framework which recognises that environmental sustainability is a prerequisite for economic growth and efforts to reduce poverty. In this context environmental sustainability is one core issue of ADB's environmental policy.

ADB requires an environmental assessment of all project loans, program loans, sector loans, sector development program loans, financial intermediation loans, and private sector investment operations. The environmental assessment is a process rather than a one-time report and includes necessary environmental analyses and environmental management planning that takes place throughout the project cycle. In the ADB Safeguards Policy, 2009, the following environmental categorization of projects is given:

- Projects of category A are these projects "which likely to have significant adverse environmental impacts that are irreversible, diverse or are unprecedented. These impacts might impact the area larger than the sites or facilities subject to project works".

- Projects of category B are characterized as: "Projects, which could have some adverse environmental impacts, but of lesser degree or significance than those in category A. For the projects of category B, an initial environmental examination (IEE) is required to determine whether significant environmental impacts warranting an EIA are likely. If an EIA is not needed, the IEE is regarded as the final environmental assessment report.

Following this definition, the proposed project can be considered a Category B project for environment requiring an Initial Environmental Assessment (IEE). The project will not require the acquisition of land and resettlement activities will not become necessary at all. There is no protected area nearby and ecologically sensitive habitats will not be affected. No issue of transboundary water is triggered under the project, as the Vaksh River is already a regulated river and the plant has operated since 1964. All activities will take place within the fenced area of the existing HPP belonging to BT.

4. PROPOSED PROJECT

Picture 1 Google image of Golovnaya site, 2013

4.1.1 Project Location

The plant is located on the Vakhsh River approximately 80 km from the capital Dushanbe and about 11 km from Kurgan-Tube, Khatlon oblast centre and is very close (about 1 km) to the town of Sarband. The Golovnaya HPP which was commissioned in 1964 is a run of river plant with a current installed capacity of 240 MW.

4.1.2 Project Type

The project is of rehabilitation type, and all project activities will be implemented within the borders of the existing HPP. The specifics of the works is mainly dismantling the old equipment and installing new equipment and reinforcing the river bank adjacent to the 220 kV switchyard. A SCADA system will be installed as part of the project to provide automatic control of the equipment in the power house.

4.1.3 Project Description

The aim of the project is the rehabilitation and modernization of Golovnaya HPP which will be the first major rehabilitation and modernization undertaken since it was commissioned in 1964. The contractors will also provide much needed capacity building to BT's employees. The plant is a run of river HPP on the Vakhsh River with six operating units (the first was commissioned in 1962 and the last one was commissioned in 1963) utilizing an original

design flow of 890 m³/second and maximum head of 31 meters. The Golovnaya HPP consists of[1]:

- Dam: earth fill section and concrete gravity structures;
- Reservoir - heavily silted;
- Concrete powerhouse integral to the dam
- Spillway;
- Link Canal (tailrace for Units 1&2);
- 110 kV and 220 kV Switchyards;
- Six units with nominal installed capacity of 240 MW;
- Six vertical Kaplan units, operating as fixed blade; Unit 4 is under rehabilitation at this time;
- Three old upgraded generators, 45 MW, one generator is new, installed in 2012, two old original generators;
- Three transformers that service two units each; combined as Units 1&3, 2&4 and 5&6; Transformer AT3 that services units 5&6 is under replacement at this time. Transformer AT1 that services Units 1 was replaced in 2004. Transformer AT2 and AT3 are in need of replacement. .
- Two of the Golovnaya units discharge into an irrigation canal (capacity 350 m^3/s) which supplies the downstream Perepadnaya and Centralnaya HPPs. This is the "cascade". The other four units discharge directly downstream into the Vakhsh River.

4.1.4 Project Need

While certain rehabilitation work has been undertaken no major rehabilitation or modernization has been undertaken since it was commissioned in 1964. Some of the electrical and mechanical equipment has been upgraded or rehabilitated but most of the equipment is past its useful economic and functional life and needs replacing or a major refurbishment.

While the original quality of civil works at the site is considered sound some of the hydro-mechanical fixtures need repairing or replacement and instrumentation on the civil works needs rehabilitation and updating. Some of the structures also need to be thoroughly inspected and evaluated.

The focus of this project is to complete a comprehensive project rehabilitation evaluation and feasibility study. About 10MW of additional installed capacity will be added under the project.

[1] As described in the ToR for Feasibility Study, ADB Grant 0213 Taj, 2012;

4.1.5 Proposed scope of works

As previously mentioned, the scope for rehabilitation and modernization of the plant is huge, due to aging of most of assets, the limited replacement works in the past, as well as due to insufficient maintenance. The amount of available funding for the proposed project has forced the screening and prioritization of the activities to be included in the scope of works.

Currently, the scope of works consists of the following main activities:

- Replacement of three turbine/generators and rehabilitation of the remaining 2 old turbine/generators
- Replacement of two tailrace deck transformers
- Refurbishment and/or replacement of main spillway gate
- Refurbishment of all bulkheads and gates as required
- Replacement of the powerhouse roof membrane
- Resurfacing and water proofing of the tailrace deck
- Installation of proper oil containment and oil/water separators in the plant
- Other associated Balance of Plant (BOP) replacements and refurbishments, including the embankment of the left bank of the river;

4.1.6 Other Roles of Golovnaya HPP

In addition to serving its main objective of generation and transmitting electricity, the plant's reservoir serves as the source of drinking water for Sarband town (with a population of about 15,000) urban water supply system. Units 1 and 2 discharge into the irrigation canal which provides drinking water and irrigation water to an estimated 40,000 people in the territory of Sarband, Vakhsh and Bohtar rayons of the Khatlon oblast.

From the point of view of direct environmental benefits, the proposed investments will result in:

- **Reduced leakage of water** in the spillway will improved efficiency of the plant's operation along with other replacements, will upgrade and modernize the works;
- **Construction of oil containment system for the generation part of the HPP** (excluding switchyards) and **oil water separators for the tailrace site will minimize (or even eliminate)** the leaking of oil into the river and will prevent pollution of river water along with improved fire prevention capacity;
- **New fire-fighting system** will be installed for the power house and tailrace, based on water spaying improvement of fire-fighting system at the plant will improve the capacity to combat/minimize the fires before the professional fire-fighting brigades and vehicles arrive from Sarband;
- **Embankment of the river left bank** will stop the degradation of the slope, and will lead to improved geo-dynamic stability of the 220kV swytchyard site, will reduce the

turbidity and silting in the downstream flow towards the next HPP Perepadnaya.

- **Proper removal and utilization of hazardous wastes**, e.g. asbestos in accordance with best available international practices;

- **Health and safety, Personal Protection Equipment**: the project will address personal safety in terms of personal protection and in terms of dealing with hazardous material. The personal safety equipment (personal protective equipment) will be procured as part of the project, as well intensive on-site training in good safety practices will be provided.

5. DESCRIPTION OF THE PROJECT ENVIRONMENT

5.1 COUNTRY BACKGROUND

Picture 2 Tajikistan Country Map

5.1.1 Physical Environment

5.1.1.1 Geography and Landscape

Country specific

Landlocked Tajikistan is situated in southeast Central Asia and occupies an area of 143,000 km². The country spans 700 km from west to east and 350 km from north to south. Its borders extend 1,030 km with Afghanistan in the south, 430 km with China in the east, 630 km with Kyrgyzstan in the north, and 910 km with Uzbekistan in the north and west.

Tajikistan is mountainous with elevations ranging from 330 m to 7,495 m above sea level. Half of the territory is located above 3,000 m, and mountains occupy about 93% of the total area. One third of the country comprises foot hills and prairies with low-lands in river valleys. The five natural zones of Tajikistan are foothill plains, low mountains and valleys, mid-high mountains, light forest and forest and high mountains with snow and glacier. The vertical profile of Tajikistan ranges from 300 to 7000 meters above sea level.

Site specific

Khatlon Oblast, where the project site is located, is the most populous province in Tajikistan. It is situated in the southwest of the country, between the Hissar range in the north and the Panj River in the south and borders Afghanistan in the southeast and Uzbekistan in the west. Khatlon Oblast has an area of about 24,600 km².

5.1.1.2 Geology

Country specific

Tajikistan is a mountainous country with active ongoing relief formation (earthquakes, landslides, floods and storm waters) located within the Tyan Syan –Pamir range. The country is located in an active seismic zone which considerably affects its population and economy. All engineering designs should be based on the seismicity of 9 points of Richter scale.

5.1.1.3 Soils

The soil cover of Tajikistan is famous for its variety. Due to the elevation difference, they distinguish four soil belts:

- valley-lowland with most of grey soil
- midland with mountainous brown soils;
- highland with highly elevated meadow-prairie, prairie, desert-prairie, zang and desert soils
- nival belt (rottenstone soils among glaciers, ferns and rocks).

The main soil type of the lower belts is grey that is subdivided into three kinds: light grey formed in the conditions of the dry hot climate under a poor vegetation; contains low humus, rich in lime, often includes easily dissolvable acids. Under certain conditions, they are subjected to a secondary salinity. These soils are common for the Syrdaria River valleys, in the valleys of the flow parts of the rivers Pianj, Vakshs, Kafarnigan at the elevation of 300-600 meters and higher. Regular grey soils contain a bit more humus and are also rich in lime. They are rarely salted. Grey soils are found in the valleys of Yakhsu, Kyzylsu, Yavansu and others, and at the Dangara Plateau at the elevation from 600 to 900-1,000 meters. At a higher elevation, due to the higher level of precipitation and richness of the vegetation, regular grey soils transfer into dark ones (Gissar Valley, Zeravshan Valley and others). Dark grey soils reflect the main irrigation fund of the country land. Under the impact of the many years irrigation and cultivation, they acquired the peculiarities of the high-productivity products of cultural soils.

