OSHC "Barqi Tojik"

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Environmental and Social Impact

Nurek Hydropower Rehabilitation Project Phase 2

Republic of Tajikistan

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Acronyms and Abbreviations

BT	Barqi Tojik
CEP	Committee for Environmental Protection under the Government of the Republic of Tajikistan
EE	Environmental Expertise
EHS	Environmental Health and Safety
EHSG	World Bank Group Environmental, Health, and Safety Guidelines
EIA	Environmental Impact Assessment
EMF	Electromagnetic field (or electric and magnetic fields)
EPRP	Emergency Response and Preparedness Plan
ESHS	Environmental, Social, Health and Safety
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
ESMS	Environmental and Social Management System
GRM	Grievance Redress Mechanism
ha	Hectare
HPP	Hydropower plant
HSE	Health, Safety, and Environment
km	Kilometer
LMP	Labor Management Plan (or Procedure)
MW	Megawatt
NGO	Non-Governmental Organization
OHS	Occupational health and safety
OP	Operations Policy
O(J)SHC	Open (Joint) Stock Holding Company
PMC	Project Management Consultant
PMF	Probable Maximum Flood
RT	Republic of Tajikistan
SEP	Stakeholder Engagement Plan
WBG	World Bank Group

1 Introduction

This is the Environmental and Social Impact Assessment of Phase 2 of the rehabilitation of the Nurek Hydropower Project (HPP) in Tajikistan.

1.1 Background

The Nurek Dam and Hydropower Project located in western Tajikistan about 70 kilometers east of Dushanbe (see Figure 1). The dam 300 meters high and is the highest embankment dam in the world. The power plant was commissioned in 1972 with 3000 megawatts (MW) of installed capacity. The dam controls the flows of the Vakhsh River, which joins the Pyanj River to become the Amu Darya. The Amu Darya is the largest river oral Asia, and one of two main tributaries of the Aral Sea.

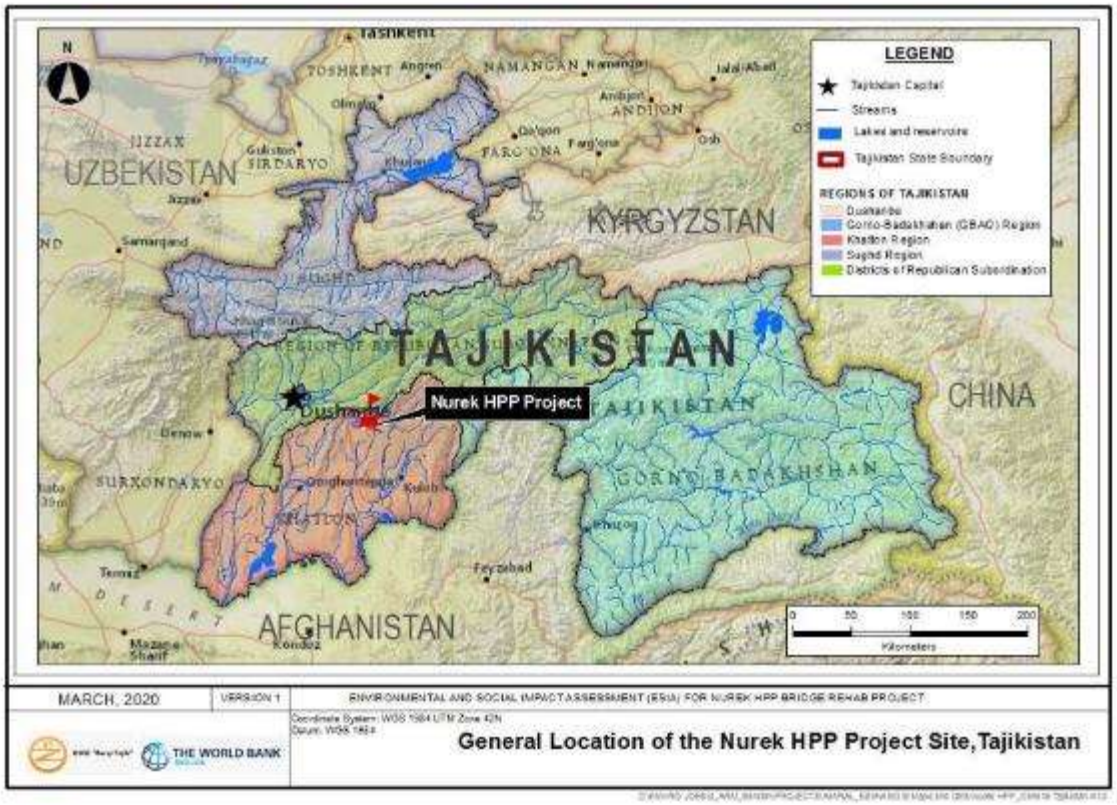


Figure 1. Location of the Nurek Hydropower Project

The Nurek Hydropower Plant (HPP) is a critical power generation asset for Tajikistan because it supplies more than 70 percent of the electricity produced in Tajikistan. In addition to electricity generation, the reservoir directly supplies irrigation water for about 70,000 hectares (ha) of land via a tunnel with additional irrigation of tens of thousands of hectares made possible by further downstream regulation of the Vakhsh River at other, smaller, dams. The Nurek HPP is owned by Open Stock Holding Company Barqi Tojik through its subsidiary Nurek Hydropower Company, which operates the plant and associated facilities. Barqi Tojik owns and operates most of the electricity generating plants and is responsible for electricity transmission, dispatch, and distribution services to around nine million people, covering all but one region of the country.

However, due to vibration of the turbines' generators and fatigue of the runner's metal, the plant is able to operate at only about 77 percent of capacity, with the upper output limit no more than 2320MW of electricity, compared to the installed capacity of 3000MW. In addition, sediment accumulation in the reservoir has resulted in a reduction of storage capacity. Further, due to time and lagging maintenance over the years, spillways were deteriorating to the point that safe discharge of floodwaters over the spillways was becoming compromised, and working conditions in the powerhouse were becoming unsafe. Conditions would be expected to continue to deteriorate if not interrupted with improvements to the power generation infrastructure and other facilities.

The first rehabilitation of the Nurek HPP since its commissioning is intended to increase the operational capacity of the plant and to improve safety. The Nurek Rehabilitation Project ("the project") is intended to meet multiple goals:

- Restore the generation capacity of Nurek HPP through refurbishment of the generating units and the balance of the plant (the "balancer of plant" refers to all key infrastructural components of the plant excluding the turbines)
- Increase efficiency of the generating units through improved hydraulic design and installation of higher efficiency equipment
- Enhance the safety of the Nurek dam through rehabilitation of spillway tunnels, refurbishment of spillway gates/hoisting system, improvement of protection on permeable zone of the embankment dam above the core zone crest, and measures to enhance safety against seismic and hydrological risks.

The rehabilitation of the Nurek HPP is being carried out in two phases. The first phase is underway and includes the rehabilitation of three generating units, the replacement of six auto-transformers used to regulate voltage, and the enhancement of dam safety, with a special focus on protection against seismic hazards and floods The first phase of the rehabilitation project is financed primarily by the World Bank ($325,000,000) with support from the Asian Infrastructure Investment Bank ($60,000,000) and the Eurasian Development Bank ($40,000,000). The remaining six units and the remaining balance of plant will be rehabilitated during Phase 2 of the project. Chapter 2 describes both Phases in more detail.

Barqi Tojik prepared an Environmental and Social Impact Assessment for the two phases of the rehabilitation project in 2017. This ESIA was prepared to meet applicable legal requirements of Tajikistan and the environmental and social safeguard Operations Policies (OPs) of the World Bank including OP 4.01 (Environmental Assessment); OP 4.37 (Safety of Dams); OP 7.50 (Projects on International Waterways), and the World Bank Policy on Access to Information. The 2017 ESIA was approved by Tajikistan authorities and cleared by the World Bank, and the first phase of the project was approved for financing by the World Bank and other Lenders.

Now, the World Bank and other Lenders are considering financing Phase 2 (Chapter 2 includes more detail on each Phase). Since the original ESIA was prepared, however, the World Bank developed and adopted a new Environmental and Social Framework, which includes 10 Environmental and Social Standards (ESSs) that the Bank's clients are required to meet. Phase 2 of the rehabilitation project will therefore need to meet these new standards. As a result, Barqi Tojik has updated the 2017 ESIA so that it meets the requirements of the new Framework and ESSs. The present document is the updated ESIA.

1.2 Purpose of the ESIA

This ESIA is intended to meet requirements established by the World Bank for projects determined to present moderate environmental and social risks. As noted above and in Chapter 2, the 2017 ESIA was reviewed and accepted by the Tajikistan Committee for Environmental Protection under the Government of the Republic of Tajikistan ("the Committee" or "Committee for Environmental Protection"). This updated ESIA will also be submitted for Committee review and approval. Prior to making decisions on proceeding with the project, the World Bank and Barqi Tojik will have to be satisfied that:

- The project will continue to meet Tajikistan national requirements and will meet the World Bank requirements in the 2018 ESSs, in particular ESS1, Assessment and Management of Environmental and Social Risks and Impacts, as described in Chapter 2.
- The project includes such measures as are necessary to avoid or minimize significant adverse impacts to environmental, health and safety, and socioeconomic conditions.
- Appropriate public consultation and disclosure has been undertaken in line with the World Bank Environmental and Social Framework (World Bank 2018) and Tajikistan law, thus ensuring that all reasonable public and other opinions are adequately considered prior to a commitment for proceeding with the project.

1.3 Organization of the ESIA

This updated ESIA is organized as follows:

- Chapter 2 provides a description of the proposed project
- Chapter 3 describes the legal and other requirements that will apply to the project
- Chapter 4 describes baseline conditions of the environmental resources that could be affected and the socioeconomic conditions in the area.
- Chapter 5 describes the methodology by which potential impacts are evaluated and how the project could affect environmental resources, infrastructure, people, and social conditions, and measures that are needed in order to avoid, reduce, or otherwise mitigate those potential impacts
- Chapter 6 summarizes the cumulative impacts the projects could have in combination with other projects and natural processes
- Chapter 7 summarizes how Barqi Tojik has consulted with stakeholders in the past and how it will continue to do so, including disclosing this updated ESIA in order to allow affected people and other interested stakeholders to receive information and provide their comments and opinions on the project
- Chapter 8 identifies and evaluates alternatives to the proposed project
- Chapter 9 outlines how environmental and social performance of the project will be managed and monitored.

2 Project description

2.1 Description of Nurek HPP

The Nurek HPP controls the Vakhsh River and is located near Nurek City (Figure 2). The Nurek Dam is located 30 kilometers (km) upstream of Baipaza dam and about 70km downstream from the Rogun dam, which is under construction. The reservoir extends nearly to the Rogun Dam location and has a surface area of 98 square kilometers (km²) and a volume of 10.5 cubic kilometers (km³) when full. In addition to electricity generation, the reservoir supplies irrigation water to about 70,000 hectares (ha) via a 14-kilometer irrigation tunnel. The Nurek dam is the second-highest dam in operation in the world, and the reservoir is the largest in Tajikistan.

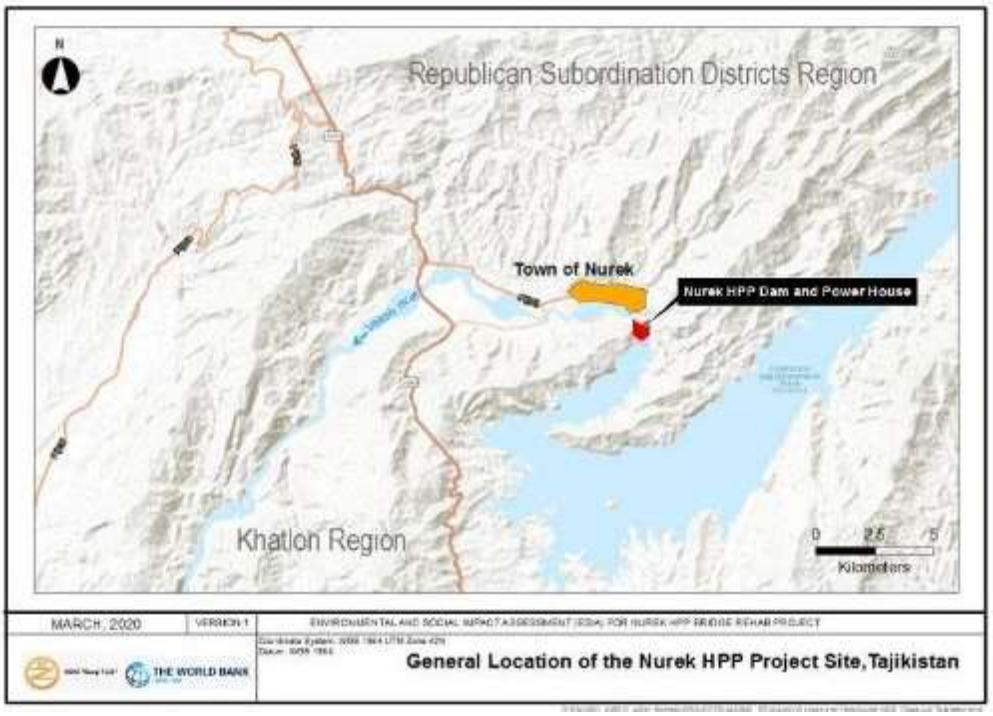


Figure 2. Location of Nurek HPP and Nurek City

The construction of Nurek HPP began in 1961 and the first turbine began operating in 1972. By 1979, the power plant had nine Francis turbines with a capacity of 300MW each (giving a total of 2,700 MW). In 1988, the hydropower capacity was increased to 3,000 megawatts (MW). The long-term average annual hydropower production is 11.2 Terawatt hours (TWh—one terawatt is one billion kilowatts, or one million megawatts).

The main structures at the HPP include the following:

- Embankment dam
- Flood control spillway with surface water intake
- Flood control spillway with submerged water intake
- HPP water intake
- Penstocks

- Turbine hall (HPP powerhouse)
- 220kV switchyard
- 500kV switchyard
- Access roads
- Reservoir and river bed.

Water is supplied to the units through three headrace tunnels that are 395 to 450 meters long with a diameter of 10 meters. The tunnels have collectors at the end with three pressure channels that are 610 to 666 meters long and six meters in diameter. Figure 3 is a schematic of the hydropower complex, while Figure 4 and Figure 5 provide aerial views of the facility. The maximum flow that the HPP can pass is 5,400 cubic meters per second (m^3/s), with 1,360 m^3/s through the turbines and 4,220 m^3/s over two spillways.

The height of the dam, the size of the reservoir, and the fact that the predominant use of downstream river water is for irrigation in spring and summery, means that Nurek reservoir management is a critical element of operation in order to avoid issues of safety and of adverse impacts on downstream socioeconomic conditions (i.e., irrigation). Reservoir management is based on the following principles:

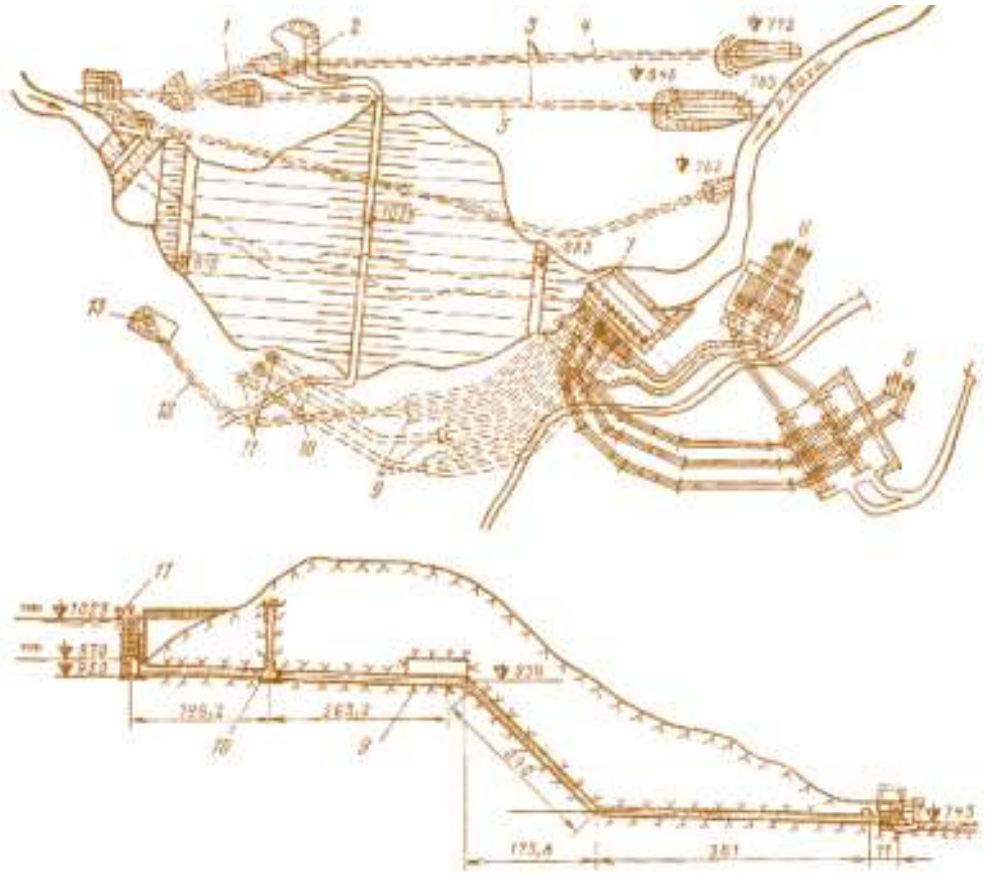


Figure 3. General layout of Nurek HPP

[1 - submerged crown of spillway; 2 - surface crown of spillway; 3 - flood spillway; 4 and 5 - construction tunnels of 3rd and 2nd tier; 6 - 220 kV switchyard; 7 - HPP powerhouse; 8 - 500 kV switchyard; 9 - Y-splice premise; 10 - emergency gate valve; 11 - water intake; 12 and 13 - temporary tunnel and water intake]

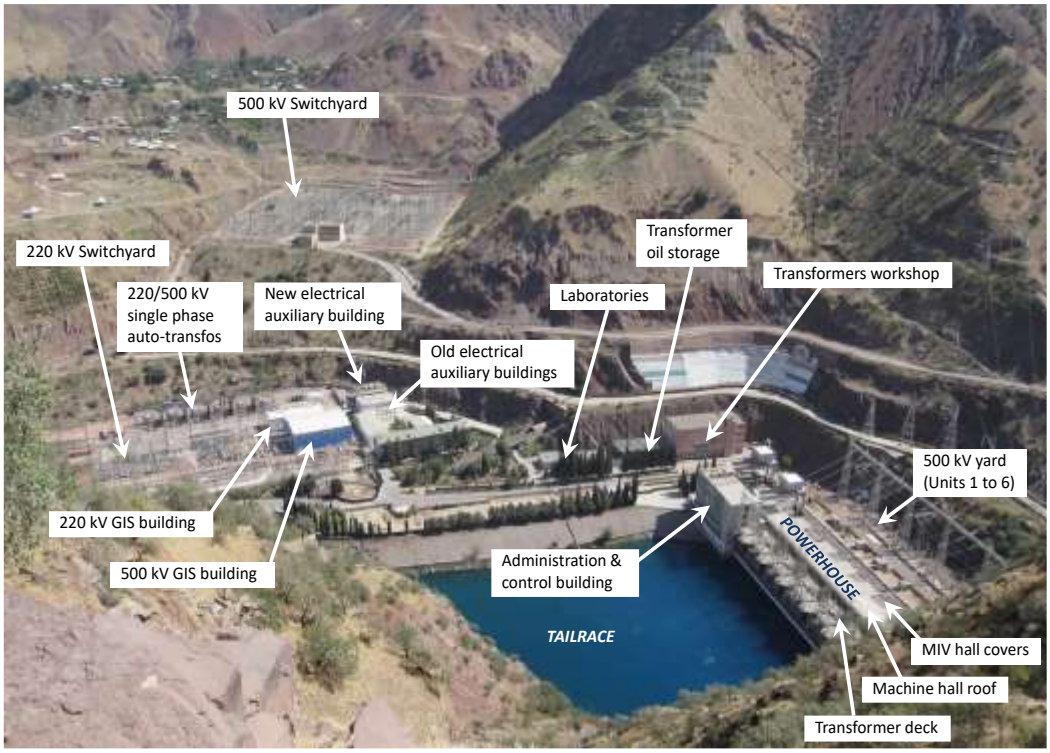


Figure 4. Nurek HPP complex (view from downstream right bank)

Figure 5. Nurek HPP complex (view from above powerhouse)

- In winter, the natural inflows of the Vakhsh River are low so nearly all the active storage in the reservoir is used during the winter season to compensate for the low inflows and maximize winter energy generation. This volume is distributed evenly throughout the season to ensure base energy production.
- In summer, the highest natural inflows of the Vakhsh River occur due to the melting of glaciers in the reservoir's catchment area. Energy production is reduced in summer both due to demand, which is lower than in winter, and to reach the reservoir's Full Supply Level before the end of the summer season.