Site specific

The soils of the project site area represent are the light grey soils.

5.1.1.4 Climate and Air Quality

Country specific

The climate is dry continental. The average annual air temperature in the foothills and valleys varies from +6 to +17 C 0 and is close to freezing in the high mountains of the Pamirs. The absolute minimum was registered in the Eastern Pamirs (-63^{o} C) and the absolute maximum of +48^{o} C in the Shaartuz, in the southern Khatlon Region. In the southern valleys, the average temperature of the hottest month (July) is +31^{o} C. The average annual precipitation is 760 mm with two thirds falling in the coldest season in most areas.

The problem of air quality is one of the basic ecological issues of industrial or urbanized areas. The air quality in the country is monitored by the State Hydromet Agency. There are three monitoring points in Dushanbe and one in Kurgan-Tube, the center of Khatlon oblast. The concentration of six major pollutants is monitored daily. Main stationery sources of air pollution in Tajikistan are mining, metallurgy, chemical industries, head plants and agriculture. The largest contributors to air pollution are: TALCO (Aluminum smelter), Dushanbe TPP, Yavan chemical plant, Isfara fertilizers factory and gold mining industries. In above mentioned activities the air pollution occurs due to explosive works, transportation of raw materials, electrolysis and chemical and thermal processes.

Transport contributes to about 80% of emission of air polluting substances. NOx, SO2, and CO emissions make about 80% of the harmful emissions from stationery sources. Also emissions of fluorine, fluorine hydrogen (280-350 t/year), as well as of chlorine (100 ton per year) occur.

The cleanest air quality area in the country is Gorno Badakshan Autonomous oblast. At the domestic level air quality is affected by the combustion of leaves and other solid wastes is applied by population as a way to utilize solid wastes. In winter, any plastic wastes are often burned in individual households along with coal and wood to produce heat. The practice to use the plastic bottles to produce heat by households is a sad reality of the recent two decades, when other sources of energy as electricity, coal or gas became either costly or not accessible. The examples are: limited import of natural gas from Uzbekistan due to poor political relations and shortage of electricity in winter.

Site specific

Climate of the project area is extreme continental with hot summer and relatively warm winter with little snow. Average annual air temperature is 19,96 0C. The coldest months are January (0- (+1) 0C), and the warmest month is July-August (+37,7 0C). The period with the temperature above 0 0C lasts about 226 days per year. Annual precipitation is equal to average of 236 mm, occurring mainly during cold season, with the daily maximum of 39 mm. The northern and southern directions of winds (at a maximum speed of 5 m/sec) are prevailing in the Vakhsh valley.

The proposed project site is located outside of the area of any significant ambient sources of air pollution, it is also out of the urban area with intensive traffic and informal domestic heating practices. The nearest air quality monitoring station is in Kurgan-Tube, about 20 km from Sarband. Therefore, the air quality in the area of Golovnaya HPP is considered as good and in general compliance with the state standard, see Table 1 below:

Air Quality Standards in Tajikistan	
Pollutant	Maximum permitted concentration (µg/m3)
Particulate Matter	0.150
Nitrogen Oxide (NO)	0.060
Nitrogen Dioxide (NO_2)	0.040
Sulphur Dioxide (SO_2)	0.050
Carbon Monooxide	3.000
Ammonium	0.200

Table 1 – Air Quality Standards in Tajikistan

Emissions levels for air pollution which may originate from industrial operations are based on the detailed assessment of the current practices and pollution sources (the main sources are: welding and movement of vehicles at the site). The ambient pollution limits are stated in the “Environmental passport of Golovnaya HPP”, which was approved in 2010 and is renewed every 6 months, and performance is checked by the Sarband environmental authority (no field measurement by mobile devices is performed).

Ambient air pollution limits for Golovnaya HPP are provided in Table 2.

Ambient Air Pollution Emissions (calculated)		
Pollutant	Permitted Emissions; t/year	Actual Ambient Pollution Performance; t/year
Particulate Matter (metal particles in the air)	0,2	0,00063
Nitrogen Oxides (NOx)	0,04	0,02
Aerosol of Lead (Pb)	0,0003	0,00061
Vapor of Fluoride Acid (HF)	0,02	0,0011
Carbon Monooxide	3	2,54
Carbohydrants	1	0,0857
Silicium oxide (SiO_2)	0,02	0,0004
Chrome oxide (CrO)	0,0015	0,00014
Vapor of sulfuric acid (H_2SO_4)	0,1	0,0008
Iron oxide (Fe_2O_3)	0,04	0,0089
Manganese Dioxide (MnO_2)	0,001	0,0088
total	4,42	2,7

Table 2 – Ambient Air Pollution Emissions

5.1.1.5 Surface water

Country specific

There are 1,300 natural lakes in Tajikistan with a total water surface area of 705 km^2 and a total capacity of about 50 km^3. About 78 % of the lakes are situated in the mountain zone above 3,500 m. On average, 51.2 km^3 of water is formed on the territory of Tajikistan which is equivalent to more than 7,000 m^3 per capita. Tajikistan accounts for about 44% of the annual water flow into the Aral Sea basin. The Amudarya River basin with 50.5 km^3 is more significant than the Syrdarya River with only 0.7 km^3. The water flow comes from the Pyanj, Vakhsh, Kafirnigan, Bartang and Zeravshan river basins and originates mainly from glacier melting and precipitation. Total freshwater reserves in Tajikistan's glaciers and snowfields are estimated at 550 km^3. Glaciers and snowfields occupy about 6% of country's territory. Over 1,300 lakes contain 44 km^3 of water, including 20 km^3 of freshwater and 24 km^3 of saltwater. Their total area is 705 km^2.

Site specific

The Vakhsh River originates from Kyrgyzstan's Kytyl-Suu River later in Northern Tajikistan after the merging of Kyzyl Suu with river Muksuu is called Surhob. After merging with another Tajikistan's Obihingou River is called Vakhsh. The total length is 524 km. Its headwaters are located in the Pamir Mountains, passing through very mountainous territory that frequently restricts its flow to narrow channels within deep gorges. The river then flows further through

the fertile lowlands of southwest Tajikistan and joins the Panj to form the Amu Darya, at the border of Tajikistan and Afghanistan. The flow of Amu Darya after crossing Uzbekistan and Turkmenistan is discharged into the Aral Sea.

The catchments area of the Vakhsh is 39,100 km^2, of which 31,200 km^2 lies within Tajikistan. The river contributes about 25% of the total flow of the Amu Darya. Its average discharge is 538 m^3/s, with an annual discharge of 20.0 km^3. However since the Vakhsh is fed mostly by melting snow and glaciers, these flow rates have great seasonal variability between winter and summer. Measurements at the Nurek Dam indicate that winter flow rates average around 150 m^3/s, whereas flow rates during the summer months can exceed 1500 m^3/s – a tenfold increase. The hydrological monitoring of the river has started in 1928 at the post in Sarband, in 171 km away from the upstream.

5.1.1.6 Climate change aspects at the site

In 1964, when the plant was commissioned, the river had an original embankment on both sides. The 100 year record of floods was modelled during the initial design. To restore the embankment and make it climate change proof, the records for the past 19 years of available hydrologic data were provided by BT. Unfortunately 100 years of recorded data in Tajikistan is not available.

A conceptual design has been prepared for the left river bank protection of the 220kV switchyard at Golovnaya HPP as part of the current feasibility study. The proposed design consists of a gabion wall founded on a gabion mattress to protect the river bank from erosion, and at the same time it has enough flexibility that protects it from undermining and progressive failure. The top of the wall will be set at 100 year flood level available from the historic plant records (the 100 year level is based on the original facility design, is el 462.60 m, The top of the gabion wall will be at el 463.00 m, plus a freeboard. The wall starts at the end of concrete training wall and stretches ~ 200 m downstream. The river bed elevation in this area is approximately at el 454.00 m so the overall wall height will be in the order of 9 m. The gabion slope facing the river is 1H:2V, and the back side gabion slope is near vertical. The slope above the gabion wall between it and the switchyard will be backfilled and graded to a slope of about 2H:1V This wall is basically new protection in this area. The presently proposed embankment protection is designed to be flexible so that if any local erosion occurs the wall will flex and conform to the new shape without undergoing a complete failure. In the event that a larger flood than 1:100 year occurs and overtop the wall, the gabion wall will remain stable although some limited rehabilitation of the slope may be required.

5.1.1.7 Groundwater

Groundwater is found in alluvial deposits in the large river valleys (Syrdarya, Kafirnigan, Vakhsh, Kyzylsu, Yakhsu) and in intermountain depressions. The average depth of operational aquifers is about 100 m. According to recent surveys, potential reserves of groundwater make up 17 km^3/year of which it is estimated that 2-3 km^3/year are exploited. It should be noted that in some areas of the country, groundwater is highly mineralized up to 10 g/l, in particular around the Kurgant Tube in the Khatlon oblast and in the Sugd oblast.

5.1.1.8 Water quality at the project site

The leakage of transformer, turbine and hydraulic oil into the river is assessed only visually and no data on any measurements are available. According to the visual assessment, the leakage of the oil into the river is very small, and in general, the river qualifies as surface water of good quality complying with the state standards as shown in Table 3 below.

Surface Water Quality Standards	
Parameter	Maximm Permitted Concentration, mg/l
Oxygen	Winter – 4.0 Summer – 6.0
Salt ammonium	0.5
BOD	3.0
Oil	0.05
Iron	0.05
Copper	0.001
Zink	0.01
Phenols	0.001
Chlorides	300
Sulphates	100
Calcium	180
Potassium	50
Suspended Matter	1000

Table 3 – Surface Water Quality Standards

5.1.1.9 Noise aspects of the site

In general, there are no noise level increases in the daily operation of the plant. The noise level can be raised during specific installation or maintenance works (e.g. directional drilling in the power house, noise during dismantling, etc.). According to the public health standards of Tajikistan, ear protection equipment is required in the industrial environment when the noise level reaches 90dB while the EHS guidelines of IFC and require ear protection at 85 dB.

5.1.1.10 Vibration at the site

Vibration aspects are not applicable to the daily operations of the plant.

5.1.1.11 Biological environment

5.1.1.11.1 Ecology, Flora and Fauna

Country specific

The vertical profile of Tajikistan, from 300-400 to 6,000-7,000 meters above the sea level is characterized by high belts complicated by the regional heterogeneity caused by the cross-country topography. Tajikistan boasts a great diversity of both flora and fauna. Generally, there are about 80 species of mammals, 360 species of settled and migrating birds, 49 species of fishes, 44 species of reptilians. More than 5,000 species of plants can be found in the country. About 30% of the country has been transformed into agricultural or urban ecosystems, and 22% is designated as protected areas.

Site specific

The site is located in the piedmont part of the valley of the Vakhsh River, and as it was transferred into the industrial zone since 1957. As the result of anthropogenic activity the original landscape, flora and fauna of the area have been impacted by the purpose of redevelopment of the site.

5.1.1.12 Protected areas and cultural heritage

Country specific

Tajikistan has established 21 protected areas, which account for 22% of its total land area. In addition, Tajikistan has 5 wetland sites of international importance. Forests in Tajikistan cover 410,000 ha and other wooded areas cover 142,000 ha. There is a number of cultural heritage sites, ranging from the signs of presence of early Persian Empire and Alexander the Great to the medieval forts and castles.

Site specific

No protected areas, wetlands or national parks are located in any the close proximity to the project site and will not be affected by the project. The same applies to the cultural heritage sites.

5.1.1.13 Socio-economic development

Country specific

Shortly after independence the country descended into a five-year civil war that brought widespread damage. Economic and political stability was restored in 1997, supported by extensive collaboration between the Government and the donor community. The country is still undergoing transition from the planned to market economy. The country's GDP for 2012 is USD 6.98 mln and GNI per capita Atlas method is USD 860, leaving Tajikistan in the low income group (WB, Tajikistan at a glance). One of the significant contributors to GDP is remittances, sent predominantly from Russia (about 50% of GDP in 2008, before the financial crisis and stable 40% of GDP afterwards) In 2012, agriculture contributed about 21% to GDP, while providing 64 % of total employment.

5.1.1.14 Administrative division and demography

Country specific

Administratively Tajikistan is divided into two oblasts (the Khatlon and Sugd provinces), one autonomous oblast (Gorno Badakhstan), four urban areas directly administered by the central government, twenty urban areas subordinated to the oblasts, and fifty eight rural rayons thirteen of which are under direct central administration. The total population numbers about 8.03 million (2012) with an average population density of 50 persons/km². According to official statistics, 25% of population resides in urban areas and 75% in rural areas[2]. During the recent decade, the population has grown at a rate of 1.5% per year with 40% of the population under the age of 15.

Site specific

The Khatlon oblast, where the project site is located, consists of twenty five districts, fourteen in Western Khatlon and eleven in Eastern Khatlon. More than 2 million people are living in this oblast. The population in Khatlon is mainly engaged with agricultural activities, especially cotton growing and cattle raising. Only 2-3% of the population is working in the industrial sector.

5.1.1.15 Natural resources

Country specific

The mineral resources of Tajikistan contain almost all elements of the Mendeleyev table and are a unique storage of wealth. Over 400 deposits of mineral resources and ores have been found, explored and prepared for development in Tajikistan. Tajikistan is one of the countries, which possess significant resources of precious metals, but in many cases, the cost of extraction is high due to lack of the sufficient access infrastructure.

[2] Source: WB Tajikistan at a glance, 2012

Tajikistan faces a complicated situation in regard to both its reserves of fuel and energy resources as well as their availability to citizens. At present, there are no commercially viable reserves of natural gas in Tajikistan (recently investigation works for gas and oil deposits in the Tajik part of Ferghana valley have been started by Tethys oil an gas exploration company and by Gazprom), although it possesses rich coal resources.

Site specific

All these energy bearing resources are not currently sufficiently developed and power supply cannot meet demand in the winter and electricity rationing affects all sectors of the economy. In this view, the development of the hydro power generation and transmission to meet the internal all year round demands and external demands for export of electricity is considered as one of the key directions for future growth. The modernization of the existing energy generation facilities and transmission infrastructure as well as improvement of their efficiency of operations is a high priority for the country.

5.1.1.16 Water resources

Country specific

In Tajikistan, agriculture consumes 85% of water, industries another 5%, urban and rural domestic water supplies about 7%, and recreation and fishery needs 3%[3]. About 93% of annual water abstraction is from surface water and 7% from groundwater. Over the past ten years, water consumption has been fairly stable.

5.1.1.17 Economic aspects of the Vakhsh River

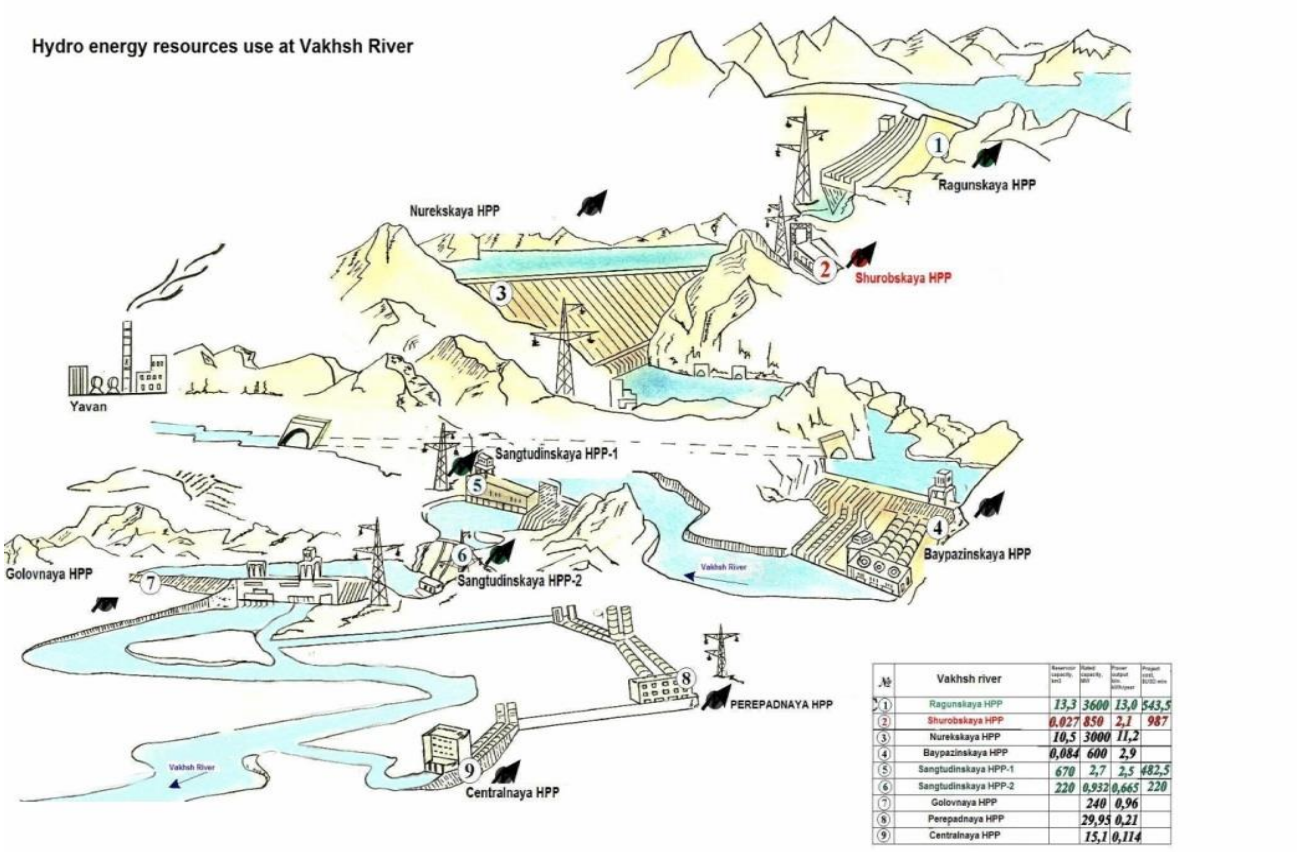
Country specific

The Vakhsh has been intensively developed for human use. Electricity, aluminum, and agricultural products are the main stays of Tajikistan's economy, and the Vakhsh is involved with all three of these sectors. Hydropower provides most of the country's electricity (99%), and 90% of that comes from the eight completed dams along the Vakhsh, dominated by the world's tallest completed dam, the Nurek. As for agriculture, Vakhsh water irrigates much of Tajikistan's crops; about 85% of the water taken from the Vakhsh goes for irrigation. During the soviet time, intensive agriculture in the Vakhsh basin has left the river polluted with fertilizers, pesticides, and salts. Also, chemicals have leached into groundwater from the heavy industries near the Vakhsh's dams, which has in turn contaminated surface water.