An operating rule is in force to limit the rate of filling of the reservoir[1]. Following this rule ensures that sufficient water is discharged to serve irrigation needs in downstream Tajikistan and riparian countries. Besides the rule limiting the filling rate, however, the principles are not formally enclosed in an operating manual.

2.2 The Project

The Nurek HPP is one of a cascade series of hydropower projects on the Vakhsh River (Figure 6). Nurek is by far the largest and most important source of energy in the country, pending completion of the Rugun HPP upstream of Nurek. From 1992 to 2005, the Nurek HPP generated about 70 percent of the electricity in Tajikistan's power grid. In 1991, the installed capacity of the HPP was increased from 2,700MW to 3,000MW. The capacity of all turbines except number five had already been increased in 1989 to 335MW. Over the years, however, performance significantly degraded due to excessive vibration and overheating of the units, and as a result the upper limit of output is now no higher than 2,320MW, or 77 percent of nominal capacity. In addition, sediment accumulation in the reservoir has contributed to reduction in generation capacity.

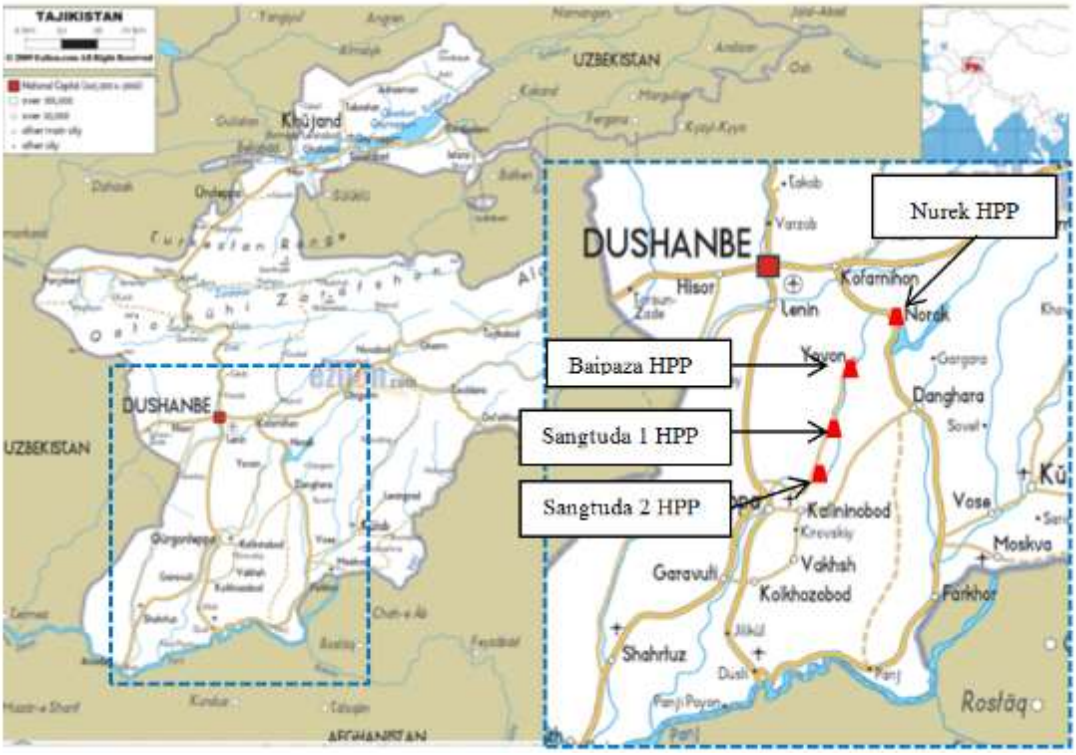


Figure 6. Hydropower projects on the Vakhsh River in Tajikistan

[1] Instruction N°922-11-T112 "About Nurek dam exploitation and surveillance of its condition".

Since the hydropower complex was completed in the 1970s, only limited refurbishment works have been undertaken, and as a result there has been significant deterioration of some infrastructure and of some operating and working conditions. To determine the extent of the action needed to improve conditions and safety, the engineering company Tractebel completed a comprehensive evaluation of the dam, powerhouse, and other structures and facilities[2].

As noted above and in Chapter 1, there are several reasons the project is needed.

- To restore the generation capacity of Nurek HPP through refurbishment of the generating units and the balance of plant (that is, repair other facilities and infrastructure, and replace or overhaul transformers, and improve working conditions, which have deteriorated over the years.
- Increase efficiency of the generating units through improved hydraulic design and installation of higher efficiency equipment. Companies who submit bids to perform the rehabilitation work will have flexibility to propose increased rated capacity as well.
- Enhance the safety of the Nurek dam through rehabilitation of spillway tunnels, refurbishment of spillway gates/hoisting system, improvement of protection on the permeable zone of the embankment dam above the core zone crest, and measures to enhance safety against seismic and hydrological risks and to enhance working conditions at the powerhouse and other facilities.

As noted above, the project works is being carried out in two phases. Phase 1, which is currently underway, includes two main components:

1. Replacement and refurbishment of mechanical, electrical, and electromechanical equipment (three generating units, balance of plant, inspection of penstocks the rehabilitation of three generating units, rehabilitation of spillway gates and intake gates, installation of flood monitoring equipment, replacement of six autotransformers (financed by EDB). This work is substantially on schedule.
2. Enhancement of dam safety, with plans and works reviewed by a Panel of Experts (see below). This will include geotechnical investigations, installation of dam monitoring and geodetic instrumentation. This will begin in the summer of 2020. In addition, this will include rehabilitation of the spillway tunnels, clearing the tailrace channels to lower tailwater levels, and others works as determined to be required. Other related works include optimizing reservoir operating rules to enhance flood-handling capacity and updating the Emergency Preparedness Plan, Dam Operation and Maintenance Plan, and Instrumentation Plan. Evaluations of existing plans and other studies have been underway for some time, and the works will begin later in 2020.

Phase 2 also comprises two main components:

1. Component 1: Rehabilitation of the remaining six generating units and other key infrastructure, and purchase of machinery required for maintenance of the power plant This component includes two subcomponents.

[2] Techno-Economic Assessment Study for Rehabilitation of Nurek HPP and Dam Safety Provisions. 3 volumes, July 2016.

a. Sub-component 1.1: Replacement and refurbishment of six generating units. This sub-component will finance (a) rehabilitation of six power generating units (generators, turbines, main inlet valves, and transformers), auxiliary systems and key balance of plant, and (b) providing spare parts, and operations and maintenance equipment.

b. Sub-component 1.2: Rehabilitation of Nurek bridge, powerhouse, and other buildings/structures at Nurek HPP site, and purchase of machinery. As noted above, the bridge is addressed in a separate document, not this ESIA.

2. Component 2: Technical Assistance, including financing for the Project Management Consultant; a separate Panel of Experts to evaluate matters pertaining to dam safety and other critical issues; technical and other engineering studies; consultant services to support BT with citizen engagement and gender-informed consultative processes during project implementation; capacity building for Nurek HPP and Barqi Tojik staff in dam safety, operation and management of hydropower facilities, project management, including fiduciary and safeguards aspects of the Project; project and management audits; and operating costs of the implementing entity.

Potentially adverse impacts during Phase 2 would result from activities that will take place under component 1, and impacts could occur until the rehabilitation activities are completed. The impacts of the overall rehabilitation project will be overwhelmingly positive, and these positive impacts will be essentially permanent, or at least as long as the life of Nurek HPP.

2.2.1 Dam Safety

In assessing dam safety, Tractebel conducted a comprehensive inspection of the dam and all facilities and activities that support the HPP. They also reviewed new calculations of flood return intervals that were completed during the recent (early 2010s) assessment of the Rogun Dam. At the time the dam was designed, the flood with a return interval of 10,000 years was estimated to be 5,400m^3/s, and the dam was designed to pass this amount of water. Using additional data since the time of design, Tractebel determined the 10,000-year flood would reach 5,670m^3/s and that the PMF was 7,770m^3/s.

The removal of one turbine from service and the degraded condition of the remaining eight turbines (which amounted to the loss of another turbine) reduced the amount of water that could pass through turbines, thus reducing the amount of water the dam could pass under extreme events. In addition, it was determined there was a risk that one or both spillways could malfunction and further reduce the amount of water the dam could handle. The study concluded that the dam was at risk under certain realistic scenarios involving extreme floods and various operational condition.

Tractebel further noted that it is now good international industry practice for dams to be designed to withstand the Probable Maximum Flood, not only the 10,000-year flood. The study concluded with a series of recommendations, which are summarized below and presented in Appendix 1.

2.2.2 Details of work to be performed

The Tractebel study cited above formed the basis for many of the various tasks during the project components described above. Tractebel described in detail the actions needed to overcome deteriorating infrastructure and equipment, improve efficiency, and improve dam safety. In summary, there were multiple recommendations in several categories, including the following:

- Development and updating of technical documentation, including the Emergency Preparedness Plan, the Operation and Maintenance Plan, and the Instrumentation Plan
- Organization of dam and operational surveillance activities, to include detailed evaluations at one - and five-year intervals, and after major events
- Works to improve the electrical supply to the dam, water intake, and spillways to prevent interruptions in case of emergencies
- Works to improve the hydromechanical equipment of the dam tunnels, including installation and/or rehabilitation of sensors, pumps, and other equipment, and a procedure for spillway operation, testing, and maintenance
- Improvements to the monitoring instrumentation for the dam, reservoir rim landslides, downstream slopes, spillway tunnels, and other key areas, including seismic monitoring, and improve the monitoring program, including both measurements and recording
- Conducting regular visual observations of specific areas, including the spillway tunnels, landslides, and other areas
- Conducting investigations and surveys, including a detailed assessment of the spillway tunnel lining (which could not be completed by Tractebel), a bathymetric survey of the reservoir, inspection of spillway gates, compaction of core in specific areas, and other specific investigations and surveys
- Conduct engineering studies, including an assessment of Glacial Lake Outburst Floods, simulation of flood routing under various scenarios, definition of various rule curves and flood risks, enhancement of flood forecasting, update of the seismic hazard assessment, check of seismic design of dam and other areas, update of landslide assessment, check of spillway gates design, establishment of communications with Rogun under construction and during operation, adapting the Emergency Action Plan to account for Nurek under construction and operation, update of switchyard foundation stability assessment, study and modeling of Nurek dambreak wave propagation for input to Emergency Action Plan, and other studies and evaluations.
- Establishment of rules for reservoir operation, including maximum Full Supply Level of 910 meters, preferentially using surface spillway, keeping drawdown rate between 0.5 and 1 meter per day, and clarifying procedure or operating under flood conditions.
- Completion of various civil works, including sealing damaged parts of bottom spillway tunnel, removing rockfalls at surface spillway and installing protection, clearing mud from tunnels, remove poor-quality concrete in certain areas, increasing discharge capacity of one tunnel, and improving water tightness of some cable and tube passes, and other works.
- Improving access and safety of staff, including clearing a road to allow access to spillway outlets, replacing rockfall protection in some locations, installing lighting in tunnels and galleries. Improving ventilation in specific locations and as required elsewhere, and installing stairs with railing in some tunnels.

The number of project workers who will be employed for the various subprojects is not yet known but is estimate to reach about 650 at the peak; at present, there are about 180 workers involved in Phase 1 works involving electromechanical and penstock rehabilitation and other rehabilitation works, including asbestos removal. Nearly all workers are and will be employed by contractors, which will

each determine their individual labor needs. Bidding documents to select the design and construction contractors for various Phase 2 subcomponents (one contract per subcomponent listed above) are in the process of preparation. Tenders for Phase 2 contracts will be announced in 2020 and works will begin later in 2020.

Barqi Tojik has appointed Stucky Ltd. as the Project Management Consultant. In that role, Stucky will be responsible for supporting Barqi Tojik during the procurements and contractor selection process and for supervising contractor performance. In addition, Barqi Tojik will appoint a consultant to work with Stucky and assist in supervising the contractors' environmental, social, and health and safety performance.

2.2.3 Refurbishment Work Schedule

The detailed schedule is shown in Appendix 1. The preferred alternative (see Chapter 8) will involve rehabilitating one generating unit at a time. This would involve taking each unit out of service one after another, and putting the unit back in service before the next one is taken out. Site activities during rehabilitation of each unit will take 10-11 months from taking out of service, dismantling it, rehabilitating and repairing, installing, and placing back in service. Procurement and transport of turbines would begin during the dismantling and installation phases of the previous one to avoid delays between units. The entire project will take about 10 years.

During the entire rehabilitation project, Nurek HPP will continue operating, with turbines taken out of service for rehabilitation in sequence. Therefore, the 730+ Nurek employees will continue to be on site and continuing their normal duties alongside contractor personnel who are completing the rehabilitation works.

3 Policy, Legal and Regulatory Framework

This chapter 2017 the national and international legal requirements that will apply to the Nurek HPP Rehabilitation Project.

3.1 National Legal and Regulatory Framework

The Law on Environment Protection, the so-called "framework environment law", was adopted in 2011 (21 July 2011, № 208). The previous Law on Nature protection was adopted in 1993 and amended in 1996, 2002, 2004 and 2007. In 2011 it was replaced by the new Law. The new Law stipulates that Tajikistan's environmental policy should give priority to environmental actions based on scientifically proven principles to combine economic and other activities that have an impact on the environment with nature preservation and the sustainable use of resources. The Law defines the applicable legal principles, the protected objects, the competencies and roles of the Government, the State Committee for Environment, the local authorities, public organizations and individuals. The Law also defines measures to secure public and individual rights to a safe and healthy environment and requires a combined system of ecological expertise and environmental impact assessment of any decision on an activity that could have a negative impact on the environment. The Law defines environmental emergencies and ecological disasters and prescribes the order of actions in such situations, defines the obligations of officials and enterprises to prevent and eliminate the consequences, as well as the liabilities of the persons or organizations that caused damage to the environment or otherwise violated the Law. The Law establishes several types of controls over compliance with environmental legislation: State control, ministerial control, enterprise control, and public control. State control is affected by the Committee for Environment Protection, the Sanitary Inspectorate of the Ministry of Health, the Inspectorate for Industrial Safety and the Mining Inspectorate. Public control is carried out by public organizations or trade unions and can be exercised with respect to any governmental body, enterprise, entity or individual.

3.1.1 Environmental and Social Impact Assessment in Tajikistan

Two laws establish requirements for impact assessment: The ***Law on Environment Protection*** and the ***Law on Ecological Expertise***. Chapter V, Articles 35-39 of the Law on Environment Protection (2012), introduces the concept of state ecological review (literally, "state ecological expertise" – SEE), the purpose of which is to examine the compliance of proposed activities and projects with the requirements of environmental legislation and standards and with the ecological security of society. These laws emphasize the cross-sectoral nature of SEE, which must be scientifically justified, comprehensive, and objective and which should lead to conclusions in accordance with the law. SEE precedes decision-making about activities that may have a negative impact on the environment. Financing of programs and projects is allowed only after a positive SEE finding has been issued. Among activities and projects subject to state ecological review are construction and reconstruction of various types of facilities irrespective of their ownership.

The laws require that all types of economic and other activities be implemented in accordance with existing environmental standards and norms and have sufficient environmental protection and mitigation measures to prevent and avoid pollution and enhance environmental quality. Environmental impact studies analyzing the short- and long-term environmental, genetic, economic, and demographic impacts and consequences have to be evaluated prior to making decisions on the sitting, construction, or reconstruction of facilities, irrespective of their ownership.

The legal and regulatory system for EIAs also include:

- Procedure of Environmental Impact Assessment, adopted by the Resolution of the Government of the Republic of Tajikistan No. 509 as of 01.08.2014
- Procedure to implement State Ecological Expertise, approved by the Resolution of the Government of the Republic of Tajikistan No. 697 as of December 3, 2012
- Guidelines on the composition and order of development of content and structure of documentation to be submitted for review as part of SEE
- List of objects and types of activity for which preparation of documentation on Environment Impact Assessment is mandatory, adopted by the Resolution of the Government of the Republic of Tajikistan No. 253 as of June 3, 2013. This extensive list contains 180 types of activities that are grouped according to four environmental impact categories (from (I) "high risk" to (IV) "local impact"). If the facility is not included in the list, then it is not required to pass an EIA or a SEE.

EIA responsibilities. Conducting the EIA study is the responsibility of the project proponent, in this case Barqi Tojik. The Procedure for carrying out the EIA (Government Resolution No. 509 of 2014) establishes general requirements for contents of the EIA documentation. The State Ecological Expertise for all investment projects is the responsibility of the Committee for Environmental Protection and its regional offices. The 2012 Law on the State Ecological Expertise requires that all civil works, including rehabilitation, should be assessed for their environmental impacts and the proposed mitigation measures reviewed and monitored by the Committee. The 2017 ESIA was reviewed and approved by the Committee, and this updated ESIA, along with the Environmental and Social Management Plan for the bridge rehabilitation, will be submitted for Committee review and approval.

Screening categories. The law on Environment Protection and the Law on Environmental Expertise stipulate that the Government is to approve a list of activities for which the complete EIA is mandatory. The current guidelines for EIAs do not provide for any preliminary assessment of the project to decide on the need for an EIA (screening) or define the scope of the EIA's contents. This is because the list of objects and activities for which the development of EIA materials is required is already very detailed. Therefore, although the CSP will not be required to prepare an EIA per existing legislation, upon its approval it will be necessary to consult with the experts for further guidance on compliance with the SEE.

The Law on Environmental Expertise provides for the rights of citizens to conduct Public Environmental Expertise (art. 7). Tajikistan is also party to the 1998 Aarhus Convention (July 17, 2001) that contains provisions for public EE. The 2014 Procedure (Order) for Conducting an EIA also describes procedures for public participation. Public participation procedures are envisaged for all categories of projects, although in practice they are mainly applied to Category I projects. The Procedure (Order) for conducting the EIA of 2014 changed the focus and timing of public discussions. Compared to the 2006 version of the Procedure for preparing EIAs which provided the opportunity for public inputs during the scoping stage while drafting the technical task, the 2014 version of the Procedure provides space for public discussions only after the preparation of the EIA report.

3.1.2 Other Relevant Legislation on Environmental and Social Matters

Other key laws and requirements will also apply to the project or be relevant for design or operation.

A number of legal acts establish liability for violation of environmental laws, which can be enforced by several State bodies. In particular, the 2010 ***Code of Administrative Violations*** establishes administrative liability for organizations, their officers and individuals for a range of violations, including careless treatment of land, violation of rules for water use or water protection or failure to comply with a SEE. Administrative sanctions for environment related violations can be imposed by the administrative commissions of Hukumats, courts, Committee for Environmental Protection inspectors, the Veterinary Inspectors of the Ministry of Agriculture, and the State Committee for Land Management and Geodezy. The most common administrative sanction is a fine of up to 10 minimal monthly salaries for individuals and up to 15 minimal salaries to officers of organizations. The 1998 Criminal Code also covers crimes against ecological safety and the environment, such as violations of ecological safety at work, poaching and spoiling land, as well as violation of rules for the protection and use of underground resources. The maximum fine is up to 2,000 minimal monthly salaries and the maximum sentence is up to eight years in prison.

The ***Law on Environmental Information*** (2011) is underpinned by Article 25 of the Constitution, which states that governmental agencies, social associations, and officials are required to provide each person with the possibility of receiving and becoming acquainted with documents that affect her or his rights and interests, except in cases anticipated by law. The Law defines the legal, organizational, economic, and social bases for providing environmental information and establishes the right of individuals and legal entities to receive complete, reliable, and timely environmental information. Article 4 provides the right of access to environmental information and Article 8 defines the conditions for restricting access to environmental information.

The ***Water Code*** (2000, last amended 2012) establishes policies on water management, permitting, dispute resolution, usage planning and cadaster. It promotes rational use and protection of water resources exercised by all beneficiaries and defines the types of water use rights, authority and roles of regional and local governments for water allocations among various users, collection of fees, water use planning, water use rights and dispute resolution. The Code provides Water User Associations with the mandate to operate and maintain on-farm irrigation and drainage infrastructure.

Two articles of the Water Code are directly relevant to the project. Article 83 (“Using water resources for energy consumption"" and Article 84” (The rights and responsibilities of hydropower companies on water usage") provide that energy companies are authorized to use water to produce electricity based on approval of the project, to organize better uses of reservoirs, taking into account water protection measures, and to require individuals to comply with the rules of normal use of reservoirs for hydropower purposes. Hydropower systems are in turn required to control the level of the reservoir, ensure the project does not affect water quality, to include a fish pass in the design, and to ensure the structure withstands floods and other natural disasters and that other measures are taken in case of floods.

The ***Health Care Code*** (2017) replaced the previous ***Law on Sanitary and Epidemiological Safety of the Population*** (2003, last amended 2011), which introduced the concept of sanitary and epidemiological expertise that establishes the compliance of project documentation and economic activities with the state sanitary and epidemiological norms and rules, as well as strengthened provisions on sanitary-hygienic, anti-epidemic and information measures. These include limits for noise that will apply to the project.

The ***Labor Code*** (2016) prohibits forced labor and adult labor. The Labor Code prohibits discrimination in employment and sets the minimum age at which a child can be employed as well as the conditions under which children can work. The minimum employment age is 15, however, in certain cases of vocational training, mild work may be allowed for 14-year-olds. In addition, there are some labor restrictions on what type of work can be done, and what hours of work are permissible by workers under the age of 18. The Code also establishes rules for minimum wages, leave, overtime, and has provisions for pregnant women and caretakers for children. It also sets the rules for settling disputes between workers and employers.

The ***Labor Code*** also sets requirements for occupational health and safety. It establishes the right of workers to work in places that are protected from exposure to dangerous and harmful factors. Employers are required to tell workers of risks and hazards of their jobs, and requires employers to provide personal protective equipment. Employers are required to provide compulsory social insurance against accidents, disease, or injuries associated with their jobs. The law gives workers the right to refuse to undertake work that violates labor protection requirements. In addition, workers engaged in hazardous working conditions are entitled to free medial and preventative care, additional paid leave and other benefits and compensation. In case of disability or death, employers must provide compensation in multiples of average annual earnings. Employers must train workers in performing their work safety and must provide for collective and personal protection of workers. Accidents must be investigated. Finally, there must be a "labor protection service" if there are more than 50 employees.

The ***2010 Law on the Safety of Hydrotechnical Infrastructure*** applies to infrastructure for hydropower and flow regulation, and flood protection. The Law places the responsibility for safety of hydrotechnical infrastructure on the owners and users of such facilities, who must ensure compliance with safety rules during construction and exploitation, perform regular inspection and safety assessment, take measures to ensure safe operation, ensure development and updating of safety criteria, and keep local warning systems operational. The Law introduces such instruments such as a declaration of safety that has to be completed by the owners or users at various stages of the installation's life. In 2015, the Government enacted subsidiary legislation: "Procedures for development and operation of state expertise for declaring the safety of hydrotechnical infrastructure", "Procedures for establishment and maintenance of the State Register of Hydrotechnical Facilities", and "Procedures for defining the financial limits of civil liability for damage caused as a result of an accident at a hydrotechnical facility" (2015 ***Resolution of the Government No. 436***).

Under the ***Law on Public Associations*** (2007, last amended 2019), a public association may be formed in one of the following organizational and legal forms: public organization, public movement, or a body of public initiative. Article 4 of this law establishes the right of citizens to found associations for the protection of common interests and the achievement of common goals. It outlines the voluntary nature of associations and defines citizens' rights to restrain from joining and withdrawing from an organization. This legislation requires NGOs to notify the Ministry of Justice about all funds received from international sources prior to using the funds and to post financial information on their websites.

The ***2014 Law on Public Meetings, Demonstrations and Rallies*** (Article 10) bans persons with a record of administrative offenses (i.e. non-criminal infractions) under Articles 106, 460, 479 and 480 of the Code for Administrative Offences from organizing gatherings. Article 12 of the law establishes that organizers must obtain permission fifteen days prior to organizing a mass gathering.

The ***Law on Self-Government Bodies in Towns and Villages*** (1994) and the ***Law on Local Public Administration*** provide the legal basis for local government. The former law assigns to Jamoats a broad range of competencies and the mandate to support community efforts to address local socioeconomic needs. The 2009 amendment aims to strengthen local self-governance and accountability by delegating budget authority to Jamoat councils, and introducing a system of direct election for Jamoat councilors. The 2017 amendment allows Jamoat councils to retain non-tax revenues earned through the provision of administrative services and a percentage of local property taxes. The 2017 amendment suggests a seriousness on the part of national government to enact policies that empower Jamoat councils with authorities and resources needed to support local development and problem-solving.

The 2010 ***Law on the Safety of Hydrotechnical Infrastructure*** applies to infrastructure for hydropower and flow regulation, and flood protection. The Law places the responsibility for safety of hydrotechnical infrastructure on the owners and users of such facilities, who must ensure compliance with safety rules during construction and exploitation, perform regular inspection and safety assessment, take measures to ensure safe operation, ensure development and updating of safety criteria, and keep local warning systems operational. The Law introduces such instruments such as a declaration of safety that has to be completed by the owners or users at various stages of the installation's life. In 2015, the Government enacted subsidiary legislation, "Procedures for development and operation of state expertise for declaring the safety of hydrotechnical infrastructure", "Procedures for establishment and maintenance of the State Register of Hydrotechnical Facilities", and "Procedures for defining the financial limits of civil liability for damage caused as a result of an accident at a hydrotechnical facility" (***2015 Resolution of the Government No. 436***).

Other Tajikistan legislation that could apply to project-related activities are listed in Table 1.

Table 1. Other potentially relevant legislation

Law of Republic of Tajikistan on Appeals of Individuals and Legal Entities
Law on Protection of Atmospheric Air (will require permit for emissions)
Law on Hydrometeorological Activity (no specific requirements)
Law on Land Administration
Law on Environmental Audit (may be required by Committee for Environmental Protection)
Law on Radiation Safety
Law on Production and Consumption of Waste (permit will be required)
The Law on Environmental Education
The Law on Environmental Monitoring
The Law on Specially Protected Natural Areas (none could be affected)
Law on Protection of Fauna (would require permission if take fauna)
Law on Protection of Flora (would require permission if cut flora)
Water Codex (permission for water usage required)

3.1.3 Permits and permissions required

Table 2 shows an indicative list of permits, license, authorizations, and other permits required from various authorities.

Table 2. Permits and permissions required

Description of authorization document	Date of issue	*Issuing authority*
Design stage (Barqi Tojik)		
Conclusion of the State Ecological Expertise on the project	2017 (original ESIA)	Committee for Environmental Protection (CEP)
Conclusion of the State Ecological Expertise on the project	Following updated ESIA	Committee for Environmental Protection
Construction stage (contractor)		
License to conduct the type of activity	Prior to construction	Ministry of Industry and New Technologies of the Republic of Tajikistan
Permission for land use for the construction of the camp, asphalt and concrete plants and the development of quarries for the extraction of soil for the preparation of building materials (gravel, sand, crushed stone) and excavation for road pavement.	Prior to construction	Local authorities (Hukumats)
Permission for special water use	Before and during construction	Committee for Environmental Protection
Permission for emissions of harmful substances into the atmosphere (MPE) from stationary and mobile sources	At the construction stage	Committee for Environmental Protection
Permission for discharge of hazardous substances into water bodies (MPD)	At the construction stage	Committee for Environmental Protection
Permission for land acquisition for temporary storage of construction waste (substandard soil, old asphalt, dismantled concrete products, etc.)	At the construction stage	Committee for Environmental Protection
Permission to remove construction and household waste for storage in specially designated areas (disposal areas)	As required	Local authorities (Hukumats)

3.2 Central Asian Water Management Agreements

3.2.1 Protocol 566

Prior to independence in 1991, the Soviet Union became concerned about the water crisis of the Aral Sea, which occurred in the late 1980s. The water allocation among the Soviet Republics of the Aral Sea Basin was thus established in a series of resolutions and protocols:

The Scientific and Technical Council of the Ministry of Water Resources established water distribution limits for the Amu Darya basin on March 12, 1987 (see Table 3). The four Soviet riparian states of the Amu Darya basin (Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan) formally endorsed this agreement in Moscow on September 10, 1987 as ***Protocol 566***[3]**.** This agreement was concluded in order to limit water use in the basin and to secure additional flows (called Ecological/Sanitary flows) to the Aral Sea.

The protocol addresses water sharing principles between the Soviet Union countries, assuming Afghanistan would abstract 2,100 million m^3/yr. Protocol 566 is still used today as a reference document for discussions on water allocation between the four countries of the Amu Darya basin. The protocol gives no information on the way these annual water allocations shall be split in time (during the year) or in space (by sub-basin).

In this Protocol, the Rogun and Zeid reservoirs were considered constructed (Zeid was already built at the time). These reservoirs and the coordinated operation of water infrastructures within the Amu Darya basin must guarantee the availability of 61,500 million m^3 of water every year (without Rogun and Zeid, and with only Nurek and Tyuyamuyun reservoirs as major regulating structures, the guaranteed volume was 54,600 million m^3).

In the water allocation context, it is useful to take note of the related issues of the Syr Darya Basin. Syr Darya and Amu Darya basins constitute the Aral Sea Basin, which has been treated as a unit for many decades. The Aral Sea Basin extends over five former Soviet Republics, namely Kazakhstan and the four riparian states of the Amu Darya.

Table 3. Water distribution limits in the Amu Darya Basin

Country	*Maximum allocation million m^3/year)*	*Share percentage (%)*
Kyrgyz Republic	400	0.7
Tajikistan	9,500	15.4
Uzbekistan	29,600	48.1
Turkmenistan	22,000	35.8
Total for basin	***61,500***	***100***
Uzbekistan	22,000	50
Turkmenistan	22,000	50

3 Protocol 566: *Improvement of the Scheme on Complex Use and Protection of Amu-Darya Water Resources* by Scientific and Technical Council, Ministry of Land Reclamation and Water Management of the USSR, September 10, 1987.

Two Basin Water Organizations (BVO, Basseynoe Vodnoe Obedinenie) were created during Soviet times, one for the Amu Darya and one for the Syr Darya).

3.2.2 September 19, 1988 Decree

In accordance with the objective of Protocol 566, on September 19, 1988, the Council of Ministers of the Soviet Union issued ***Decree 1110,*** "*Measures for Radical Improvement of Ecological and Sanitary Situation in the Region of the Aral Sea, Enhancing the Efficiency and Use to Strengthen the Protection of the Water and Land Resources in its Basin*".

This Decree specified minimum inflow volumes for the Amu Darya and Syr Darya and to the Aral Sea (including drainage waters) as follows: 8,700 million m^3 in 1990; 11,000 million m^3 in 1995; 15,000 million m^3 in 2000; and 20,000 million m^3 by 2005. These annual minimum environmental flow volumes to the Aral Sea agreed upon in this Decree are still considered to be valid by the four countries.

3.2.3 October 12, 1991 Declaration

On October 12, 1991, a joint statement of the Water Ministers of the five post-Soviet states in the Aral Sea basin (Kazakhstan, the Kyrgyz Republic, Tajikistan, Turkmenistan and the Uzbekistan) was issued with regards to compliance and continuity in the allocation of water to the various Republics.

3.2.4 February 18, 1992 Agreement

On February 18, 1992, within a year of their independence, these five Central Asian countries signed an agreement regarding transboundary water resources[4]. The "*agreement on cooperation in joint management, use and protection of interstate sources of water resources*" or ***Almaty agreement***. In this agreement, they agreed to maintain and adhere to the sharing of the transboundary water resources as set out in Protocol 566 for the Amu Darya (and in another document, Protocol 413, for the Syr Darya[5)].

These agreements form the basis for the current water allocation practice among the Central Asian states (Kyrgyzstan, Tajikistan, Uzbekistan and Turkmenistan for the Amu Darya basin). The Almaty agreement established an Interstate Commission for Water Coordination (ICWC) and designated it as the body responsible for the definition of seasonal allocations in line with the annual agreements. The Syr Darya BVO and the Amu Darya BVO are the operative branches of the ICWC.

3.2.5 September 20, 1995 Nukus Declaration

Although it does not specifically refer to Protocol 566, the ***Nukus Declaration*** restates this agreement on water sharing that allots a percentage of annual river flow to each state along the river.

4 Agreement between the Republic of Kazakhstan, the Kyrgyz Republic, the Republic of Tajikistan, Turkmenistan and the Republic of Uzbekistan on cooperation in interstate sources' water resources use and protection common management, February 18, 1992.

5 Protocol 413: Improvement of Scheme of Complex Use and Protection of Water Resources of Syr-Darya Basin, February 7, 1984.

3.3 International Obligations

In addition to national legislation and regulations on environmental issues, Tajikistan is also party to a number of international treaties focused on environmental issues:

- Vienna Convention for the Protection of the Ozone Layer, 1996, as updated
- UN Convention to Combat Desertification (CCD), 1997
- UN Convention on Biological Diversity (CBD), 1997, as updated by Cartagena and Nagoya protocols
- Ramsar Convention (joined 2000)
- Bonn Convention on the Conservation of Migratory Species of Wild Animals (joined 2001), as updated by Bukhara Deer Memorandum, 2002
- UN Framework Convention on Climate Change, 1998, with related update Kyoto Protocol, accessed on December 29, 2008, and entered into force on March 29, 2009
- Stockholm Convention on Persistent Organic Pollutants (ratified 2007), as updated
- Aarhus Convention (UNECE Convention on Access to Information, Public Participation in Decision Making and Access to Justice in Environmental Matters) (joined 2001), as updated by Kiev Protocol on Pollutant Release and Transfer Registers to the Convention on Access to Information, on May 21, 2003
- Convention on International Trade in Endangered Species of Wild Fauna and Flora, 2016
- UNESCO Convention Concerning the Protection of the World Cultural and Natural Heritage (joined 1992)
- Rotterdam Convention on Prior Informed Consent (PIC) procedure on September 28, 1998, ratification pending
- The United Nations Convention to Combat Desertification (1997);
- Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (2016)

In addition, Tajikistan has ratified a number of core labor standards of the International Labour Organisation, including the following:

- Forced Labor (C029) and Abolition of Forced Labor (C105)
- Minimum Age (C138) and Worst Forms of Child Labour (C182)
- Discrimination (C111)
- Freedom of Association and the Right to Organize (C087)
- Right to Organize and Collective Bargaining (C098)
- Equal Remuneration (C100)

3.4 World Bank Environmental and Social Standards

3.4.1 Environmental and Social Framework

Barqi Tajik is seeking financing for the project from the World Bank, which requires that the project meet the Bank's environmental and social standards, as well as relevant Tajikistan legislation if it is more stringent. The World Bank's Environmental and Social Framework (ESF) includes the Environmental and Social Policy for Investment Project Financing, which describes the requirements the Bank must follow for projects it supports through Investment Project Financing, and 10 Environmental and Social Standards (ESSs), which establish requirements for Borrowers and grantees such as Barki Tajik to identify, assess, and control environmental and social risks and impacts of Bank-supported projects. Relevant ESSs include:

- ESS1: Assessment and Management of Environmental and Social Risks and Impacts: identification, control, and monitoring of risks and impacts, including identification of applicable requirements and monitoring outcomes.
- ESS2: Labor and Working Conditions: labor relations, rules of employment, occupational health and safety, workforce protection, worker grievance mechanism, with specific requirements for contractor and subcontractor employees.
- ESS3: Resource Efficiency and Pollution Prevention and Management: conservation of resources and control/prevention of wastes and pollution.
- ESS4: Community Health and Safety: avoidance and control of risks and impacts on communities from project activities and workers, emergencies, security, and other factors. ESS4 includes an annex outlining procedures for Safety of Dams.
- ESS10: *Stakeholder Engagement and Information Disclosure*: identification and engagement of local and other stakeholders throughout the project life cycle, disclosure of project information, grievance redress mechanism for external stakeholders.

The following Standards do not apply to the Project:

- ESS5: *Land Acquisition, Restrictions on Land Use and Involuntary Resettlement*: There is no physical or economic displacement associated with the Project as there is no expansion of Project activities, either during construction or operations, beyond its existing footprint, which has been established for nearly five decades.
- ESS6: *Biodiversity Conservation and Sustainable Management of Living Natural Resources* is not relevant for the Nurek HPP rehabilitation since potential impacts on the Vakhsh River would be extremely limited. It is noted that a separate ESMP is being developed for the proposed repair and upgrade of the bridge over the Vakhsh River.
- ESS7 *Indigenous Peoples/Sub-Saharan African Historically Underserved Traditional Local Communities*) is also not relevant since there are no communities that meet the World Bank criteria for Indigenous Peoples living within the Project's area of influence.
- ESS8: *Cultural Heritage*: protection of tangible and intangible cultural heritage. As with ESS5, there is no expansion of Project activities, either during construction or operations, beyond its existing footprint, which has been established for nearly five decades.
- ESS9 (Financial *Intermediaries)* is not relevant since Bank funding is not being provided to financial institutions for further on-lending.

Table 4 summarizes the ESSs and provides a summary of key gaps between the World Bank's environmental and social standards and comparable Government of Tajikistan regulatory requirements. As noted, the more stringent of the requirements will apply to the Project.