5.1.1.18 Hydro Power Resources on the Vakhsh River

There are currently eight HPP's situated on the Vakhsh River with a feasibility study currently being undertaken to complete a ninth, the Rogun HPP, which will be located at the head of River and which has a design capacity of 3,600 MW. The current installed hydropower facilities are: Nurek HPP (3000 MW), Baipaza (600 MW). Vakhsh cascade, including Golovnaya (240 MW), Perepadnaya (30 MW), Centralnaya (15 MW); Varzob cascade (25 MW), Kairakkukm HPP (126 MW), Sanktuda 1 (670MW), Sanktuda 2 (220MW). Potential energy resources on the Vakhsh River are estimated to be 75.5 TWh/year. The existing (and these under construction) hydro power plants of the Vakhsh are shown in Picture 3 below.

[3] State water inspection, under the MMWR, 2006



№	Vakhsh river				
1	Ragunskaya HPP	13,3	3600	13,0	543,5
2	Shurobskaya HPP	0,027	850	2,1	987
3	Nurekskaya HPP	10,5	3000	11,2	
4	Baypazinskaya HPP	0,084	600	2,9	
5	Sangtudinskaya HPP-1	670	2,7	2,5	482,5
6	Sangtudinskaya HPP-2	220	0,932	0,665	220
7	Golovnaya HPP		240	0,96	
8	Perepadnaya HPP		29,95	0,21	
9	Centralnaya HPP		15,1	0,114	

Picture 3 Hydro Stations on the Vakhsh River

The reservoirs behind the dams were built with the purpose to store water for irrigation, to control the river flow and to provide reliable water supply to downstream Uzbekistan and Turkmenistan. As part of the centralized economy of the USSR, the following water/energy arrangements were in place: during the summer, when river flows were greatest, Tajikistan (located upstream) released water from its reservoirs on the Vakhsh and exported the hydroelectricity to power irrigation pumps downstream, in Uzbekistan and Turkmenistan, along the Amu Darya. In winter, Tajik dams accumulated water, and the fossil-fuel-rich downstream nations supplied Tajikistan with oil and gas to compensate for forgone hydroelectricity generation.

With increasing regional tension post-independence however this system has broken down, with no conclusive cooperative arrangement. Fuel deliveries from downstream nations have been getting less reliable and more expensive and impoverished Tajikistan cannot adapt by increasing winter hydroelectric generation since this would jeopardize irrigation and electricity exports in the summer. This dependence has caused energy crises in the winters of 2008 and 2009, in which the capital, Dushanbe lost power and heating. Tajikistan is therefore pursuing a course of action to increase hydropower capacity by building more dams on the Vakhsh and rehabilitation/upgrading the existing plants, in order to promote economic growth and move towards energy independence. The effort to upgrade and modernize the power generation at the Golovnaya is fully consistent with the aim to develop the energy sector in the interests of the economy and population.

5.1.1.19 Engineering Infrastructure /Access roads

Site specific

- **Transport infrastructure** - The project site is located about 1 km from the center of the town of Sarband (population 15,000). The site is connected to the country's network of the roads, with Dushanbe, being the center of the road network. The roads from the borders with Uzbekistan, Kyrgyzstan and China are all functioning. At the entrance to Sarband from the main motorway from Kurgan-Tube there is a bypass, about 5 km long leading straight to the Golovnaya site and avoiding the crossing of residential areas.

- **Electricity infrastructure** - The site is covered with electricity supply (power for internal needs is generated locally), plus the plant can be fed from the national grid.

- **Other support infrastructure** - The plant has its own water supply system. The water is taken from the reservoir and treated in sedimentation basins. This water is used for fire-fighting system and for domestic water supply needs. There is no formal sewerage system with waste water disposed of in a cess pit. The state fire-fighting services are operating from Sarband town, with specialized vehicles; these services can be mobilized in addition to plant's own fire-fighting resources. The plant's fire-fighting system is maintained and regularly certified by the state fire-fighting services.

- **Solid waste management**. The solid waste generated at the plant, including construction waste, is collected at the plant and regularly transported to the nearest solid waste dumping site in the Sarband town. The site is not qualified as landfill due to the absence of measures and practices required for sanitary landfill (waste is dumped and occasionally covered with soil, no lining is available) It is however still a restricted access area managed by the Department of Communal Services of the Sarband Municipality. The site has no section for hazardous waste.

  There are two sites called hazardous waste sites, one in Faizaband and one in Taboshary. These sites store radioactive waste and are therefore "locked" for any other types of waste, even other toxic waste.

  Under a project financed by EBRD a first sanitary landfill site is currently under construction in Dushanbe. The recycling market is rather informal in Tajikistan with paper waste, wood, scrap metal being collected by informal waste pickers.

5.1.1.20 Health and safety

Site specific

Occupational safety is an important aspect of the plant's operations with each new member of staff being required to undergo compulsory, essential safety training. A special training room is available at the site.

Safety practices are regularly monitored by the relevant department of BT. At the same time, the availability and use of personal protection equipment (PPE) and knowledge of hazardous materials is not to the comprehensive level at Golovnaya.

Public health: in case of accidents, if the first emergency assistance is not sufficient, the professional healthcare from Sarband is called. There is a rayon hospital in Sarband

providing the major emergency/general physician heath care services. More specialized health care is available in Dushanbe.

5.1.1.21 Hazardous materials

Site specific

A number of hazardous materials are present on the site. The major ones are asbestos used in the equipment and in some operation and maintenance practices and newly introduced SF6 gas in the circuit breaker of generator 4. While, the staff is already aware on the SF6 dangers and required accuracy in its handling, the asbestos awareness is still low. This issue is described in the separate Environmental and Social Compliance Audit Report.

6. SCREENING OF POTENTIAL ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

No changes to the ecology and hydrology of the river Vaksh in the area of influence of Golovnaya HPP are expected as the river is already regulated and the plant has been operating since 1962. The proposed embankment, which takes into account recent trends in river flow dynamics and flood frequency, is a replacement of the original embankment which has been eroded. Re-establishing the embankment will improve river conditions downstream through a reduction in turbidity.

The project will deal with the removal and proper disposal of asbestos containing paper from the dismantled equipment (rotors of generators). In the absence of national regulations in Tajikistan this will be undertaken in accordance with international standards. The project will also build capacity in correctly handling SF6 gas which is a green-house gas used as insulation in circuit breakers.

6.1 IMPACTS OF THE PRE-CONSTRUCTION PHASE:

This is described in the social and environmental compliance audit report.

6.2 POTENTIAL IMPACTS OF THE CONSTRUCTION PHASE:

6.2.1 Potential impacts on land and land use

Project activity: all project works

The project works will be located within the existing boundaries of Golovnaya HPP and therefore no additional land will be required for the project. All the possible construction sites will be within the fenced area of Golovnaya. There are no illegal properties (land squatting or farming) at the site of HPP so involuntary resettlement and land acquisition policy of ADB will not be triggered. There is no need to set the worker's camp at the site as the HPP is very close to the rayon center, town Sarband, where the personnel of the contractor will be based (renting the houses or apartments on the local estate market).

A good practice example is available at the Nurek HPP where another ADB project is currently ongoing (500 kV switchyard reconstruction project) where the contractor's staff reside in the town of Nurek. As the proposed Golovnaya project will be administrated by the same PMU, there is already a capacity and lessons learnt in proper implementation of projects in the sector.

Impact: no impact

Mitigation measures: not required

6.2.2 Potential impact on air quality

Project activities: installation of new generator breakers; river embankment civil works;

Some minor unavoidable dust generation will take place during excavation activities, mainly on the site for the new river embankment. In dry weather conditions, spraying of water over excavated soil will be applied. Good practice of dust management is shown at the site of the ongoing ADB project at Nurek HPP "Construction of new GIS switchyard".

The new generator breakers will be filled with SF6 gas instead of transformer oil, currently used in breakers as isolation liquid. SF_6 the gas which will be used in the new breakers is a highly effective and persistent greenhouse gas, but this is the state of the art option for breakers. The gas is already present in unit 4 generator so the staff have sufficient knowledge in handling and the detection of leaks. Further training in its handling will however be provided during construction. The manufacturer should guarantee the maximum annual

losses of SF6 at the level of 0.5%. The new breakers should be equipped with SF6 detectors and personnel will be trained in safety procedures.

6.2.3 Potential impact of noise:

Project activities: transportation of equipment and construction materials to the site and various types of solid wastes from the site; dismantling and installation works in the power house and at the tailrace deck;

Noise due to construction work will be limited to construction activities. Other than crane(s) and trucks no large machinery is required. Whenever possible, only machines with low sound power should be used. Noise can also be generated by the trucks, crossing residential communities.