3.4.2 World Bank Operational Policy 7.5, Projects on International Waterways

In addition to the Environmental and Social Framework, Operational Policy 7.50 applies to projects on international waterways, which includes rivers that form boundaries between countries, or their tributaries, The Policy requires notification of all countries of the project details. The Vakhsh River is considered an International Waterway since it is a tributary to the Amu Darya, which runs through Turkmenistan and Uzbekistan and forms a border of Afghanistan. The World Bank notified these riparian countries at the time of Phase 1, and will again notify them of Phase 2 in the spring of 2020.

3.4.3 World Bank Group Environmental, Health, and Safety Guidelines

The World Bank Group has promulgated a number of Environmental, Health, and Safety Guidelines (EHS Guidelines). Among those applicable to this project include: *General EHS Guidelines* (April 30, 2007), which provides guidance for environmental controls during facility construction and operation (air and water emissions, hazardous materials management, noise, contaminated land, etc.) and occupational and community health and safety during operation. This guideline also covers the same topics for construction. In addition, the *EHS Guidelines for Electric Power and Distribution*, which include relevant information on power transmission between the powerhouse and the facility's substation.

3.4.4 World Bank Good Practice Notes

Several good practice notes promulgated by the World Bank are potentially applicable to the project, including:

- *Asbestos: Occupational and Community Health* (2009). This Note (2009) provides guidance on the handling, storage and disposal of asbestos containing materials and to minimize the health risks related to occupational asbestos exposure among workers and communities. The Good Practice Note provides a list of resources on international good practices available to minimize these risks.
- *Non-Discrimination and Disability* (2019) describes how environmental and social assessment and other steps in World Bank financing can identify and overcome issues related to nondiscrimination and disability.
- *Addressing Gender Based Violence in Investment Project Financing involving Major Civil Works* (2018) provides guidance on identifying approaches to identifying risks of gender-based violence, in particular sexual exploitation and abuse, and sexual harassment, and to providing advice to best manage such risks.

Gender (2019) explains how the World Bank Environmental and Social Framework supports the closure of gaps between men and women, girls, and boys, and enhance women's leadership and voice.

In addition, the IFC *Good Practice Note on Environmental, Health and Safety Approaches for Hydropower Projects* (2018) is a technical reference document with industry-specific examples of Good International Industry Practice (GIIP) in the hydropower sector.

The recent *World Bank Group Response to COVID019 Advisory note on Contingency Planning for Existing Operations* provides guidance for preparing for dealing with outbreaks of the disease among workers or communities.

3.5 Environmental and Social Risk Classification

The World Bank ranks the overall environmental and social risk associated with all projects that it finances into one of four classifications: High Risk, Substantial Risk, Moderate Risk, or Low Risk. In determining the appropriate risk classification, the Bank takes into account relevant issues, such as the type, location, sensitivity, and scale of the project; the nature and magnitude of the potential environmental and social risks and impacts; and the capacity and commitment of the Borrower (including any other entity responsible for the implementation of the project) to manage the environmental and social risks and impacts in a manner consistent with the ESSs.

The environmental risks associated with the Nurek HPP Rehabilitation Project are considered *Substantial*. Potential adverse impacts would be during the 10-year construction phase and can be avoided or controlled by implementation of appropriate mitigation measures. The major rehabilitation works will take place within the powerhouse, switch-yard, and elsewhere on the premises of Nurek HPP (intakes and tunnels, spillway gates, slopes above tailrace, etc.). The primary risks would be to project workers, including working at heights and with heavy machinery, working with electricity, working within confined spaces, exposure to asbestos and other hazardous materials and waste that may be present in the existing infrastructure and equipment, exposure to loud noise, and exposure to electromagnetic fields. There is some risk of downstream flooding if emergency and safety procedures are not followed during work on the tunnels and spillways; to reduce this risk. There is some limited risk of spills that could affect water quality if materials are not stored and handled properly. The only risks to community members that could be expected would be due to project traffic. The Environmental and Social Management Plan in Chapter 9 describes actions that Barqi Tojik, the Project Management Consultant, and the Contractors will be required to undertake in order to avoid, reduce, or otherwise mitigate the risks.

Table 4. Summary of World Bank requirements and key gaps with Tajikistan legal requirements

ESS &Topic	*Major requirements*	*Key requirements/gaps in Tajikistan legal framework*
ESS 1: Assessment and Management of Environmental and Social Risks and Impacts		
Scope of application	ESSs apply to Associated Facilities to extent of Borrower's control/influence	Associated facilities not covered by Tajikistan law as such, except to the extent that all activities in Tajikistan are subject to laws
Borrower's E&S Framework	May use Borrower's framework if can meet objectives of ESSs. This is not the case here, which requires application of World Bank requirements.	No provision for alternative requirements except that international standards take precedence if agreements are in place
A. E&S Assessment	– Conduct E&S assessment, including stakeholder engagement – Retain international expert(s) for high-risk projects – Apply national framework, ESSs, EHSGs/GIIP – Apply mitigation hierarchy – Offset significant residual impacts – Differential measures for vulnerable or disadvantaged people – Consider primary suppliers – Assess cumulative impacts	– ESIA law has much less emphasis on social conditions and impacts, but other laws partly fill gaps, but with less specificity concerning community impacts – No distinction between international and Tajikistan experts – No reference to EHSGs or GIIP – No equivalent provision for offsets – No equivalent provisions for vulnerable and disadvantaged people – No coverage of primary suppliers – No requirement for assessment of cumulative impacts
B. ESCP	ESCP includes specific requirements that must be met within a specified time, and also can and should be updated during implementation as conditions and risks change.	No provision in permits/approvals for delayed compliance or for updating requirements.
C. Project monitoring & reporting	– Monitor proportionate to nature of project, risks and impacts, and compliance requirements – Reports to World Bank	Monitoring required but less emphasis
D. Stakeholder engagement and information disclosure	Engage stakeholders through life cycle	Generally consistent but no requirement for project-specific stakeholder engagement plan

ESS &Topic	*Major requirements*	*Key requirements/gaps in Tajikistan legal framework*
ESS2: Labor and Working Conditions		
Scope of application	ESS2 applies to workers employed by Barqi Tajik who work on the project and to contracted workers, primary supply workers, and community workers	– Labor Code applies to all workers in Tajikistan, including foreign workers – Requirements apply to employer but do not extend to prime contractor
A. Working conditions and management of labor relations	– Written labor management procedures – Terms and conditions of employment – Nondiscrimination and equal opportunity – Worker's organizations	Generally consistent
B. Protecting the work force	– Child labor – Forced labor	– Minimum employment age is 14, with other limits consistent with ILO, but no work that could "cause health or moral damage" if under 18 – Forced labor prohibited
C. Grievance mechanism	Grievance mechanism has to be provided for all direct and contracted workers	No specific requirement for grievance mechanism for workers
D. Occupational Health and Safety (OHS)	Measures relating to occupational health and safety will be applied to the project: – Apply World Bank Group General and sector-specific EHS Guidelines – Requirements to protect workers, train workers, document incidents, emergency preparation, addressing issues – Provide safe working environment – Workers allowed to report safety issues and refuse to work under certain circumstances – Provide appropriate facilities (canteens, toilets, etc.) and ensure accommodations meet needs of workers – All employers to collaborate on applying OSH requirements – Monitor OSH performance	– Generally consistent but less detailed
E. Contracted workers	– Reasonable efforts to verify contractors have labor management procedures to meet requirements of ESS2 (except those that apply to community and primary supply workers) – Procedures for managing and monitoring performance – Access to grievance mechanism	Safety requirements apply to all employers, including contractors, but no obligation for developers to verify compliance

ESS &Topic	*Major requirements*	*Key requirements/gaps in Tajikistan legal framework*
F. Community workers	Requirements for working conditions and OHS applied to community labor	Labor Code applies to employers and employees, not volunteers
G. Primary supply workers	Depending on level of Barki Tajik/contractor control/influence, assess risk of child labor, forced labor, and safety issues and require suppliers to address significant risks	– Tajikistan law applies if work is done in Tajikistan – No obligation on employers in other countries – No requirements for prime contractor
ESS3: Resource Efficiency and Pollution Prevention and Management		
Resource Efficiency		
Scope of application	Borrowers must apply feasible resource efficiency and pollution prevention measures in accordance with mitigation hierarchy	Some requirements
A. Energy use	Adopt measures in EHSGs if project is significant energy use	No specific limits. No significant energy usage.
B. Water use	Assess water use and impacts and communities and adopt mitigation measures as needed	Permits required for water usage
C. Raw material use	Use GIIP to reduce significant resource usage	Resource usage requires permits
Pollution prevention and management		
General requirements	– Avoid, minimize, and control release of pollutants, apply the more stringent of EHSGs and national law – Historic pollution and non-degradation requirements	Specific numeric requirements
A. Management of air pollution	Requires assessment of potential air emissions and implementation of technically and financially feasible and cost-effective options to minimize emissions	Emissions limits. Project will have only minor emissions.
B. Management of hazardous and nonhazardous wastes	– Apply mitigation hierarchy to waste management – National and international conventions for hazardous waste management and movement – Verify hazardous waste management contractors are licensed and disposal sites operate to meet standards	– Detailed requirements for hazardous and other wastes – Signatory to international conventions – No requirements to verify haulers/contractors
C. Management of chemicals and hazardous materials	– Minimize use of hazardous materials – Avoid use of internationally controlled materials	– Regulations on hazardous materials – Signatory to international conventions
D. Management of pesticides	Requirements for pesticide use: Not applicable to this project	Not applicable

ESS &Topic	*Major requirements*	*Key requirements/gaps in Tajikistan legal framework*
ESS4: Community Health and Safety		
Community health and safety		
. A. Community health and safety	– Evaluate risks to community health and safety and apply mitigation hierarchy and GIIP to reduce risks – Consider third-party safety risks in designing infrastructure and equipment, with regard to high-risk locations – Ensure safety of services provided to communities – Identify traffic/road risks, assess risks if needed, consider safety in fleet decisions, take measures to protect public – Assess and avoid impacts on provisioning and regulating ecosystem services as appropriate – Avoid or minimize potential for disease transmission and communication (including HIV/AIDs and sexually transmitted diseases), including due to labor influx – Consider and provide necessary protections for vulnerable groups – Address risks to community of hazardous materials management – Prepare for and respond to emergencies, consider in EIAs, prepare response plans	General requirements to minimize risk, no specific requirements for services, ecosystem services, emergencies, etc.
. B. Security personnel	– Assess and address risks of security arrangements – Apply principles of proportionality, GIIP, and law – Verify contracted workers are not implicated in past abuses and are trained – Investigate incidents, report unlawful acts to authorities	No specific requirements
Annex 1. Safety of Dams	– Design and construction of new dams to be supervised by experienced professionals – Dam safety measures to be adopted and implemented during design, tendering, construction, operation, and maintenance – Safety measures designed by qualified engineers to be adopted in accordance with GIIP (paragraph 5) – Confirmation of no or negligible risks to communities due to failure of dam (in footnote 123)	Some analogous requirements but not as detailed

ESS &Topic	*Major requirements*	*Key requirements/gaps in Tajikistan legal framework*
ESS5: Land Acquisition, Restrictions on Land Use and Involuntary Resettlement		
Not relevant to this project		
ESS6: Biodiversity Conservation and Sustainable Management of Living Natural Resources		
General	- Consider direct, indirect, & cumulative impacts in ESS1 EIA - Characterize baseline conditions - Manage risks with mitigation hierarchy and GIIP, including adaptive management - Differentiated habitats, ESS applies to all, provides for offsets - ESS applies to modified habitat with significant biodiversity value - Avoid natural habitats unless no feasible alternative; if affected achieve no net loss of biodiversity Critical habitat - Requirements if a project will affect legally protected and international recognized areas of high biodiversity value - Strict conditions on affecting critical habitats, requires BMP - No introduction of spreading of invasive species - Requirements for projects involving primary production and harvesting	Requires protection of biodiversity but less detailed requirements
Primary suppliers	- Requirements when Borrower purchases natural resource commodities under certain circumstances	No equivalent requirements
ESS7: Indigenous Peoples/Sub-Saharan African Historically Underserved Traditional Local Communities		
Not relevant to this project		
ESS8: Cultural Heritage		
Not relevant to this project		
ESS9: Financial Intermediaries		
Not relevant to this project		

ESS &Topic	*Major requirements*	*Key requirements/gaps in Tajikistan legal framework*
ESS10: Stakeholder Engagement and Information Disclosure		
Requirements	– Engage stakeholders throughout project life cycle, determine how they wish to be engaged – Provide stakeholders with information, – Maintain documented record of engagements	Generally consistent but less detailed
. Engagement during project preparation	– Identify and analyze stakeholders, including disadvantaged or vulnerable – Stakeholder Engagement Plan (SEP) required, with detailed requirements for disclosure, timing of consultations, measures for disadvantaged or vulnerable, etc. – Disclosure of information early to allow consultation on design – Consultation to allow ongoing two-way communication throughout project life cycle	– No requirement to analyze stakeholders – No formal plan required – Early disclosure required
. Engagement during project implementation and external reporting	Engagement and disclosure of information to continue throughout implementation, following Plan	No specific requirement for continuing engagement
. Grievance mechanism	– Establish and implement prompt, effective, culturally appropriate, and discreet grievance mechanism – No limit on legal remedies	Tajikistan law provides channels for filing complaints, requests, and appeals
. Organizational capacity and commitment	Define roles & responsibilities, assign personnel to implement stakeholder engagement activities	No specific requirement for assigning roles and responsibilities
Annex 1: Grievance mechanism	Options for managing mechanism: ways of submission, log, advertised procedures, appeals process, mediation	No specific requirement

4 Baseline Conditions

This chapter describes baseline environmental and social conditions of the project area and the Vahksh and Amu Darya river basins in which the project is situated. The Nurek HPP was commissioned in 1972 and has resulted in significant impacts to the environmental resources that existed before its construction. The purpose of this ESIA is to address the impacts of the rehabilitation project on the environmental and social resources that exist now. The existing dam, its associated facilities, and the long-established effects are therefore considered as baseline conditions.

4.1 Methodology

Baseline data were collected by visiting and observing most of the area likely to be affected by the project. The following methods were used to characterize baseline conditions:

- National and local agencies with an interest and jurisdiction were contacted to collect information and sources of information on baseline conditions such as….
- Local institutions who have surveyed the area for decades were contacted to collect information on local biodiversity and other topics.
- Scientific and other literature sources were reviewed and brief visits were conducted to gain an understanding of environmental and social resources in and near the project area, and of the wider region.

4.2 Project Area of Influence

The activities of the rehabilitation project will be concentrated in a relatively small area but, due to transport, replacement of turbines and the schedule of these operations, project activities can influence their surroundings in different ways. Thus, for the purpose of this EIA, the study area has been delineated into four specific areas. These areas are:

- Nurek HPP Powerhouse and the nearby surrounding area – The intensity and duration of project activities will have impacts on operational efficiency of the powerhouse and could also affect the occupational health and safety of the contractor's labor force during construction and the staff of Nurek HPP during operations.
- Access road – The project will stimulate an increase in traffic carrying heavy equipment from Dushanbe to the project site, and workers housed in Nurek city and other surrounding towns and villages, all of which will have impacts on community health and safety. A feasibility study has been prepared for the rehabilitation of a bridge over the Vakhsh River near the Nurek HPP to take advantage of a road that bypasses the city to the project site. A separate Environmental and Social Management Plan has been prepared for this component of the project based on a rapid assessment of impacts included therein.
- Downstream of Nurek HPP – During the replacement of turbines, the potential impacts on the downstream area, including floodplain habitats, would include: (1) water pollution from construction activities and its potential impacts on water users in the downstream area and (2) the risk of modification of the hydrological regime during and after replacement of the turbines. The downstream area can be delineated into two regions:

  - Vakhsh River downstream of Nurek HPP to the confluence with Pyanj River (forming the Amu Darya). In this section, changes in operational regime could cause cumulative impacts on the hydropower cascade, modification of water flow for irrigation, and affect floodplain habitats;
  - Amu Darya Basin from Vakhsh River and Pyanj River confluence to the Aral Sea. In this section, discharge flow modifications from Nurek HPP due to operational changes could affect riparian countries.
- Upstream of Nurek HPP – The upstream reservoir area could be affected by the Project insofar as changes in the reservoir level could occur due to changes in operations. The water inflow to, and outflow from, the reservoir is therefore considered.

The study areas are considered from the perspective of the physical environment, biodiversity and ecosystem services, and the human Environment.

4.3 Physical Environment

4.3.1 Hydrology

Hydrology is perhaps the central issue of concern. The objective of this section is to identify and characterize the main issues related to water in terms of quantity and quality, in the context of Nurek HPP rehabilitation project. In the hydropower plant rehabilitation, attention needs to focus on the changes that the project could introduce in the operation of the plant, both during the period of rehabilitation works or once the Project is completed. Such changes could affect the upstream reservoir area (if modifying normal reservoir levels) and the downstream area (if changing the water discharge patterns).

The hydrological assessment of this chapter presents a description of the Vakhsh River upstream and downstream of Nurek HPP.

4.3.2 Baseline

The Amu Darya is the largest river of Central Asia, and one of the two main tributaries of the Aral Sea. The river is formed by the confluence of its two most important tributaries, the Pyanj and Vakhsh Rivers. The Vakhsh contributes an average of about 26% of the annual flow of the Amu Darya, and the Pyanj about 40 percent In the Amu Darya, as in the Vakhsh, the flow pattern is highly seasonal, with high flows in summer due to snow and glacier melt in the mountains, and low flows in winter since most of the precipitation in the catchment area falls as snow.

For this section, historical data have been used. Historical records of the reservoir's operation that have been made available by Nurek HPP include:

- Daily inflows to the reservoir between 1972 and 2013
- Daily turbined flow between 2007 and 2013
- Daily discharges by the spillways between 2007 and 2013
- Daily reservoir and tail water levels between 1972 and 2013
- Daily produced power and energy between 1972 and 2013
- Turbine hill charts.

4.3.2.1 Downstream: hydrology with Nurek HPP in operation

The flow downstream of Nurek HPP includes water that passes through the turbines and water that passes the spillways. The total flow (turbine + spillways) is shown in Figure 7, Table 5, and Figure 8.

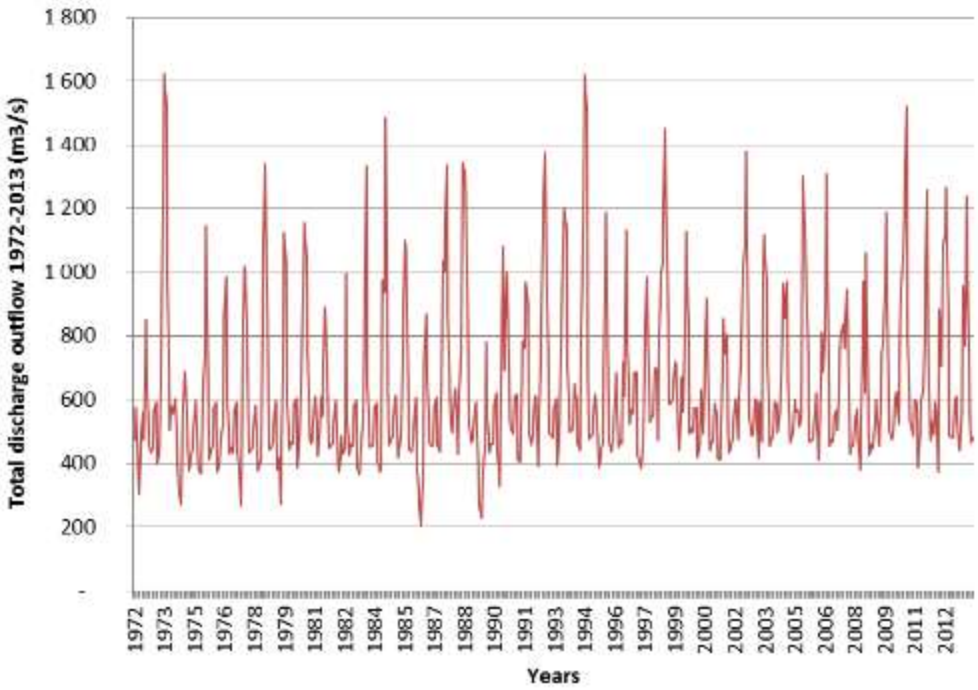


Figure 7. Daily discharge outflow, 1972-2013 (m^3/s)

Table 5. Monthly average outflow, 2007-2013 (m^3/s)

Jan.	Feb.	March	April	May	June	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.
590.16	606.04	428.88	470.20	568.62	811.47	937.92	1,110.46	705.84	475.28	479.25	482.83

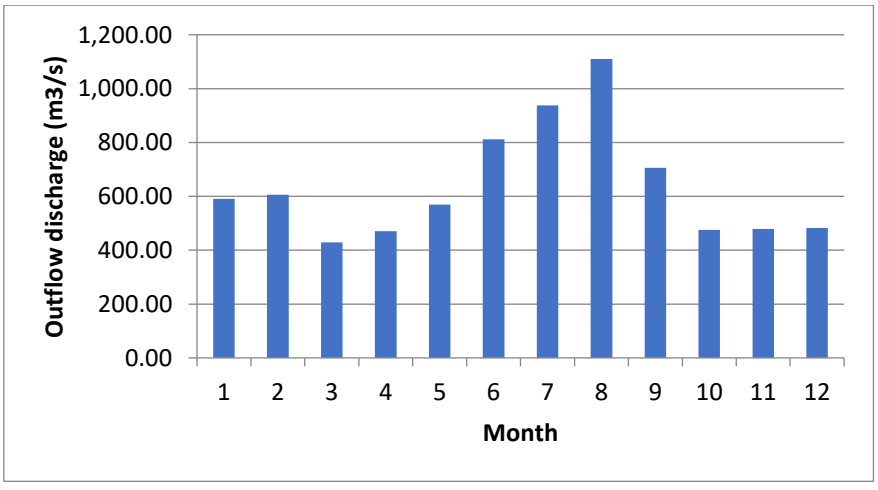


Figure 8. Total monthly outflow average discharge, 2007-2013 (m^3/s)

4.3.2.2 Upstream: Nurek HPP Reservoir Characteristics in Operation

Since 1972, The Vakhsh River has flowed into the reservoir that is impounded behind the Nurek dam. The daily inflow into the reservoir for the period 1972-2013 (available data) was available or analysis. Figure 9 shows the daily inflow to the Nurek reservoir since 1972. The presence of the HPP has reduced the extreme differences between winter low flows and summer high flows that would have occurred before the dam was constructed. Monthly average inflow is shown in Table 6 and Figure 11.

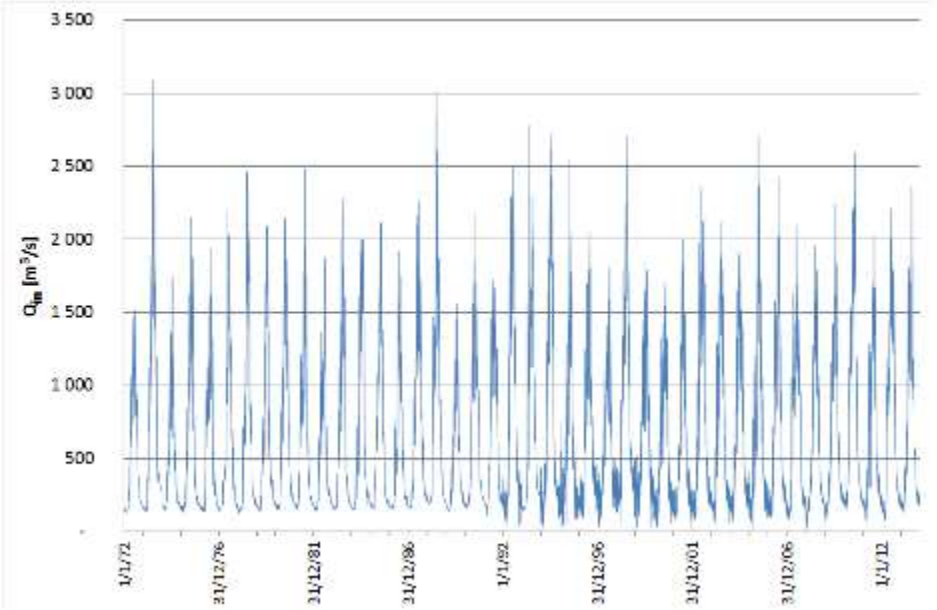


Figure 9. Daily inflow into Nurek reservoir, 1972-2013

Table 6. Monthly average inflow in the reservoir (m^3/s)

Jan.	Feb.	March	April	May	June	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.
181.28	164.78	215.41	492.76	851.39	1,283.75	1,585.25	1,348.57	706.44	343.22	253.71	213.79

4.3.3 Flooding

The peak inflow values corresponding to the 10,000-year flood and the Probable Maximum Flood (PMF) have been evaluated[6] as 5,690 m^3/s and 7,770 m^3/s respectively. The hydrographs of these floods are shown in Figure 11. The most important inflows to the Nurek reservoir occur between May and September.

The reservoir volume at the 920 m water level is 9.65 billion cubic meters. Based on the flood hydrograph in Figure 11**Error! Reference source not found.**, the total flood volumes of the PMF and t he 10,000 year return flood are evaluated at 46.8 billion cubic meters and 34.3 billion cubic meters respectively. Therefore, the two mentioned floods can generate water inflow volumes 3.5 to 4.8 times the reservoir volume.

6 Database system implementation at Nurek Dam, IH NURE COND 00021 A BPE, EDF, 2007

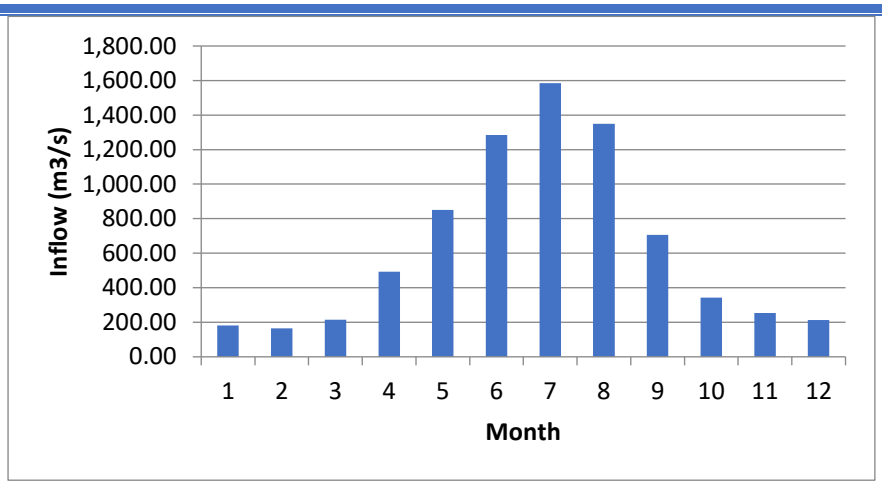


Figure 11. Monthly average flow into Nurek reservoir, 1972-2013 (m3/s)

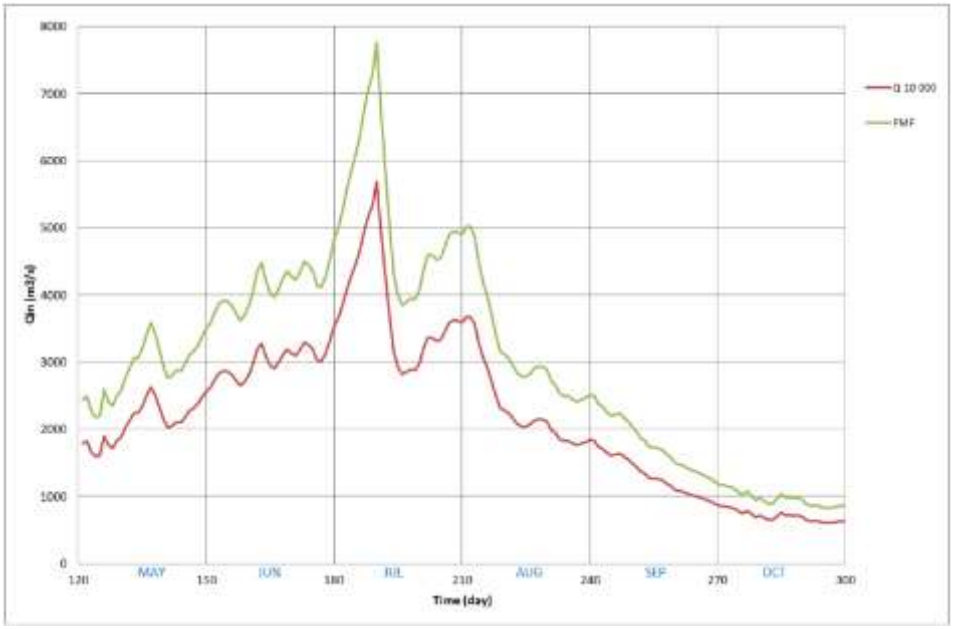


Figure 11. Floods in Nurek reservoir with return intervals of 10,00 years and PMF

4.3.4 Water Quality

4.3.4.1 Water Quality Within the Amu Darya Basin

The quality of drinking water in many populated parts of the Amu Darya is deteriorating, particularly downstream of Nurek, where it is causing a rise in kidney, thyroid and liver diseases and preventing iron absorption, leading to anemia[7]. The Amu Darya River in its lower reach is characterized by a degradation of its quality mainly related to salinity (sulphates, chlorine, sodium and potassium).

7 According to FAO "studies show that of the 700,000 women in Karakalpakstan, more 90 per cent are anemic with hemoglobin levels in their blood well below the World Health Organization's standards and probably with the highest rates in the world (source www.fao.org/news/1997/970104-e.htm)

Between 1960 and 1989, the average salinity of the Amu-Darya's increased from 540 mg/l to 1,161.2 mg/l, with 856.6 mg/l measured in 1990 (L.P. Pavlovskaya)[8]. The situation has not improved since.

Mineralization levels increase downstream of the Vakhsh and Pyanj confluence. Mineralization levels are also fluctuating depending on the season: levels decrease with the spring-summer increase of river flow. The longitudinal increase in deoxygenating pollutants can be mainly considered as indicative of the loss of organic matter from the irrigated areas, which, in conjunction with salinization, contributes to the major degradation processes affecting the land resources surrounding the Amu Darya River.

The major factor impairing water use in the lower part of the river can thus be attributed to the secondary salinization processes originating from the lithological composition of the watershed and which are driven and increased by the irrigation return flows. Major pollution sources are collector-drainage (irrigation runoff) waters from irrigated fields in the mid and downstream reaches of the Amu Darya. In addition to regular irrigation in summer months, the practice of washing agricultural soil in winter considerably increases the salinity of return water, and consequently further compromises river quality, making water flowing in the delta region unsafe for drinking. As a result, the regions located in the Amu Darya delta are affected by both the river's failure to reach the Aral Sea and by the high level of pollution in the water that does reach it.

4.3.4.2 Water Quality in the Vakhsh River Upstream of Nurek HPP

The data of this section is sourced from the Environmental and Social Impact Assessment of Rogun HPP (Pöyry, 2014), based on the hydrological station of Nurobod located in the future Rogun reservoir, which is upstream of Nurek HPP. In this project, with regards to water quality and sedimentation, the Nurek reservoir is considered as unchanged.

Like most rivers of Amu Darya basin, the Vakhsh River in Nurobod has a rather high carbonate concentration ([HCO_3^-] = 105 mg/l). The concentration of sulphate regularly exceeds the Tajik requirements for surface water and the concentration of chlorine is rather high, which altogether indicates corrosive water. Table 7 shows concentrations of selected parameters. Only two heavy metals are being monitored in Nurobod: Chromium (Cr VI) and Lead (Pb). Both show concentrations which are close to the normative limits (Table 8). These high concentrations most probably result from the geochemical characteristics of the catchment rocks, and the intensive erosion processes.

As in the Amu Darya, the Vakhsh River water is characterized by a degradation of its quality mainly related to salinity.

Regarding sediments loads, due to the intensity of erosion processes in its catchment, the Vakhsh River is characterized by a high sediment load. The concentration of suspended solids fluctuates during the year and reaches its maximum during the flood season. Per unit water discharge, sediment concentrations are higher during the flood increasing period than during the flood decreasing period.

Due to the Nurek Dam, the bulk of the sediments from the upper Vakhsh catchment no longer reaches the lower catchment but instead is deposited in the Nurek reservoir. Various estimates of the sediment volume in Nurek reservoir have been made, but no bathymetric study has ever been implemented to define the actual figure.

8 Fishery in the lower Amu-Darya under the impact of irrigated agriculture, L.P. Pavlovskaya

Table 7. Water quality of Vakhsh and Amu Darya Rivers

Parameter	unit	Vakhsh Nurobod 1998-2010 average	Amu Darya Termez 1996-2001 average	Amu Darya Samanbay 1996-2001 average	Tajikistan requirement for surface water
O2	mg/l		10.5	10.8	4.0 in winter 6.0 in summer
	%sat		99.7	98.7	
BOD	mg/l	-	0.8	1.4	3.0
COD	mg/l	0.6	4.5	15.1	
salinity	mg/l		551.4	1170.0	
pH		7.6	7.6	7.6	
PO_4^{3-}	mg/l	0.06	0.75	0.60	
NO_3^-	mg/l	1.6	0.6	0.5	40
HCO_3^-	mg/l	105.4	131.1	142.9	
Cl-	mg/l	85.4	73.3	213.9	300
$SO4^{2-}$	mg/l	169.6	176.6	433.6	100
Temp.	°C	7.6	16.7	13.6	

Source: for Vakhsh river, TajGidromet, for Amu Darya, Crosa et al., 2006

Table 8. Chromium and lead concentration for Vakhsh River in Nurobod

Station	average annual concentration	maximum annual concentration	EU Directive 75/440/EEC (surface water intended for drinking water production)	Tajikistan requirement for surface water
Cr VI (mg/l)	0.017	0.031	0.050	0.100
Pb (mg/l)	0.025	0.030	0.050	0.100

Source: for Vakhsh river, TajGidromet, for Amu Darya, Crosa et al., 2006
Values for 1980-2010

4.3.4.3 Water Quality Downstream of Nurek HPP

The water of the Vakhsh River, downstream of the Nurek HPP, is influenced by the reservoir water quality. Large and deep reservoirs situated in temperate climates, like Nurek HPP reservoir, usually show a thermal stratification during summer when water temperature at the surface is significantly higher than water below the reservoir surface. This thermal stratification and water intake for the turbines in deeper (cooler) layers can lead to the input of very cold water into the river downstream of the power plant. Moreover, in the deeper layers of the reservoir the small amount of biomass and the reduced oxygen circulation lead to anoxic conditions that can influence the quality of the water released downstream for at least a short distance before it is well oxygenated again.

The water quality downstream of the Nurek dam could have a negative impact on the local aquatic ecosystem. Poor water quality would affect the quality of fish habitats, including resources, and reproduction: the modification of the physicochemical parameters of the environment will disrupt habitat and its resources (nutrients and plants) that would cause disruption of reproduction. However, in the project framework, the species in the river will at least begun to acclimatize to such environmental conditions. The dam construction will have led to changes in the original fish populations. Today the present species are regularly subjected to variations in water quality (temperature, oxygen, ammonia, etc.) and will have adapted to these conditions.

As noted in the Impacts chapter, the rehabilitation of Nurek HPP would not alter the conditions of the local aquatic ecosystem immediately downstream of the dam that has been established for nearly fifty years.

4.4 Biodiversity and Ecosystem Services

As noted, the reservoir will not change as a result of the rehabilitation. Therefore, terrestrial and aquatic biodiversity and ecosystem services upstream of the dam are not described or evaluated in this ESIA. The examination of biodiversity and ecosystem services is limited to the study area located downstream of Nurek HPP, and mainly on habitats, fauna and flora species dependent upon the hydrology of the Vakhsh River.

4.4.1 Downstream Protected Areas

In this section, protected areas downstream of Nurek HPP are identified and characterized because they have a legal protection status. Any interference with them, in any way not in compliance with this legal protection, would be considered an illegal activity. Furthermore, such protected areas potentially contain some species of exceptional value or habitats, which must be protected under Tajikistan law and World Bank Environmental and Social Standard 6. In the present project, this is especially true for protected areas which depend on river characteristics (Vakhsh or Amu Darya rivers).

4.4.1.1 Protected Area in Tajikistan: the Tigrovaya Balka National Reserve

Downstream of Nurek HPP, only one protected area has been identified. This area is the Tigrovaya Balka National Reserve located downstream of Sangtuda 2 HPP (Figure 12). The Reserve is located in the lowermost part of the Vakhsh river basin, down to its confluence with Pyanj River, close to the border with Afghanistan. It was created by decree n°1163 of the Tajik SSR on November 4, 1938. Its main objective is the conservation of the unique Tugai complex and of the animals living in it. Tugai designates a specific type of floodplain habitat in desert areas of Central Asia. It is characterized by a groundwater level close to the surface, which conditions a specific vegetation type composed of a number of tree species, reeds etc. It is also a habitat for many fauna species. Tugai systems have come under increased pressure through intensified human use of these floodplains.

Figure 12. Tigrovaya-Balka floodplain

The reserve, with an area of 49,786 hectares, is located about 200 kilometers south of Dushanbe. It is of great importance for the conservation of the Tugai ecosystem and its unique fauna and flora. It was the last habitat of the Caspian Tiger, which became extinct around 1950. Human pressure on this area reached its maximum after the collapse of the Soviet Union and the ensuing civil war. Illegal and uncontrolled logging, hunting and fishing led to a sharp decline of many species - the Bukhara deer, black and golden pheasant, gazelles, the striped hyena, etc.

The area has a continental and arid climate. The average annual temperature is +14 to +17°C, the temperature of the coldest month (January) is + 2°C. Temperatures in the hottest month (July) range from 32 to 38°C sometimes reaching 48°C. The length of the frost-free period is 250-310 days. Winters are short and mild, which is typical for dry subtropical zones.

Precipitation is distributed unevenly throughout the year, with up to 70% falling in winter and spring months, usually in the form of rain.

The reserve contains about 20 lakes of different sizes. Their water is poorly mineralized, with about 1.92 to 4.67 mg/l of carbonates. In addition to 438 species of vascular plants, there are about 30 reptile species, 34 mammal species, 2 amphibian species and 150 bird species within the reserve. It is one of the few remaining habitats of the Bukhara subspecies of the red deer or Hangul (*Cervus elaphus bactrianus*).