Impact; low negative

Mitigation measures: the traffic through residential areas should be regulated: truck might be crossing residential areas only between 7.00 - 22.00 hours. In Sarband, the 5 km bypass road to the plant will be used, avoiding the disturbance of the town. At the site ear protection devices will be used by all workers at the HPP (both BT and the contractor's employees). Personnel will be obliged to use these devices when the noise level exceeds 85 dB (WB/IFC EHS Guidelines, 2007). The SanPin of Tajikistan requires ear protection to be used when noise levels reach 90 dB. Training in noise measurement should be provided as part of the turnkey contract (personnel safety training).

6.2.4 Potential impact on access roads

Project activity: transportation of new equipment and construction materials to the site, transportation of solid wastes to the dumping site of Sarband.

The new equipment will be brought to the site by trucks, coming in several shifts. The experience of the Islamic Development Bank project at the Golovnaya, shows that all proper arrangements were in place and several shifts of 10-14 trucks were received.

Impact: low negative;

Mitigation measures: the limit of load on the roads per axe of transport vehicle will be strictly followed; No traffic interruptions are expected, as the traffic police and road authorities will be informed in advance. All traffic safety regulations to prevent accidents will be in place, and the traffic police will be controlling the movement of trucks.

6.2.5 Potential impact on biological environment (flora and fauna), national parks and other protected areas; on cultural heritage and historical sites

Project activity: all project activities.

No impact on wild life of the area is expected, due to the fact that the project will be implemented at the existing facility. There are no national parks or other protected areas, affected by the Project and there are no historic or archaeological sites within the area of Golovnaya HPP.

Impact: no impact;

Mitigation measures; not required;

6.2.6 Potential impact on water resources/hydrology of the river/Soil erosion

Project activity: construction of river embankment.

As part of the current feasibility study a conceptual design has been prepared for the left river bank protection of the 220 kV switchyard at Golovnaya HPP. The proposed design consists

of a gabion wall founded on a gabion mattress to protect the river bank from erosion, and at the same time it has enough flexibility that protects it from undermining and progressive failure. The presently proposed embankment protection is designed to be flexible so that if any local erosion occurs, the wall will flex and conform to the new shape without undergoing a complete failure. In the event that larger flood than 1:100 year occurs and overtop the wall, the gabion wall will remain stable although some limited rehabilitation of the slope may be required.

Impact on the water resources/river hydrology: positive;

Impact on soil erosion: positive, it prevents further degradation of the bank;

Mitigation measures: not required;

6.2.7 Potential impact of wastes, generated by the project

Project activity: increased amount of solid waste at Golovnaya due to removed packaging for various types of equipment brought under the project; brining the new equipment to the site; increased number of people at Golovnaya due to the presence of the personnel of the Contractor; dismantling of old equipment; removal of old oil from the power house and tailrace deck equipment;

- **Wastes, generated by the personnel of the contractor - t**he additional amount of domestic solid waste generated by the personnel of the Contractor will be handled in the same way as before the project. Domestic solid waste will be stored in waste containers and then transported to the dumping site of Sarband town.

- **Wastewater -** the site has no sewerage system and therefore waste water is discharged into an unlined cess-pit. The same facilities will be used by the personnel of the Contractor as the capacity is considered sufficient.

Impact: low negative;

Mitigation measures: not required

- **Ceramic wastes** - generated as a result of removal of old equipment. These wastes are inert and can be handled as regular solid wastes;

Impact: low negative;

Mitigation measures: these wastes should be removed from the site along with other solid wastes; this is part of the regular civil works practice; costs should be incorporated in the civil works costs.

- **Batteries -** removed as a result of the project. It is not envisaged that any batteries will be replaced by the Project. The battery for Unit 4 was replaced during the unit replacement while other batteries are in the switchyards;

Impact: no impact;

Mitigation measures: not required;

- **Packaging materials** - generated as a result of the project. All the non-metal packaging from the new equipment will be treated as regular solid waste and will be disposed at the dumping site of Sarband.

Impact: no impact;

Mitigation measures: not required;

- **Disposal of asbestos containing paper from removed old rotors** - Asbestos containing paper is currently used as insulation between the wiring of the rotors, being covered with the lacquer on both sides. The paper was originally installed by the manufacturer and during maintenance works the required layers are replaced with new paper sheets. The paper is certified in Russia by the GOST 23779-95. The paper contains chrysotile asbestos fibre, cotton fibre and organic glue. In order to be safely removed and then safely disposed, international standards and best practices will be applied under the project.

  The removal of asbestos can be done in two ways; either mechanical abrasion method, or chemical dissolving of the lacquer from the copper. The choice will be made by the Contractor. The conditions of the project for asbestos removal and disposal are to either use HSE licensed subcontractors or to use personal protection equipment for workers. There must be restrictive access to the site, delineation of the section of the dumping site where the removed asbestos will be buried.

Impact: low negative, providing proper safe practices applied;

Mitigation measures: the removal of asbestos paper will be carried out in a safe to workers and to air pollution way, as referred by EHS Guidelines IFC 2007; the same refers to the safe disposal of removed asbestos paper (mixed with lacquer particles). The costs are stated as specific EMP costs and the works will be part of turnkey contract. Close and documented supervision will be part of IC services.

- **Metal wastes (scrap metal)** - the largest amount if waste generated by the project, will be in form of dismantled equipment. Most waste metal will originate from the dismantling of three generator units and two transformers. An estimate of the amount and type of metal is provided in Table 4 below. It should be mentioned that the metal waste detailed in Table 4 below is in demand on the recycling market.

One Generator Unit	Total For Three Dismantled Generator Units
total weight 700 tones, including:	
1t of non-ferrous metals	3 tones
140 tonnes of stainless steel	420 tones
135 tonnes of alloy steel	305 tones
40 tonnes of copper (including in rotor winding- 14 t/unit, stator bars – 12 t/unit)	120 tones
power transformer T3 125 000 kVA	**power transformer 2AT**
manufacturer: Zaporozhie, Ukraine, 1963	Manufacturer: Zaporozhjie, Ukraine, 1963
total weight : 129 t	132 t x 3 =396 t
including weight of copper: 40t	51 x 3=153 t
including weight of steel 60 t (electro technical steel and alloy steel)	80 x3-240 (electro technical steel and alloy steel)
nonferrous metal – about 1 t	Non-ferrous metals about 3 t
oil volume: 28 t	46x3=138 t

Table 4 – Waste Metal Estimates

Impact: low negative

Mitigation measures: recycling of scrap metal is beyond the scope of the project. Prompt removal of generated large quantities of metal wastes by BT is expected in regular shifts, "as soon as ready", and will be arranged by the PMU. The transportation costs are not part of the project and should be carried by BT.

- **Old oil removed as a result of the project:**

    - **Type; Old transformer oil and issue of Polychlorinated Biphenyl (PCBs)** 166 tonnes of old transformer oil will be removed from two dismantled transformers and about 200 litres of oil in generators breakers per unit (in total 600 litres for three to be replaced units) and will be collected by BT for re-use at other sites.
      Both transformers were checked for the presence of PCB by certification database. The database was developed by the Government of Russian Federation (Ministry of Natural Resources and Environmental protection) and covers all the manufacturers of transformers with PCB in CIS countries as well as imported transformers by year, factory, type of transformer, up to 1990. According to the database, both transformers are free of PCB.

      There is no data on the original content of PCB in the generator breakers but the oil has been changed many times since 1964 and the oil which is currently procured is oil type under TU (technical specifications) 1500 U (TU 38401-58-107-97), manufactured in Russia and is guaranteed by the manufacturer as free of any phenols.

      Handling of old removed oil is beyond the scope of the project, as it remains the property of the BT, but will no longer be used at Golovnyaya. Other oil used at the plant, turbine oil and hydraulic oil - are not a subject to PCB content.

Impact: low negative

Mitigation measures: accurate handling to prevent the oil spill during equipment removal. The oil will be collected by BT and transported to other sites for reuse.

- **Type: Old turbine oil** - 18 tonnes of turbine oil per each generator unit; in total 54 tonnes of old turbine oil, will be removed from the dismantled equipment. The oil will be collected by BT and after required treatment will be re-used at other sites. Turbine oil is not subject to possible content of PCB. As the three turbines will be new and other two will be rehabilitated, plus there is the recently installed unit 4 turbine, it is expected that the leakage of the plant's turbine oil into the river will be eliminated.

  Handling of removed oil is beyond the scope of the project, as it remains the property of the BT, but will no longer be used at Golovnyaya.

Impact: low negative

Mitigation measures: accurate handling to prevent the oil spill during equipment removal. The oil will be collected by BT and transported to other sites for reuse.

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- **Type: Old hydraulic oil -** There are about 600 litres of hydraulic oil in cylinders and in other parts supporting the openers of sluice gates per unit. Thus, in total, about 3,000 litres of hydraulic oil from the three dismantled generator units and from two rehabilitated units will be removed under the project.

  Handling of removed oil is beyond the scope of the project, as it remains the property of the BT, but will no longer be used at Golovnyaya. The oil will be collected and transported to other sites of BT where it can be re-used after required treatment.