The main threats to the reserve are the development of land adjacent to its borders, the lack of buffer zones, poaching, regular forest fires, reduced water levels in the Vakhsh in summer, and illegal logging. Like every floodplain habitat, it depends directly on the dynamics of the river forming this plain, in this case the Vakhsh River. The river dynamics are driven by the amount of water flowing, but to a very great extent also by the seasonal distribution, and especially by seasonal floods. As noted previously, the rehabilitation project will not change the seasonal flows of the river.

Hydrology

The ecosystems of the Tigrovaya Balka floodplain depend on a meandering river and its dynamics. These dynamics are conditioned by the variation in river flow, by regular seasonal variations (low flows in winter, high flows in summer) as well as by rare and extraordinary flood events (extreme floods).

The hydrographical network of the reserve is formed by the Pyanj and Vakhsh Rivers. The territory of the reserve is connected to the Vakhsh River which has a temperature dependent regime influenced by glacial and snow melts. Currently, the Vakhsh River is regulated by Nurek, Sangtuda 1 and Sangtuda 2 dams. The floodplain is a highly dynamic system sustained by the ever-changing river conditions: seasonal flow variations, successions of dry and wet years, and extreme flood events (Pöyry Energy GA, 2014).

Effects of river regulation on floodplain ecosystems

River regulation caused by the large storage reservoir of Nurek HPP has established the following main direct effects on floodplain dynamics:

- Shift of some water volume from the wet season (summer) to the dry season (winter). This means that normal summer flooding will on average be lower than was before the dam was constructed, and higher winter flows mean less land will be dry in winter.

- Reduction in frequency and severity of high floods: a large reservoir such as Nurek also has an effect of reducing flood peaks, thereby providing flood protection to downstream areas. This means that the effects of such flood events as described above will be less marked.

As Figure 13 illustrates, the discharge pattern of the Nurek HPP has modified the natural discharge regime of the Vakhsh River. River regulation has also modified downstream sediment transport due to sediment trapping in reservoirs (again mainly in Nurek), and this will typically have caused a number of adverse effects in the downstream area such as bed and river bank erosion, morphological changes within the river bed, and lowering of ground water tables. As noted, these impacts would have occurred in the past following construction of the Nurek dam.

These direct impacts on the floodplain dynamics influence the vegetation in the following ways:

- Areas that are no longer flooded regularly in summer because flows are not as high become gradually colonized by dryland species. It is also possible that people would begin to cultivate areas which would now be flooded only very exceptionally.
- Erosion as well as sediment accumulation processes are slower, while flood events where the river destroys vegetation occur more rarely or not at all.
- The entire process can lead to a more uniform habitat becoming inhospitable to many of the plant and animal species that require specific conditions. In addition, the inflow of drainage water from irrigation schemes in the surroundings leads to the input of salts, fertilizers and agrochemicals, which all contribute to changing the situation in the ecosystem (Pöyry Energy GA, 2014).

Tigrovaya Balka would be considered critical habitat in the sense of ESS 6: an area legally protected on the national level, possessing a type of rare habitat with high importance for biodiversity conservation). Unlike other floodplains affected by the project, Tigrovaya Balka is also an Important Bird Area (IBA) according to Birdlife International (www.birdlife.org/datazone/country/tajikistan/ibas).

4.4.1.2 Protected Areas Outside Tajikistan

Downstream of the Nurek HPP, outside Tajikistan, along the Amu Darya River, several protected areas associated with the river have been identified.

Three Tugai sites are protected outside of Tajikistan, namely **Amu Darya Reserve** in Turkmenistan and the **Kysylkum Protected Area** and **Badai Tugai** in Uzbekistan. They are conditioned by the same dynamic processes as were described above for Tigrovaya Balka, and therefore they suffer from the same impacts: reduction in water flow, change in seasonal flow patterns, invasion of plants not adapted to Tugai conditions and encroachment by human use.

All along the Amu Darya, small patches of this ecosystem remain outside protected areas; not being protected, however, does not mean that they have no ecological value; they are basically a habitat for the same set of plant and animal species as the protected parts.

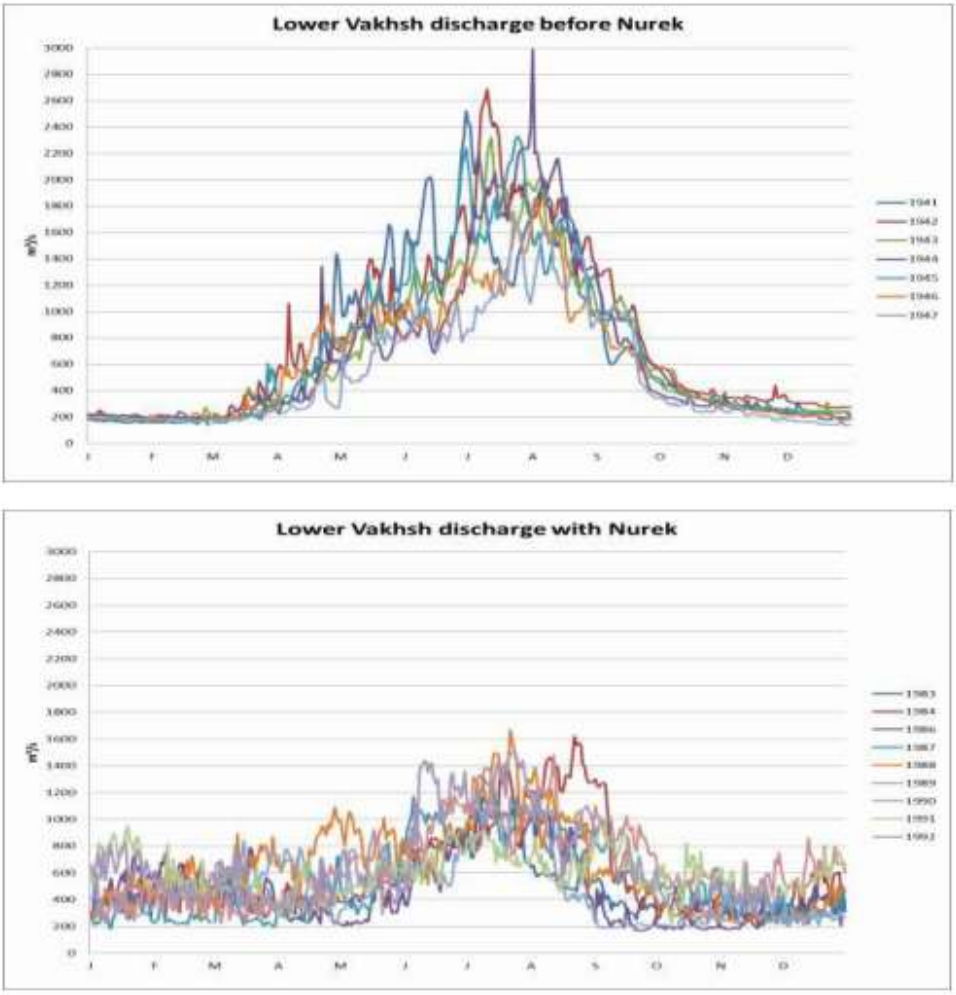


Figure 13. Daily flows in the Amu Darya with and without Nurek

Effects could arise due to changes in water regime of the river. However, the water coming from Nurek HPP, unlike in the case of Tigrovaya Balka, constitutes only a small part of the total amount of water (naturally) flowing here, and flow conditions are not mainly controlled by Nurek HPP, but by the other numerous hydraulic structures along the course of the Amu Darya.

The influence of Nurek HPP on Amu Darya, Kysylkum Protected Area and Badai Tugai is therefore already considered to be marginal.

4.4.2 Downstream Terrestrial Flora

This section focuses on floodplain and riparian habitats dependent on the Vakhsh River and/or the Amu Darya River that can be influenced by the modification of the water flows during and after the rehabilitation of Nurek HPP.

The vegetation of the downstream floodplains has been influenced and modified principally by changes in the flow regime of the Vakhsh River downstream of the Nurek HPP and also by intensive agriculture.

The description of vegetation and flora of the area to be affected by the Project focuses on vegetation on the land that might be affected by changes in river discharge pattern by the Project, mainly Tigrovaya Balka National Park.

Floodplains along large river systems like the Amu Darya usually have a high biodiversity and provide a wide range of ecosystem services for the human population. In the floodplains in this zone *Juglans regia* (walnut), *Platanus orientalis* (sycamore), *Populus spp*. (poplars) and a number of *Salix spp*. (willows) can be found.

Tugai complexes are widespread in the floodplains of rivers dominated by *Populus euphratica* (Niels Thevs *et al.,* 2011)9*, Populus pruinosa* and *Elaeagnus angustifolia.* Tugai, alternated with bushes of giant reeds (*Phragmites communis*), *Erianthus ravennae*, sugar-cane (*Saccharum spontaneum*) are also widespread in low-lying areas.

Water reservoirs and wetlands of the reserves are widespread along the Vakhsh and Pyanj. Ox-bow lakes are densely overgrown by water vegetation: *Myriophyllum L. sp.*, different species of pondweed, hornwort, and buckwheat and somewhere by naiad.

4.4.3 Downstream Terrestrial Fauna

Regarding the potential impact of the project, fauna occupying floodplain habitats are the only fauna that can be indirectly impacted by the project (through the modification of these habitats linked to the river flow).

As explained in the previous section on vegetation, all habitats in the project area have been significantly modified by human activity, and therefore have been changed and degraded. Downstream of Nurek HPP, habitats and thus fauna, which depend on water flow, have long been impacted by the construction and operation of Nurek HPP. These modified conditions are considered in the present study as the baseline.

In an article dated 1980 regarding the Nurek reservoir environment, Beilinson *et al.* (1990)[10] described the ecological status in the region of the reservoir. Before the construction of the dam, practically no zoological investigations were carried out. A census of wild animals was taken only in 1978 and 1989. The main observations were the wild boar (*Sus scrofa*), Siberian ibex (*Capra sibirica*) and urial (*Ovis orientalis*). The urial has been entered into the red list of the IUCN as "vulnerable". It is assumed that these species can also be found downstream of the dam.

The floodplain of the Vakhsh River and riparian vegetation are particularly important. Both amphibian species and five reptile species can be found in the floodplain area. The *Vipera lebetina* (Blunt-nosed viper) is categorized as an endangered species by IUCN. Just nine species of mammals have been identified for the floodplain. *Lutra seistanica* (Eurasian otter) is one of the key species in the floodplain habitat and is categorized by IUCN as near threatened. However, its presence in the floodplains downstream of Nurek HPP has not been confirmed. Forty-four bird species are found in the floodplain, 26 of them nest in the floodplain. Eighteen species of birds, mainly water birds (ducks, goose, little

9 Niels Thevs, Allan Buras, Stefan Zerbe, Elfi Kühnel, Nurbay Abdusalih, and Amangul Ovezberdiyeva "Structure and wood biomass of near-natural floodplain forests along the Central Asian rivers Tarim and Amu Darya", Forestry 2011: cpr056v1-cpr056

10 Nurek reservoir and the environment, M. E. Beilinson, A. V. Kolichko, S. M. Sherman, 1990

egret, grey heron etc.), can be considered as migratory species for spring or autumn (Pöyry Energy GA, 2014).

4.4.4 Downstream Aquatic Fauna

The section focuses mainly on fisheries. The baseline of the aquatic fauna, upstream (reservoir) and downstream of the dam has long been in a modified condition with the presence and operation of Nurek HPP. The dam's obstruction of upstream/downstream migration for migratory species, the change from river to reservoir upstream of the dam, and the change of the downstream flow impacting spawning areas, and the possible introduction of exotic species in the reservoir (as compensation for the development of a fishery) are already existing impacts.

Baseline

No long-range fish migration presently takes place in the Vakhsh River. If such migrations existed earlier, they were interrupted by the construction of Nurek dam in the 1970s. As a result, the Vakhsh River is not considered as a natural habitat. Moreover, the Vakhsh River with its exceptionally high sediment load (up to 4,000 g /m³) is not considered to favor fish migration.

Upstream of Nurek HPP (reservoir)

In the upper part of Vakhsh (Surkhob) River, in the region of Jirgital and further upstream, there are a number of small lakes which are connected to the river, and in these areas there are populations of Amu Darya trout (*Salmo trutta oxianus*), brown trout (*Salmo trutta fario*) and common marinka (*Schizothorax intermedius*). Fish species present in the river system upstream of Nurek dam still carry out short range migrations, e.g., between Vakhsh River and its tributaries.

During the first 10 years of the Nurek HPP reservoir, the fish population consisted mainly of common Marinka (*Schizothorax intermedius)*, Samarkand khramulya (*Varicorhinus keratensis stendachneri*), Turkestan catfish (*Glyptosternon reticulatum*), Amu Darya trout (*Salmo trutta oxianus*), etc. However, once the reservoir reached its full supply level, the input of organic material stopped, and nutrients were washed out of the reservoir and fish populations declined. For this reason, over the last 25 years the fish species mentioned above have disappeared almost completely from Nurek reservoir. One species, the peled or Northern Whitefish (*Coregonus peled*), a pelagic plankton feeder, had been introduced to the reservoir at the beginning of the filling phase. The population grew over the first few years but died out at the end of the filling phase due to the development of more oligotrophic conditions (lack of nutrients). A number of exotic fish species were introduced into Nurek reservoir with limited success. Table 9 provides a list of fish species from the wider area, with some indications on distribution.

In 2011, specific investigations in the Nurek HPP reservoir for the Rogun HPP project provide information. Today, none of the species still present in Nurek reservoir is found in substantial numbers. The conditions in the reservoir are not considered suitable for the development of fish stocks. The massive reservoir drawdown during the winter months is a severe limiting factor.

Downstream of Nurek HPP

Investigations have been done for Rogun HPP EIA. Due to the location of this project located 70 km upstream of Nurek site, we can suppose that the same species can be found downstream of Nurek HPP.

As shown in Table 9, fish fauna in the Vakhsh, downstream of Nurek HPP include the common Marinka, Turkestan catfish, Amudarya trout, rainbow trout, brown trout, Tibetan stone loach, crested loach and Carps.

Table 9. Fish species in Nurek reservoir

Family	*English name*	*Scientific name*	*1979-1982*	*2011*
Salmonidae	Amu Darya trout	Salmo trutta oxianus	Frequent	Rare
	Brown trout	Salmo trutta fario	Frequent	Rare
	Rainbow trout	Oncorhynchus mykiss (Salmo gairdneri)	Introduced	Rare
Coregonidae	Peled	Coregonus peled	Introduced	Absent
Cyprinidae	Marinka	Schizothorax intermedius	Frequent	Absent
	Khramulya of Samarkand	Capoeta (Varicorhinus) capoeta	Frequent	Absent
	Carp (sazan)	Cyprinus carpio	Introduced	Present
	Silver carp	Hypophthalmichthys molitrix	Introduced	Present
	Spotted silver carp	Hypophthalmichthys (Aristichthys) nobilis	Introduced	Present
	Chebachok of Amur	Pseudorasbora parva	Introduced	Present
	Striped bystranka	Alburnoides taeniatus	Introduced	Present
Cobitidae	Tibetan loach	Triplohysa (Nemacheilus) stoliczkai	Frequent	Present
	Crested loach	Paracobitis (N.) malapterura	Frequent	Present
	Tajik loach	Iskandaria kuschakewitschi (N. pardalis)	Frequent	Absent
Sisoridae	Turkestan catfish	Glyptosternon reticulatum	Frequent	Absent
Gobiidae	Amur goby	Rhinogobius similis	Introduced	Absent
Source: Rogun HPP EIA, Pöyry Energy AG, 2014				

4.5 Human Environment

4.5.1 Administrative Context

The Nurek HPP is located 80 km (by road) from Dushanbe, the capital of Tajikistan, in the Danghara and Nurek districts of Southern Tajikistan, in the Khatlon Province (see Figure 14). Its reservoir is located in the Khatlon region and Region of Republican Subordination. Khatlon has an area of 24,800 km^2 (around 17 percent of the country's area) and consists of 24 administrative districts, four towns and 133 rural jamoats[11]. The region is informally divided into Western Khatlon (comprising Kurgan-

11 Third-level administrative divisions, similar to communes or municipalities

Tube and the Kofarnihon and Vakhsh river valleys) and Eastern Khatlon (Kulyob and the Kyzylsu and Yakhsu river valleys). Kurgan-Tube is located 100 km from Dushanbe.

Nurek HPP is located in the vicinity of Nurek City (Figure 15). The city is situated on the Vakhsh River, 885 m above sea level, and is 70 km southeast of Dushanbe, the capital.

4.5.2 Socio-economic Context

4.5.2.1 General

Nurek City

As previously mentioned, Nurek HPP is located close to the city of Nurek. The city was founded in 1960 to support the construction of Nurek Dam. The population of Nurek in 2013 was approximately 52,000.

Administrative authorities and services: Mayor, Department of Social Development and Communication with the Public, Department of Organization and Labor, General Department of Citizen Monitoring and Treatment. Two fire stations, one for the city and the other dedicated to the HPP, are present in Nurek. There is also a Russian military base and a Tajik military base.

Educational institutions. Officially, the country has a literacy rate of 100%. Educational institutions are shown in Table 10.

Table 10. Educational institutions in Nurek

Type	Kindergarten, nursery school (< 7 y.o.)	Primary School (8-10 y.o.)	Secondary School (11-17 y.o.)	Gymnasium	High School	MTI	Total
Number	11	4	17	1	1	1	35
Source: http://norak.tj/?show=maorif-ru&lang=ru&mId=44):							

Health facilities (http://norak.tj/?show=tandurusti-ru&lang=ru&mId=32): one city hospital, one health center, three rural health centers, 13 isolated health centers, the Sanitary and Epidemiological Station, on Center for Childhood Illnesses, one Center for the Development of Good Hygiene, a vaccination center, and a center for the fight against tuberculosis.

Population: The Nurek population was estimated to be 28,100 inhabitants in 2015(http://www.undp.org/content/dam/tajikistan/docs/projects/democratic_governance/UNDP_TJK_MHDT_2014_Eng.pdf). The structure of the population corresponds roughly to that of the country, which is shown in **Figure 16**.

Religion: The city of Nurek is majority Muslim, with approximately 10% of the population being Russian Orthodox.

Economy: Apart from Nurek HPP, industry in Nurek City is represented by a reinforced concrete structure factory and a textile factory. There are also local markets, a central market, several commercial streets (agricultural products, textiles, computers, etc.), crafts (garages, woodworking, etc.), and mainly subsistence farming in the vicinity. Construction activities constitute the heart of economic activity.