Impact: low negative;

Mitigation measures: will be aimed at prevention of oil spill during removal from equipment and filling in storage tanks before BT collects it from the site; costs of measures will be included in the civil works;

6.2.8 Potential impacts on the safety situation at the plant

Project activities: all project works at the site;

The aim of the project is' zero accident construction. The contractor will be required to prepare an EHS plan before the start of construction activities, the plan should be approved by the PMU.

Impact: no impact, providing the EHS plan is properly implemented;

Mitigation measures: no additional to EHS plan measures are required

6.2.9 Potential impacts on the socio economic development

Project activities: all construction works;

- **Impact on power supply to consumers -** Ad hoc cases of power supply interruptions might be occurring during replacement works for generators or transformers.

Impact: low negative;

Mitigation measures: During rehabilitation/replacement works, single turbines, only 1 at a time will be shut down, if required, BT will ensure the additional feeding into the national grid.

- **Impacts on water supply to consumers -** Units 1 and 2 discharge into the irrigation canal. The canal is the source of irrigation water as well as drinking water for about 40,000 people in Khatlon oblast. During rehabilitation works operation of the irrigation canal might be interrupted but the supply of water to the system of Sarband from the reservoir will not be interrupted.

Impact: low negative;

Mitigation measures: for units 1 and 2 it is proposed to shut only 1 at a time.

- **Income generating activities -** It is expected, that the project will create a number of unskilled jobs for people living in the project area although this will depend on the contractor's proposal. In addition the Contractor's staff will reside in the town Sarband (current population is about 15,000) with the economic benefits in terms of housing and local restaurants and shops that should accrue.

Impact: locally positive;

Mitigation measures: not required;

6.3 POTENTIAL ENVIRONMENTAL IMPACTS OF THE OPERATION STAGE

6.3.1 Potential impact of noise and vibration

Activity: operation of the plant's equipment and mechanisms;

After completion of construction, there will be no significant noise levels in day to day situation. The new generators will be more sound protected then the old ones. Vibration is not an issue in the daily plant's operations.

Impact: no impact;

Mitigation measures; not required;

6.3.2 Potential impact on soil/water resources

Activity: daily plant's operations

The project will address the oil leaks in the power house and in the tailrace area. The situation will be improved comparing to the "before the project" realities. Embankment of the river bank will prevent the further degradation of the slope ground and will protect the site stability as well will prevent additional silting and turbidity of the river flow for downstream dams. .

Impact: locally positive;

Mitigation measures: not required;

6.3.3 Potential impacts on the health and safety aspects at the plant

1. Activity: Personnel's' safety practices;

Improved safety practices will be introduced and adapted at Golovnaya HPP as a resltof the project;

Impact: locally positive;

Mitigation measures: not required;

2. Activity: Operation of new fire protection system

The situation will be improved with new water spray fire protection system and introduction of oil containment facility.

Impact; locally positive;

Mitigation measures: not required;

6.3.4 Potential impact on socio-economic development

Activity: daily operation of upgraded and modernize plant;

The project will result in more reliable power supply within Tajikistan and will reduce the unserved demand during winter.

Impact: regionally positive;

Mitigation measures: not required;

7. ANALYSIS OF ALTERNATIVES

7.1 ALTERNATIVE "PROPOSED PROJECT"

The prioritization of the sites of energy sector of Tajikistan, requiring massive repairs, rehabilitation and modernization was done by BT, based on the design life, current state and share of the site's contribution to the electricity output. The detailed assessment of Golovnaya has shown that most of the plant's value is highly deteriorated and in need for replacement or rehabilitation. The only significant investment in the recent decade is the replacement of one transformer in 2004 and of unit 4 generator (Islamic Development Bank Project, completed in 2012).

The amount of financing available has limited the proposed investment project to be focused solely on the electricity generation part of the plant, leaving 220 kV and 110 kV switchyards currently as they are. The aim of the project is to assure safe operation of the rehabilitated/replaced and modernized assets for the next 50 years, in the country, where the sector currently underserves the population and the economy during winter season. As for environmentally friendly materials and technologies, all proposed solutions for the project reflect the best to date practices in the world. Possible adverse impacts will be minimized or prevented by the sufficient mitigation measures.

As for the alternative way of handling the oil removed from the old transformers and from the old turbine/ generators. The new equipment will be supplied with the new oil. The use of old oil for new equipment is not permitted and it is against of manufacturer's guarantee responsibility. Therefore, the old oil will not be needed at Golovnaya and there is not enough local storage capacity to store. The oil will be collected by BT and transported to other sites for regeneration and reuse.

Removal of gases treatment of oil 9regeneration) is currently not available at Golovnaya, it is recommended that such equipment can be purchased under the project.

7.2 ALTERNATIVE "NO PROJECT"

In the situation "no project" the quality of the HPP Golovnaya operations will continue to degrade, resulting in less and less efficient use of installed capacity, more frequent and longer interruptions in the plant's operations, degraded level of personnel safety and increased probability of work accidents, shortage of electricity to the larder extend, and further rationing of supply (potentially even beyond the winter season).

8. ENVIRONMENTAL MANAGEMENT PLAN

8.1 PLANNED PROJECT IMPLEMENTATION SCHEDULE

The Feasibility Study report in its finalized version is planned to be completed by mid-September 2013. Tender Documents and bid solicitation will occur in late February 2014, with bids due in March 2014. The project implementation is planned for 5 years, from 2015 to 2020.

8.2 PROJECT IMPLEMENTATION ARRANGEMENTS

The project will be administrated by the PMU for Energy Sector Projects, which operates under the Government of Tajikistan since 2006 and supervised by the Ministry of Energy and Industry of RT. The PMU is responsible for implementation of all projects in the energy sector, financed by the Government of RT and IFIs, except for projects of the WB and EBRD, for which the separate PMU is established. The PMU will hire an Implementation Consultant for the purpose of the support of technical supervision of the implementation by be implemented as turnkey contract for detailed design, construction works and installation of equipment.

8.3 ARRANGEMENTS FOR INCORPORATION OF ENVIRONMENTAL SAFEGUARDS MEASURES INTO THE PROJECT

Within the PMU the 'Social Sector and Environmental Monitoring Department is established and presently consists of 8 persons. The department is in full operation and will be responsible for conducting and/or supervising all necessary works in the field of implementation of the mitigation measures and monitoring actions. The overall supervision and advice will be provided by the International Environmental Health and Safety Expert, staff of the Implementation Consultant (4 man-month over implementation period), supported by the Local Environmental Expert, (8 man-month). During the construction period regular inspection visits by staff of "Social Sector and Environmental Monitoring Department" shall be performed twice a month, or more frequently, as advised by the Implementation Consultant. Presence of International Health Safety and Environmental Expert of the Contractor is expected to be at the level of 12 man-month over the 6 year of the project implementation period.

Project Activity	Potential Environmental Impact	Proposed Mitigation Measure	Institutional Responsibility	Cost Estimates
Construction activities in general	Safety hazards to workers	Development and implementation of a site specific EHS Plan	Turn Key Contractor	Included in construction costs
Excavations (river embankment works)	Dust emissions	Under dry conditions spraying of the construction site with water	Turn Key Contractor	Included in construction costs
Waste generation as a result of equipment replacement	Pollution of land with different type of wastes	Excavated soil: if occurs, dumping at the special site at the plant; Packaging: collecting of domestic wastes at construction site regularly, dumping at the official dumping site of the city of Sarband. Metal: recycling is outside of the project scope, but the wastes will be handled by BT Ceramic waste: will be dumped at the dumping site; Asbestos paper: to be removed along with lacquer layer and disposed safely at the Sarband dumping sites, wrapped in PE film, below the surface level, but above ground water level.	Turn Key Contractor	Included in construction costs

Noise	Possible hazard to workers	Use of machines fitted with silencers or mufflers, ear protection devices shall be handed out to all workers. Wearing these devices where 85 db(A) are exceeded;	Turn Key Contractor	Included in construction costs
Shut down of single generator	Power shortages for consumers	Shut down of single generator should be done preferably during summer, when the demand is low. Otherwise, the alternative power supply should be ensured by in-feed from other plants;	Barki Tajik	at no costs to the project
Use of SF_6 in breakers	Release of greenhouse gas SF_6	Proper transportation of gas in steel containers, filling and Proper handling following international standards; installation of state-of-the-art leak detection system;	Turn Key Contractor	Included in construction costs

Project Activity	Potential Environmental Impact	Proposed Mitigation Measure	Institutional Responsibility	Cost Estimates
presence of SF_6 in new generator breakers	Release of greenhouse gas SF_6	Regular checking of function of leak detectors; follow the relevant internationally used guidelines as listed below.	Barki Tojik	Included in operational costs

Uses of new transformers installed by the Project	Transformer oil pollution of the water	Proper use of oil containment facility, use of oil-water separator and proper handling of waste oil, generated after separation.	Barki Tojik	Included in operational costs

8.4 COST OF EMP

For most of impacts of the construction stage, the mitigation costs are incorporated in the scope and costing of civil works and no additional costs for are involved. The only activity from EMP, which is related to the safe removal and disposal of asbestos paper from the rotors of 3 generator units, which will be replaced by the project. The removal and disposal of asbestos will be performed for the first time within the BT sites in accordance with international practices and therefore, requires specific attention and supervision. Therefore, these works will be reflected in the costs of EMP, while still to be performed by the turnkey Contractor. Other costs of EMP consist of related consulting services as part of turnkey contract, as well as part of PMU cost and costs of environmental expertise within the Implementation Consultant scope of services. The overall relate costs are summarised in the table below.

Item of EMP	Duration	Estimated costs
Safe removal and disposal of asbestos containing paper	Lump sum, implementation time is limited to the duration of the project and is in the scope of turnkey Contract.	US$ 500 000
Supervision/support to EMP implementation		
Cost of International EHS expert in the Contractor's team	4 man-month over the 5 year period; intermittent input.	to be known after the turnkey contract is signed
Cost of local Environmental expert in the turnkey Contractor's team	8 man - month over the 5 year period; intermittent input.	to be known after the turnkey contract is signed
Cost of international EHS expert in the Implementation Consultant team	4 man - month over the 5 year period	to be included in the IC's contract, approximately US$ 25K per man – month;
Cost of training in environmental aspect of the project: monitoring and management	lump sum	US$50 000, spread over the project implementation period;
Supervision of EMP implementation by the PMU	Environmental and social monitoring department of PMU, should be present in the project over 5 year period.	part of regular project supervision costs of PMU;

Table 5 – Cost of Environmental Management Plan

8.5 TRAINING REQUIREMENTS

It is expected, that most of training will be done during the course of construction, including training by manufacturer, including the handling and safety measures for dealing with SF6 and for safe removal and disposal of asbestos containing material in accordance with international standards. For other aspects of personal safety and hazardous materials, present at the site of Golovnaya, it is proposed to conduct the special training session a part of the Project launch workshop at the start of the construction. The participants should include: staff of Golovnaya, staff of PMU and relevant units of BT, as well as representatives from the Sarband division of Environmental Protection Agency. The cost of training and source of financing will be specified at later stages.

8.6 ENVIRONMENTAL MONITORING PLAN AND REPORTING REQUIREMENTS

Issue	Action	Responsibility
Hazardous materials in the project generated solid wastes;	Specific control and supervision of removal of asbestos paper and it's proper disposal: through visual inspections and official records;	Contractor under the control of PMU, assisted by IC; in accordance to the schedule for removal of old equipment;
Health and safety at the project site	day to day monitoring	Contractor under the control of IC
Dust emissions	in dry weather conditions, during relevant earth works;	Contractor under the control of IC;
Reporting to ADB:		
Quarterly project progress reports	Reflect the status of project activities, including implementation of EMP	Prepared by the PMU with the assistance of IC
Six monthly environmental monitoring reports	Specific reports on the status of EMP progress in the project	Prepared by the PMU with the assistance of IC

Table 6 – Monitoring Plan and Reporting Requirements

9. PUBLIC CONSULTATION AND INFORMATION DISCLOSURE

The public consultations on the project were conducted in Sarband town, in the conference room of the Town administration on August 6, 2013. The meeting was attended by the representatives of PMU, Golovnaya management staff, Mayor and Deputy Mayor of Sarband, heads of local office of environmental protection, public health office, office of traffic police and population, represented by the heads of mahallya (quarter) committees and apartment buildings association (about 40 persons). The full list of participants is in the Annex 2 to this report.

The introduction to the meeting was done by the Mayor of Sarband, who has explained the goal and expected results of the project: rehabilitation, modernisation, replacement works, giving the additional 50 years of smooth operation to the plant, plus a 10 MW of added installed capacity. In more details, the parameters, benefits and mitigation measures for environmental impacts as well the schedule of the proposed ADB project were presented by the consultants for feasibility study. The major gave guidance on available grievance mechanisms for the community (see paragraph below). There were no any questions from the community representatives. One person has expressed his thanks on behalf of the town of Sarband for the proposed project.

10. GRIEVANCE REDRESS MECHANISM

In the course of the project, people may suffer from accidental environmental impacts or feel otherwise treated unjustly. Due to the fact, all construction works will be on the territory of HPP, only limited factors may influence the nearby communities: increased traffic on the main road to Sarband, and the Contractor's staff, residing in the town. The cases of accidental environmental pollution are very unlikely to happen, and the risk can be only related to transportation of SF6 and release of this greenhouse gas into atmosphere. In such cases, the local division of Environmental Protection agency must be involved and all legal procedures of the RT should be in implemented. In case of individual grievance with the aim to estimate the environmental and economic damages and costs of removal of consequences of the damage, to be carried by the party of fault. These decisions should be made by the relevant courts in RT, and this should be stated in the Contractor's contract. In case of individual complaints (grievance), affected individuals are encourages to inform the local authorities and the Project director (who will be appointed by PMU and will be based in Dushanbe, visiting the project site regularly), as well as copying the complaint to the management of Golovnaya HPP.

The complains regarding the project transport travelling to the site with new equipment and material pr form the site with solid wastes not depending the location of the grievance party, should be delivered to the PMU in Dushanbe. The trucks will be located through the number plate.

11. CONCLUSIONS AND RECOMMENDATIONS

As can be seen from the impact assessment only some low negative impacts will occur mainly during the construction phase. The positive social effects of the construction stage can be expected due to the creation of additional workplaces for unskilled workers, and capacity development of the staff of Golovnaya. During the operational phase, the positive impacts are obvious and consist in a much more reliable and efficient power supply from this source, also targeting better response to demand in winter.

Mitigation measures are given in Sections G of this report along with necessary monitoring actions during construction and operational phases. If the stipulated measures are implemented, the positive effect of this Project on the social side is eminent (regional in Tajikistan and national) whereas the negative impacts on the environmental side are very low. The findings of the IEE are clear and sufficient to meet the aim of ADB's safeguard policy, and there is no need to co carry further assessment in the form of EIA

12. REFERENCES

1. BT Institutional assessment, 2013, ADB grant 0213 TAJ, Regional power transmission project.
2. Tajikistan: winter energy report, WB 2013;
3. ADB, Grant 0124, Nurek 500kV switchyard reconstruction project, IEE report, 2011;
4. ADB TA 7704 KGZ Power rehabilitation project. IEE for Rehabilitation of Toktogul HP, 2012;
5. ADB, Safeguards Policy Statement, 2009;
6. WB, Tajikistan: water and wastewater sector note, 2010;

13. ANNEX 1 - LAND OWNERSHIP ASPECTS OF GOLOVNAYA HPP

The main documents, defining the status of land ownership and land use rights are the Constitution of the Republic of Tajikistan and the Land Code. According to these documents, the land in Tajikistan is the property of the state.

The design of the HPP was completed in 1957 by the: Trust GlAVENERGO USSR, Central Asian Division, Tashkent. During the same year, the state has transferred the proposed land of the size of 60, 01 ha for the sole and permanent use by the Golovnaya HPP.

Previously, the area was used for pastures. As for the land use, the old narrow track railway was on the site territory, ending at the current dam location. The railway was used partly for the purpose of construction, but later was removed to another location, at the original route was in flooded area. At the end of 1980th, the narrow track railway was decommissioned.

On June11, 2008 the most recent land inventory (the letter by land use committee for the town of Sarband is below) has confirmed that the land use rights belong to the Golovnaya HPP within the same borders of 60,01 ha, including: 0,9 ha of underwater area (under river flow) and 59,9 ha of open surface land. The land of water reservoir belongs to the Ministry of Melioration and Water Resources. The Golovnaya HPP pays the land use tax to the local authorities in Sarband

ЧУМХУРИИ ТОЧИКИСТОН
ВИЛОЯТИ ХАТЛОН
КУМИТАИ ЗАМИНСОЗИИ
ШАХРИ САРБАНД

РЕСПУБЛИКИ ТАДЖИКИСТАН
ХАТЛОНСКОЙ ОБЛАСТИ
КОМИТЕТ ПО ЗЕМЛЕУСТРОЙСТВУ
ГОРОДА САРБАНД

Инд. 735140 ш. Сарбанд кучаи Каленин 23
Тел: 6 – 15 – 04, 2-40-36

Инд. 735140 г. Сарбанд улица Каленин 23
Тел: 6 – 15 – 04, 2-40-36

№ 32 «13» 06 2008 с.

Ба директори СНОБВ-и
шахри Сарбанд
мухтарам Эмомов А

Чавоб ба мактуби Шумо аз 11.06.2008 сол № 1/21-168

Кумитаи заминсозии шахри Сарбанд ба маълумоти Шумо мерасонад, ки китьаи замини СНОБВ-и шахри Сарбанд дар майдони 60,01 га чойгир шуда, аз чумла заминхои саноати 22,70 га, чарогох 7,77 га, зери об 0,90 га, богдори ва полезкори 12,42 га, посиракори 4,74 га, майдонхо 1,0 га, сангзор 7,75 га, камишзор 1,0 га, анор ва бог 0,63 га, нуктаи санчиши 0,45 га, ва захбурхо 0,65 га-ро ташкил медихад.