Figure 14. Administrative map of Tajikistan

Figure 15. Location of Nurek City

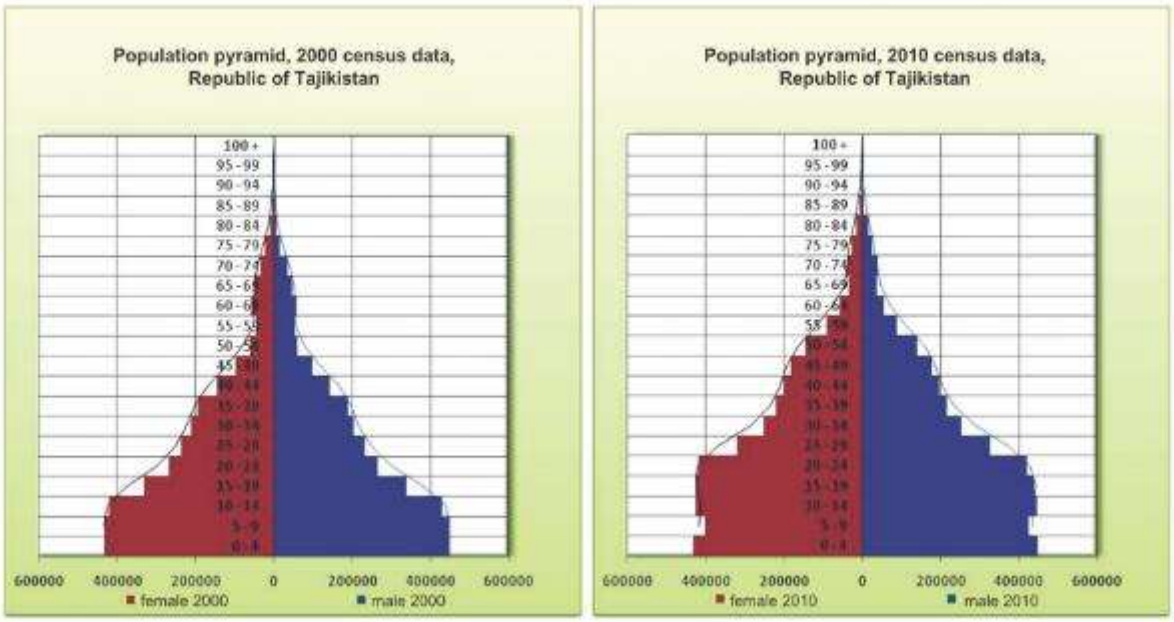


Figure 16. Population of Tajikistan by age and gender in 2000 and 2010

At the national level, unemployment is 2.5 percent, but locally it is likely to be higher, although (no local data are available; many young people leave the region, often to go to Russia, to seek employment.

Summer tourism is linked to the exploitation of reservoir potential and other ancillary activities still linked to the Vakhsh (boating, fishing, restaurants) (https://tajikistantourism.org/destinations/norak-nurek/), and there is an active socio-cultural center in the city. But there are only three or four hotels inside the city, including one relatively large hotel, and a movie theater that no longer operates.

Infrastructure: The main road linking Nurek with Dushanbe road is in good condition, but secondary roads are in average or bad condition, declining in quality with distance from the center of the city. A municipal drinking water system exists, but is not reliable. The electrical network is in good condition, and in fact is better than in the rest of the country. Telecommunications (telephone and Internet) are also present.

Cultural heritage: Since the city was founded in 1960, there is no historical heritage in the city, but some small physical cultural resources have been found over time. There is a museum in Nurek City.

Khatlon Region

Downstream of Nurek HPP, the Vakhsh River is located in the Khatlon Region. Several population centers are located close to the river: Sangtuda, Gulistan, Kazanguzar, Sarband, Qurgonteppa, Kolkhozabad, Jilikul, etc. Along the access road (A385 and M41), localities are mainly situated in the vicinity of Dushanbe: Tezgar, Neftyanik, Vahdat, Rohati, etc.

The project area and the region are largely rural (83% in the Khatlon Region) and remain predominantly dependent upon subsistence agriculture. Less than 3% of the population is employed in the industrial sector. The project area, as is the Khatlon Region, is a major industrial agricultural region with the highest rates of undernutrition and the largest number of people living below the

poverty line[12]. The region accounts for half of the agricultural output of the country, including 65% of total cotton production. Khatlon's irrigated watersheds and cotton-dominated agricultural production is a promising sector to demonstrate the effect of water distribution and land reforms.

According to the 2009 Living Standards Measurement Survey (LSMS), Khatlon was the poorest region in the country with a 54% poverty rate. Being the largest region in the country (36% of the total population), Khatlon has a higher rate of population growth than the national average. The average size of households is a staggering 8.5 people. Given the high percentage of the youth in the total population (almost 40% below 14 years old), Khatlon accounts for only approximately 14% of the labor force and at the same time is characterized by a very high unofficial unemployment rate (35%) (World Bank, 2013)[13]. The official unemployment rate is 7%. As noted, many workers, primarily men, migrate to Russia or Dushanbe for employment.

4.5.2.2 Water Use in the Amu Darya Basin

Water allocation in the Amu Darya Basin

Water allocation in the Amu Darya Basin is calculated annually by the Basin Water Organization (BVO) Amudarya[14], based in Urgench, Uzbekistan, which is mainly responsible for overseeing the allocation of water, according to the agreed quotas to users in the basin. It also controls the discharges to the Aral Sea and the operations of interstate reservoirs.

Table 11 shows that on average between 1992 and 2010, water allocation by country is below the water volume allocation estimated in 1987 (Protocol 566). All countries have systematically used less than their water share during years when water availability largely exceeded the forecasts.

Table 11. Average water allocation by country compared to Protocol 566

Allocation by BVO Amu Darya	Tajikistan	Kyrgyzstan	Uzbekistan	Turkmenistan	Total
Protocol 566	9,500	400	29,600	22,000	61,500
Average allocated (1992-2010)	8,845	216	21,378	20,960	51,400
Source: Rogun HPP EIA, Pöyry Energy AG, ICWC website					

volume allocated to each member country (Table 11) is calculated as a share of the total allocation. This share has appeared to be rather steady in recent years (see Figure 18). Nevertheless, as shown in Table 11 and Figure 18, the actual water flows in Amu Darya do not match with the estimations used to calculate the allocation by country. Sometimes, the actual flow in the Amu Darya exceeds the water flow estimation and thus exceeds the total volume of water allocated. However, more often, the actual flow in the Amu Darya is less than the forecasts and less than the total volume of water

12 Feed the Future, Tajikistan fact sheet.

13 Tajikistan, Reinvigorating Growth in the Khatlon Oblast; World Bank 2013.

14 The BVO AmuDarya is part of the International Fund for saving the Aral Sea (IFAS), the overarching institution in transboundary water management. IFAS consists of several administrative bodies including the Interstate Commission for Water Coordination (ICWC), the ICWC Scientific Information Centre and the BVO AmuDarya, the basin management organization for the river.

Figure 18. Amu Darya flows: forecast, allocated, and actual, 2000-2010

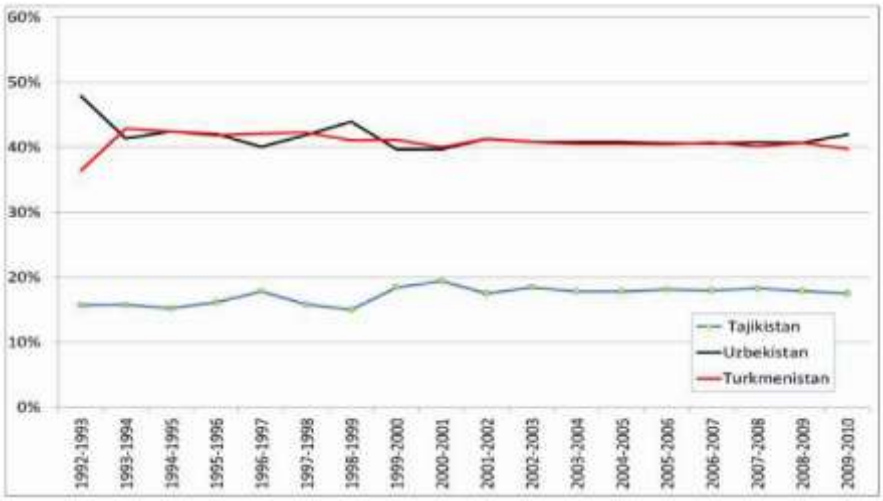


Figure 18. Water allocation to Tajikistan, Uzbekistan, and Turkmenistan, 1992-2010

(Source: Rogun HPP EIA, Pöyry Energy AG, ICWC website)

allocated. Over the period 2000-2010, ICWC forecasts have more often overestimated rather than underestimated water availability (Rogun HPP EIA, Pöyry Energy AG).

Agriculture/Irrigation. Under the Soviet economic system, Central Asia was a source of agricultural products, energy and minerals. The Soviet Union invested massively in developing an immense system of dams, canals and water pumping stations. The period between 1950 and 1990 saw huge investments in the water infrastructure of the region with the construction of reservoirs, irrigation canals, pumping stations and drainage networks for irrigation to support the cultivation of cotton, wheat, fodder, fruit, vegetables and rice in the arid steppe and desert areas. Between 2005 and 2010, the average area under irrigation in the Amu Darya basin exceeded five million hectares. Uzbekistan has the largest area under (large-scale) irrigation followed by Turkmenistan, Tajikistan and Afghanistan[15] (ENVSEC, 2011).

15 Uzbekistan 2-.3 million ha; Turkmenistan 1.7 million ha; Afghanistan 0.4 million ha; Tajikistan 0.5 million ha (Horsman, 2008; FAO, 2007, BVO, 2008).

Along the Vakhsh River, there are several irrigation schemes, as shown on Figure 20 and Figure 20. All irrigated lands are located downstream of Nurek HPP:

- The Dangara tunnel with a capacity of 100 m^3/s was built to irrigate the land in the Dangara area (70,000 ha). A tunnel carries water from Nurek reservoir 14 km to the Dangara area.
- The Yavan tunnel with a capacity of 75 m^3/s supplies water to the Yavan and Obikiik valley irrigation scheme (40,000 ha). The Yavan tunnel is 7.3 km long and supplies water from the Baipaza reservoir.
- The Vakhsh main canal with a capacity of 210 m^3/s is used to supply irrigation water in the regions of Vakhsh, Bokhtar, Jilikul, Kumasangir and Rumi.

In addition to these major systems there are also several small size irrigation systems that provide public and private farms with irrigated water. A significant portion of agricultural land in southern Tajikistan is currently not irrigated because of the poor conditions of the irrigation infrastructure.

Agriculture and economy

Today, the economies of the region are still essentially agricultural, especially with regards to the predominant occupation of the labor force. In 2007-2008, agriculture constituted about 20% of national GDP in Tajikistan, 25% in Turkmenistan and more than 28% in Uzbekistan. Agriculture employs 67% of the labor force in Tajikistan, 45% in Uzbekistan and 48% in Turkmenistan. In the case of Afghanistan some 80% of the population depends on farming and herding (UNEP, 2003). In Tajikistan, 68% of women are employed in agriculture. Crop production in a recent year is shown in Figure 21. Wheat is the main crop cultivated on both irrigated and rain-fed land. All the countries in the region except Afghanistan rely on primary exports (cotton, oil and gas, gold, aluminum) to earn foreign exchange (ENVSEC, 2011). Under the Soviet Union, wheat was imported to the Amu Darya basin mostly from other Soviet republics in exchange for cotton.

After independence, wheat imports had to be paid for in foreign currency and this quickly became a major burden for states and became a food security issue. To decrease dependence on outside food sources, governments opted to shift production away from cotton to wheat. Since independence in 1991, agriculture has been diversified. Nevertheless, as noted below, although wheat is becoming the first production in terms of quantity, cotton lint remains the most important production in terms of value. Figure 21 shows the quantities and value of the main crops grown in Tajikistan.

Water demand and seasonality

Currently, approximately 90 percent of the water demand in the Amu Darya Basin is for irrigation (Figure 22). Of water taken for irrigation in the mid- and upstream reaches of the Amu Darya, about 30 percent (about four km^3) is returned to the Amu Darya. Greater amounts of the water used for irrigation are diverted into the deserts and other lands deemed unsuitable for cultivation. The water that is returned to the river increases the quantity of water in the river but substantially decreases the water quality and makes it unsuitable for drinking, as described above (Rogun EIA, Pöyry Energy AG).

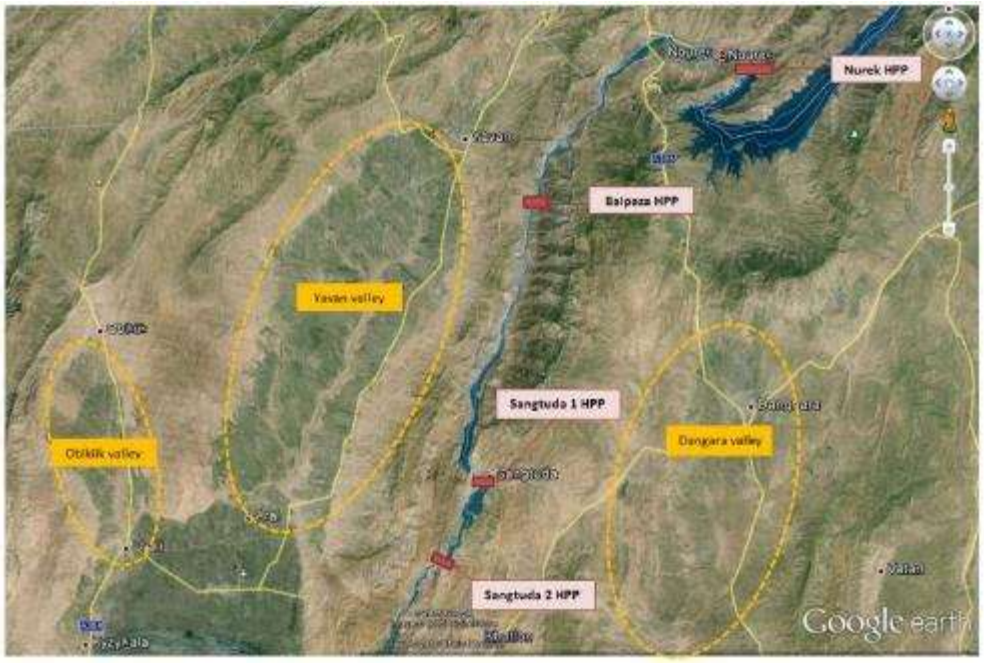


Figure 20. Location of irrigated areas downstream of Nurek HPP.

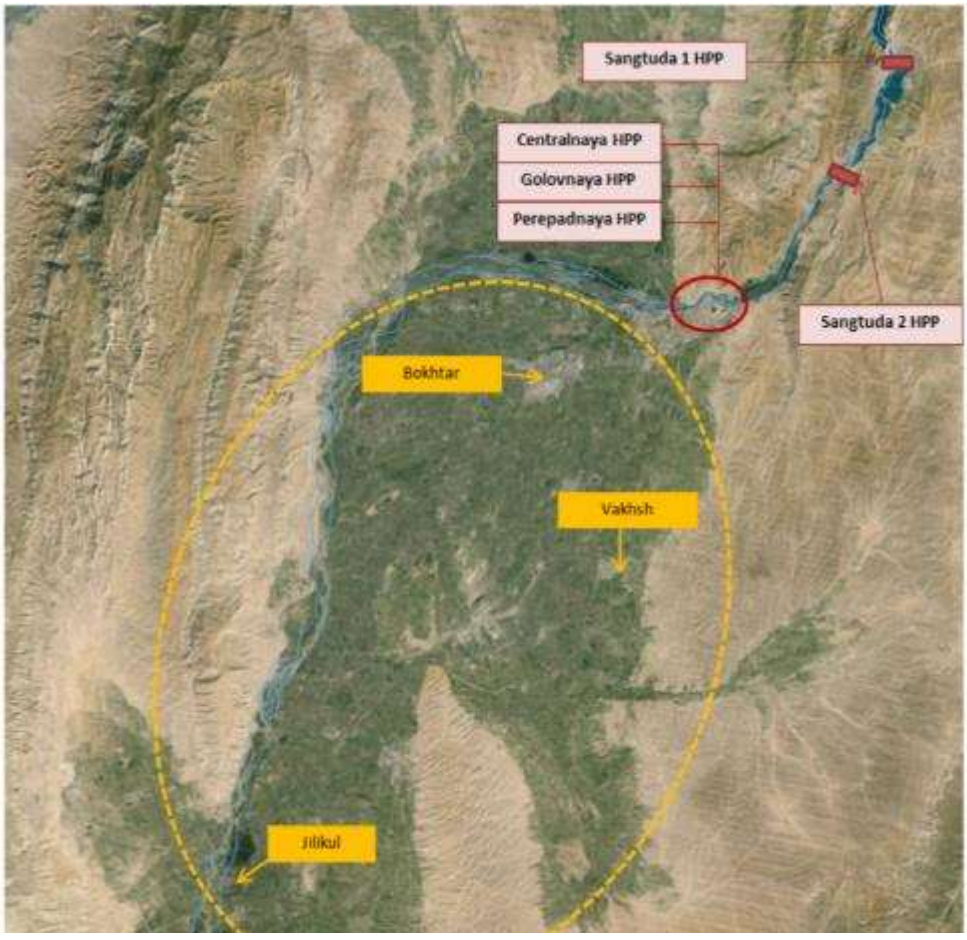


Figure 20. Irrigated areas farther downstream

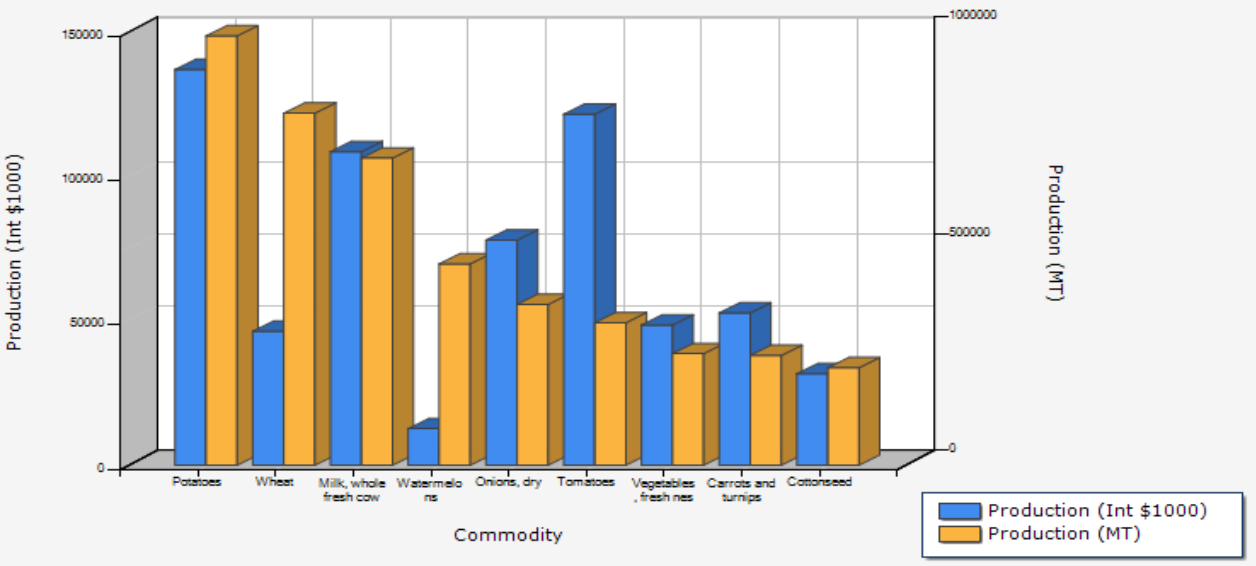


Figure 21. Crop production, 2012

Most of the water used for irrigation is taken during the vegetation period ("summer period") which, subject to the altitude and type of crop, extends from April to October. The months between November and March may be considered as the "winter period". A first consumption peak is observed in March which corresponds to the use of water for artificially inundating the fields before the start of cropping.