РАИСИ КУМИТАИ ЗАМИНСОЗИИ ШАХРИ САРБАНД **Х.САЛИМОВ**

Ичрокунанда: Абдуллоев С

Picture 4 – Official Letter from Sarband Land Registration Office

14. ANNEX 2 – LIST OF ATTENDEES PUBLIC CONSULTATION FORUM 6 SEPTEMBER 2013

РӮЙХАТИ ИШТИРОКЧИЁН

06.09.2013 ш. Сарбанд

№	Ном ва насаб	Куча/Маҳалла	Имзо
1.	Бузмаков М.	роҳбари КХФ ҶХМК	
2.	Гулоев Али	раиси маҳалла Борбед 33, 35	
3.	Хозаев Раҳмон	Борбед 33, 31	
4.	Мохмадиев Зулмахон	Н. Хуҷаев 45, 47, 42	
5.	Абдуллоев Музаффар	Обинорон – 1, 2, 3, 4	
6.	Мукимов Рустамҷон	Н. Абдуллоев	
7.	Курбонова Гуласаноҳ	И. Сомони 21, 25 Н. Абдуллоев 44	
8.	Хасанова Курбонова	Н. Хусров 37, 29	
9.	Карчиев Ҷамшед	Кӯчаҳои И. Турсунзода, Н. Махсум, Беҳзод, Шероз, Исмоили...	
10.	Комилов Фаррух	Сомони 7, 8	
11.	Курбонов Партов	д. Оқгаза 2	
12.	Носиров Худойберди	д. Оқгаза 1	

1

13.	Шодиев Шериф	д. Гулистон	
14.	Раҷабов Камолиддин	д. Меҳробод	
15.	Файзов Раҷабали	д. Меҳробод	
16.	Нодиров Мустафоқул	д. Оқгазе	
17.	Гуломов Ҳикматулло	д. Меҳробод	
18.	Бутоёров Нозқул	д. Оқгазе	
19.	Қозоқов Сафар	д. Истиқлол	
20.	Сомиев Ашур	д. Устотобенос	
21.	Раҳимова Зебиноз	Борбад ҷ.о, Б. Раҳимзода 3	
22.	Иброҳимова Ҳабибуно	Борбад-16, 14, 29	
23.	Мирмоҳидова Мунавара	Б. Раҳимзода-2 Зебунисо-10	
24.	Саидов Элмурод.	роиси 3/4. Гулистон	
25.	Сарникозова Хафиза	роиси 3/4. Вахдат	
26.	Бобобова Хумоюн	Сомони-8, 4	
27.	Қодиров Ҳамза	п. Фирдавси, Ӯзбекистон Зебониссо	

28.	Азимов Неъмат	деҳқон Тоболо	[signature]
29.	Саидов Ёрмахо	кузов Согд Шахр	[signature]
30.	Мустафова М	кузов Сино	[signature]
31.	Каримов Умар	кузов Ширинсой	[signature]
32.	Ахмедов Бахрида	мохонак нов	[signature]
33.	Сафаров Акрам	Ҷ.Д. Ваҳдат	[signature]
34.	Тоиров Шерали	Ҷ.Д. Ваҳдат	[signature]
35.	Қурбонова Эркамо	К.Д.Ф. Х.И.К.-и ш Сарбанд	[signature]
36.	Гулонова Майрам	К.Д.Ф. Х.И.К.-и ш Сарбанд	[signature]
37.	Хайдарова. Гулнисо	К.Д.Ф. Х.И.К.-и ш Сарбанд.	[signature]
38.	Холиков. Искандар	К.Д.Ф. Х.И.К.-и ш Сарбанд	[signature]
39.	Юлдошев. Баходур	К.Д.Ф. Х.И.К.-и ш Сарбанд	[signature]
40.	Саидахмадов. Маназон	К.Д.Ф. Х.И.К.-и ш Сарбанд	[signature]
41.	Рахимова Гулзан	Ворбод 20-3	[signature]
42.	Рамазонов Х.Н	РМV	[signature]

43.	Ваганов А	PMU	
44.	Peter Graham	Team Leader, CS	
45.	Mavluda Abdullaeva	CS	
46.	Zarina Abdulalieva	ADB	
47.	Лейла Тасимова	CS	
48.	Александр Бурдинов	CS	
49.	Chris Bailey	CS	
50.	Юсео Йексии	MHI, Hatch	
51.			
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15. ANNEX 3 - INFORMATION ON SELECTED ENVIRONMENTAL IMPACTS

Sulfurgexafluoride

Sulfur hexafluoride (SF_6) is used within circuit breakers. This gas is an effective gaseous dielectric that allows the safe transmission and distribution of electricity. SF_6 provides excellent insulation and arc quenching performance, this gas represents the currently best available technology for high and medium voltage breakers (in low voltage breakers, the vacuum is used). SF_6 gas itself is an inert gas, which has no influence on humans, animals or plants. However, as a result of the electric arc, extremely small traces of agents detrimental to health may be formed. On the other hand, SF_6 is a very highly effective and persistent greenhouse gas (substances absorbing infrared). One ton of SF_6 corresponds to about 23,900 tons of CO_2. Once emitted into the atmosphere it lasts more than 3,000 years (!) until SF_6 is disintegrated by energy-rich UV radiation. Up to now, the effects of SF_6 in the atmosphere are minor compared to other industrial greenhouse gases. The total worldwide quantitative contribution to global warming of SF_6 is below 0.1% with respect to the other man-made greenhouse gases (for the European Community it is estimated to be about 0.05%). However, actually the SF_6 concentration in the atmosphere is increasing (an exponential increase in the late 90ties and a slight decrease since beginning of this century is reported) which requires consequently specific careful handling with this substance.

Some guidelines for proper handling of SF_6 are given below:

IEC (DIN EN)* 60376 'Specification and acceptance of new sulfur hexafluoride'

IEC (DIN EN) 60480 'Guide to the checking of sulfur hexafluoride (SF_6)

taken from electrical equipment';

IEC 81834 'High voltage switchgear and control gear – Use and handling

of sulfurhexafluoride (SF_6) in high-voltage switchgear';

The amount of SF_6 emitted during the operational of new breakers will be : manufacturer guarantees annual leak of the gas not more then 0.05%; the staff is trained in proper handling of SF6 (keeping the gas fill record, proper storage refining). The leak detectors should be installed at the site.

Polichlorinated Biphenils (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. PCBs are a group of manufactured organic chemicals. There are no known natural sources of PCBs. PCBs are oily liquids and are colorless or light. They have no known smell or taste.

Due to this fact, there are 209 individually chlorinated chemicals possible, known as congeners. Some of them have a chemical similarity with 2,3,7,8- tetrachlorodibenzo-p-dioxin (TCDD). That is why the WHO considers the toxicity of these PCBs to be similar to the toxicity of TCDD. However, in general the acute toxicity is small, but looking at the chronic effects a high toxic potential of PCBs has to be stated. In addition, PCBs are suspected to cause cancer if people are exposed to these substances over a longer period. Extraordinary problems, however, arise when PCBs are exposed to high temperature as they occur during e.g. transformer fires. Between 600°C and 900°C, PCBs form highly toxic and carcinogenic furans (PCDF) and dioxins (PCDD). The toxicity of dioxins is well known. Destroying of PCB molecules without generating of dioxins requires temperature of about 1,200°C as prevailing in special incineration plants. As it is not possible to analyze all congeners of PCBs, it is internationally accepted to measure six different typical PCBs following DIN 38414 S20 E according to Ballschmiter and Zell. ('Analysis of Polychlorinated Biphenyls (PCB) by Glass Capillary Gas Chromatography, Fresenius Z. Anal. Chem. 1980, 302, 20-31). These measurements allow drawing conclusions about the total PCB content in oil samples. The mentioned PCB congeners are:

PCB 28 2,4,4-trichlorobiphenyl

PCB 52 2,2,5,5-tetrachlorobiphenyl

PCB 101 2,2,4,5,5 - pentachlorobiphenyl

PCB 138 2,2,3,4,4,5-hexachlorobiphenyl

PCB 153 2,2,4,4,5-hexachlorobiphenyl

PCB 180 2,2,3,4,4,5,5-heptachlorobiphenyl.

US EPA gives now the following definitions: 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[3] oil containing less than 50 PBC can be burned in a regular incineration plant. The Stockholm Convention (signed by Tajikistan in 2002) requires to cease production of new PCBs immediately and to eliminate the use of equipment containing PCBs by 2025. PCB was formerly used widespread in capacitors (often trichlorobiphenyl PCB 28) and in smaller distribution transformers.

Asbestos

Asbestos is a group of minerals with thin microscopic fibers. Because these fibers are resistant to heat, fire, and chemicals and do not conduct electricity, asbestos has been mined and used widely in the construction, automotive, and other industries. If products containing asbestos are disturbed, the tiny fibers are released into the air. When they are breathed in, they can become trapped in the lungs and stay there for many years. Over time these fibers can accumulate and lead to serious health problems, often the lung diseases. Asbestos exposure may occur in the workplace, home, or community. Mined and used commercially since the 1800s, asbestos has been used in many products, including: car brake shoes and clutch pads; building materials, including ceiling and floor tiles; paints, coatings, and adhesives; plastics; vermiculite-containing garden products; water supply pipes, roofing material, and some talc-containing crayons. Most cases of asbestos poisoning occur in asbestos workers. There are different forms of asbestos. Although all forms are considered hazardous, different types of asbestos fibers may be associated with different health risks. Most of the countries have banned the use, manufacturing and import of asbestos containing products. In order to support the ban for asbestos, ADB, as well other IFIs do not allow the purchase and use of asbestos containing material under their projects. If asbestos is present at the project site and has to be removed, the removal and its disposal should be done in accordance to international standards (e.g. US EPA standards), as there are no standards for safe disposal of asbestos in Tajikistan.