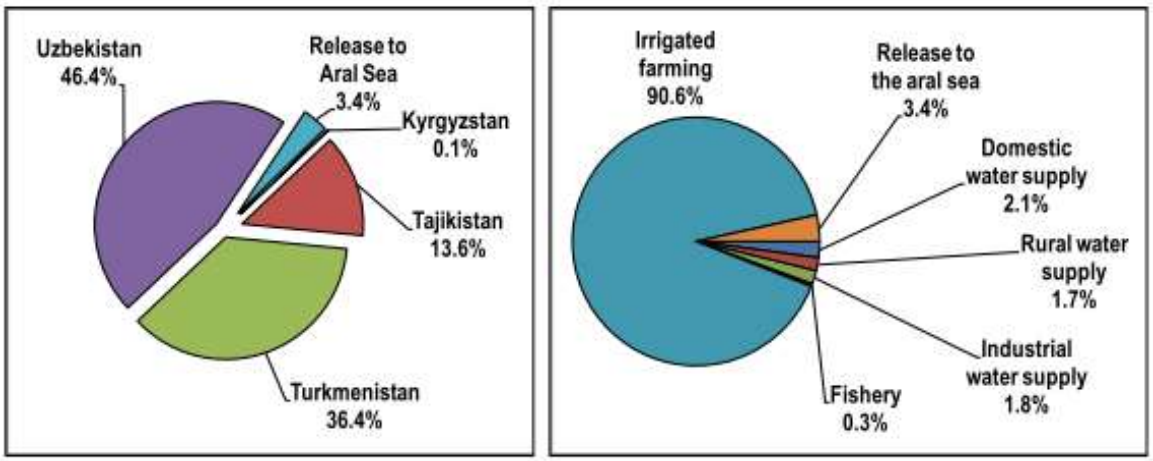


Figure 22. Distribution of water in Amu Darya basin, 1997

(Source: BVO)

A significant water deficit frequently occurs in February and March due to the current irrigation practice in the Amu Darya (Froebrich *et al.*, 2005).

In Uzbekistan, additional regulation of the Amu Darya water flow could have a serious negative impact on agricultural production because of the water-intensive nature of cropping and because extra water availability in winter months due to the presence of the Nurek HPP does not make up for the reduction in growing-season irrigation capacity.

Hydropower

Nurek HPP. The largest hydropower schemes of the Amu Darya basin are located in the Vakhsh River basin. Nurek HPP is the largest HPP and has the second largest regulation reservoir in the Amu Darya River basin, after Tyuyamuyun reservoir in Uzbekistan. Nurek is the second highest dam in the world, and provides around 70 percent of the electricity produced in Tajikistan and satisfies 98 percent of the electricity demand. Nurek is the only reservoir in the upper Amu Darya basin (i.e., in Kafirnigan, Vakhsh and Pyanj basins) with an interannual regulation capacity.

Previously, the dam accumulated water from November to April and released it from May to August-September to maximize (or guarantee) water for agriculture. The current Nurek operating regime provides for increased water discharge in late winter to generate energy. Downstream of the HPP, this water seems to be used mainly for end-of-season irrigation and off-season leaching. The dam's current operating mode should not significantly affect downstream agriculture since outflow does not contribute a great deal to the total flow in the Amu Darya (Wegerich *et al.*, 2007). However, silting increasingly impedes Nurek's ability to satisfy demand for irrigation and energy, storage capacity having been reduced by almost 20 per cent in the last 30 years.

Downstream of Nurek HPP. Table 12 provides key details of the six hydropower projects on the Vakhsh River from Nurek downstream, Vakhsh River, all of which are run-of-river schemes.

The Tyuyamuyun Hydrocomplex (THC) downstream of Nurek is on the Amu Darya on the border between Uzbekistan and Turkmenistan about 300 km south of the Aral Sea. THC was constructed to provide water for irrigation, industry, and drinking water for the lower Amu Darya region. The installed capacity of this complex is 150MW. The operation of the THC depends largely on the inflow regime, and this is strongly influenced by releases from the Nurek reservoir. The schematic diagram in Figure 23 shows the primary hydropower projects on the Vakhsh and Amu Darya Rivers.

There are some small hydropower schemes in the Pyanj river basin (in particular the Pamir HPP near Khorog, Tajikistan), which all work as run-of-river schemes (without regulation capacity) and therefore do not affect the seasonality of the Amu Darya flows. The Kafirnigan river basin also has several small run-of-river hydropower schemes, notably in the Varzob river close to Dushanbe. In Uzbekistan, hydropower schemes exist in the Zeravshan and Kashkadarya basins (notably, Gissar HPP).

Rogun dam and power plant are being constructed on the Vakhsh River upstream of the Nurek dam. Its operation will be coordinated with Nurek in order to allow Nurek to maintain the same production over the course of each year.

Industry (mainly aluminum production), agriculture (mainly electrical pumps for irrigation), and the public sector are the main users of energy. The amount of electricity consumed by the population has risen by more than 300 percent since independence. The growth of industrial power consumption is linked to increasing aluminum output by Tajik Aluminum Company (TALCO) (ENVSEC, 2011).

Navigation

In the past, the Amu Darya provided a major transport route into and out of the Central Asian region. In 1953, the Amu Darya was navigable over a 2,000 km stretch, from the Aral Sea to the lower reaches of Pyanj River (*Annales de Géographie*, 1953). Historical data indicates that barges at least up to 500

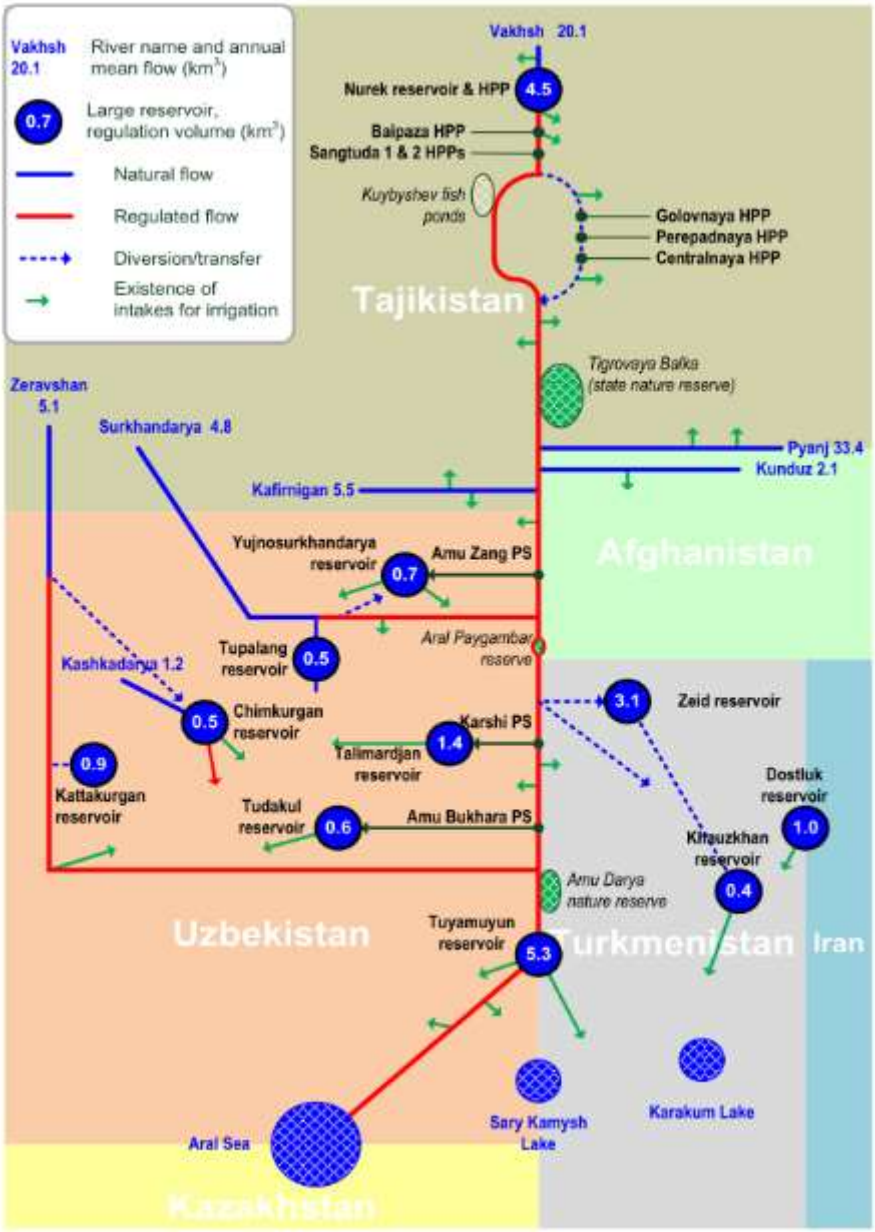


Figure 23. Amu Darya regulation scheme

(Source: Rogun HPP EIA, Pöyry Energy AG)

tons were commonly used on the Amu Darya, which was the only navigable waterway for Afghanistan and Tajikistan. During the Soviet era, long distance river travel became restricted by the construction of permanent pontoon bridges and in the 1980s by the construction of Tyuyamuyun dam.

In addition, water use for irrigation has resulted in increasing limitations to navigation possibilities, due to the decrease of water levels in the Amu Darya lower reaches. Navigation on the Amu Darya downstream of the Tyuyamuyun dam is almost impossible today. Navigation on the Amu Darya and on the Vakhsh and Pyanj rivers is nowadays limited to local activities using small boats for local transportation, fishing, tourism, riverworks, etc. (www.karakalpak.com).

Table 12. Characteristics of Vakhsh River cascade HPPs

HPP	Regulation capacity	Reservoir			Installed capacity	Head (m)
		Total volume (hm^3)	Active storage (hm^3)	Surface		
Nurek	Annual	10,500	4,536.8	98	3,000	265
Baipaza	Weekly-daily	97	80	8.04	600	60
Sangtuda 1	Daily	258	12	9.75	670	64.4
Sangtuda 2	Daily	66.5	3.53	-	220	22
Golovnaya	Daily	94.5	18	7.5	210	23.3
Perepadnaya	Daily	-	-	-	29.9	-
Centralnaya	Daily	-	-	-	15.1	-

Domestic and industrial water use

Over 90 percent of water abstracted or diverted from the Amu Darya basin is used for irrigation needs. Other uses are for domestic and industrial needs. The volumes of water used for industrial, rural and urban needs are all in the same order of magnitude and make up a total of about 5% of the volume abstracted from the Amu Darya (see Figure 22).

Fisheries and aquaculture

Historical evolution. During the past 30 years, the Amu-Darya waters have been used for large-scale irrigation leading to the construction of numerous irrigation canals (Kairrakum canal, Karshi and Amu-Bukhara canals, etc.). A number of water storage reservoirs were also constructed. As noted previously, the impact of human measures on the river has had major impacts on fish. The chemical composition of the river water has changed under the impact of the discharges of drainage waters from irrigated fields and from industries. Regulation of the Amu Darya, manipulation of the flow for irrigated agriculture, and the introduction of Far Eastern fish (especially Chinese carps) in the 1960s led to radical changes in the river biota. Some fish species, whose life cycle was dependent on the river delta, almost disappeared.

In the past, the Amu Darya played an important role in maintaining the fish stocks of the Aral Sea. Its floodplains, delta, and lakes created favorable conditions for natural reproduction of the major economic fish such as bream, carp and roach. In the Amu Darya and Syr Darya rivers, the migratory Aral barbel (Barbus brachycephalus) and Aral sturgeon used to feed in the sea, migrate for spawning into rivers at distances of more than 1,000 km and return to the Aral Sea (Pavlovskaya L., 2005)[16]. This is no longer possible.

In Soviet times, fish production largely focused on pond culture. The first fish-breeding farm was established on the Luchobka River in 1936 and Kuybyshev, the first hatchery was established at Vakhsh in Khatlon oblast in 1951 (Khaitov, 2008:7). Originally covering 72 ha, the farm expanded within a period of 20 years to cover more than 200 ha and to produce 14 million larvae for domestic

16 Pavlovskaya, L. (2005). Fishery in the lower Amu Darya under the impact of irrigated agriculture. www.fao.org/docrep/v9529e/v9529E04.htm

consumption and export purposes. A hatchery and feeding ponds were developed in Kuybyshev in 1951, when the Vakhsh River changed course, leaving a series of large ponds on its original watercourse. In 1988, a larvae reproduction complex was constructed at Kuybyshev with a projected capacity of 250 million units to supply all the former USSR's needs for herbivorous stock.

The favorable conditions for pond culture in Tajikistan saw a further ten fish-breeding installations being opened across the republic. Fish production reached its zenith in 1991 in the newly constructed reservoirs in the north principally at Farkhadskiy, Kayrakkum and Katasey, and in the south at Nurek. In that year, pond culture which contributed 3,298 tons or 84 percent of the total fish production was largely focused on carp (silver and common carp comprised 94 percent of the catch) and smaller quantities of freshwater bream (130 tons).

However, independence and the fracturing of economic links with the former Soviet bloc caused production to decline, and the main reproduction unit were destroyed during the civil war. Since 1991, there has been a swift decline in production (Figure 24). Other than the loss of facilities, the decline has been attributed to three factors:

- Water pollution from industrial enterprises, agrochemical runoff and sewage;
- An increased incidence of illegal poaching
- Institutional failure, specifically the inability of post-independence institutions to guarantee a regular feed supply, to control fish diseases, and to adequately disinfect and/or maintain production facilities and/or restock effectively, factors in part related to the financial impoverishment of such institutions (Thorpe *et al.*, 2009)[17].

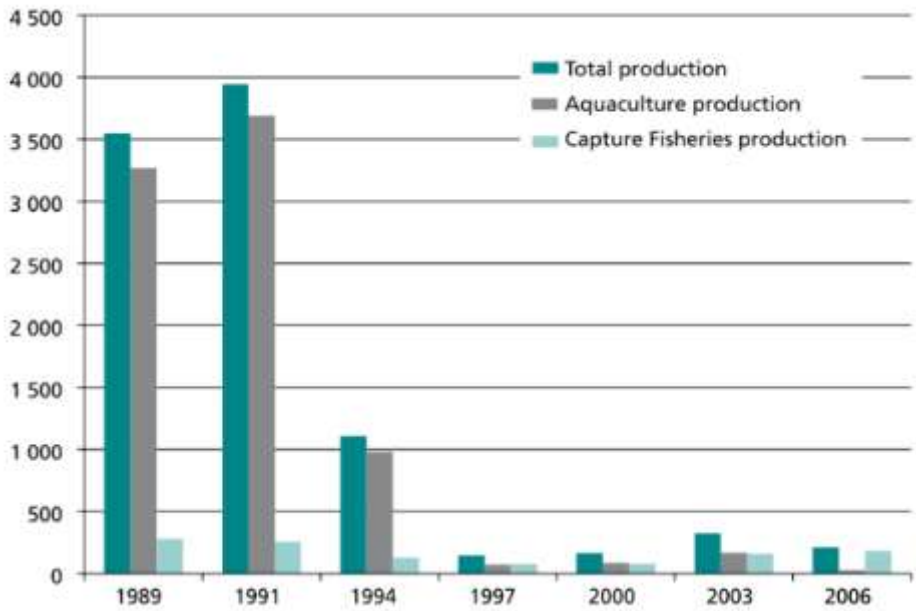


Figure 24. Fish production in Tajikistan, 1989-2006

The decision was taken to privatize the facility, and the hatchery and feeding ponds passed into the hands of the joint-stock company A. Djami in 2002/2003, which has since invested in the

17 Thorpe, A.; van Anrooy, R. Inland fisheries livelihoods in Central Asia: policy interventions and opportunities. FAO Fisheries and Aquaculture Technical Paper. No. 526. Rome, FAO. 2009. 61p.

reconstruction of the reproduction facilities. The present enterprise covers 23 ponds varying in size from 10 ha to 43ha, with a total of more than 600 ha (Thorpe *et al.*, 2009).

Current situation. After the Aral Sea fishery ceased to exist, the fishery activities moved to lakes and reservoirs. Other than Nurek, most of the water bodies have a low to medium productivity level. They are mostly shallow, of an average depth of 2-4 m, quick to warm up, rich in bottom plant detritus and aquatic macrophytes, with alkaline water o and no oxygen deficit. The water is usually saline, dominated by sulphates or sodium chlorides (Pavlovskaya L., 2005).

The fishery sector currently plays a minor role in development of the rural economy of Tajikistan. Its contribution to the country's Gross National Product was in recent years less than 0.1 percent Despite the availability of extensive water resources (ponds, reservoirs, lakes, rivers and channels), fish production has fallen from 4,000 tons in 1991 to 214 tons in 2006 (Khaitov *et al.*, 2013)[18], as shown on Figure 24.

Fishing on the Amu-Darya is forbidden. Fishing is allowed only in the Tuyamuyun reservoir. There is widespread poaching, especially downstream of the dam, and this has a major impact on fish stocks. The reservoir fishery is low-scale and has considerable potential for further development. One of the serious problems facing the fish is the passive transport of the young from the river into irrigation systems. About 90 percent of the drifting young fish enter irrigation canals and perish on the irrigated fields (Pavlovskaya, 1982). Virtually none of the Amu-Darya irrigation uptakes has a fish protecting device; those installed in the 1970s turned out to be ineffective. The other serious problem is the preservation of the rare fish species which are disappearing from the modified water bodies.

4.6 Nurek HPP Workplace Safety

The assessment on occupational safety at Nurek HPP is based on the findings of a field visit to the HPP in 2016. It was determined that if basic occupational safety rules are followed (wearing PPE, housekeeping, presence of physical protections such as guardrails, safety signage, etc.), workers would be adequately protected. However, the equipment and facilities are aging, which generates new risks, such as lack of lighting or deteriorating ladders and stairs (Figure 25)

The operation of the power plant is based on established procedures that are applied methodologically and rigorously, but most of these procedures appear to date from the commissioning of the plant. This was at a time when occupational health and safety procedures were not as well-developed as they are today. Therefore, there is a need to upgrade health and safety conditions, equipment, training and management procedures. This will be an important part of the overall rehabilitation project.

18 Khaitov, A.H., Gafurov, A., van Anrooy, R., Hasan, M.R., Bueno, P.B. and Yerli, S.V. 2013. Fisheries and aquaculture in Tajikistan: review and policy framework. FAO Fisheries and Aquaculture Circular. No. 1030/3. Ankara, FAO. 90 pp. www.fao.org/3/a-i3151e.pdf

Lack of lighting in Nurek HPP

Aging protective covers

Good Practice Safety measure

Figure 25. Example workplace conditions in Nurek HPP

5 Environmental and Social Risks and Impacts

5.1 Scope

This Chapter describes potential environmental and socioeconomic risks and impacts during construction and operation phases of the Project. The assessment of these risks and impacts was conducted using the methodology described in Section 5.2. The assessment of potential impacts was based on the project activities described in Chapter 3 and summarized in Table 17 below, considered within the context of the baseline conditions described in the previous chapter. When potential impacts could be more than minor, the assessment also identifies measures that will be taken to avoid or reduce the potential impacts. The measures were identified and selected using the mitigation hierarchy. The Environmental and Social Management Plan and the Monitoring Plan in Chapter 8 then summarize all mitigation requirements and describe how impacts will be monitored.

> "The environmental and social assessment will apply a ***mitigation hierarchy***, which will:
> "(a) Anticipate and avoid risks and impacts;
> "(b) Where avoidance is not possible, minimize or reduce risks and impacts to acceptable levels;
> "(c) Once risks and impacts have been minimized or reduced, mitigate; and
> "d) Where significant residual impacts remain, compensate for or offset them, where technically and financially feasible."
>
> *World Bank ESS1, paragraph 27*

One of the primary objectives of sustainable development is to achieve economic development within the framework of plans which are compatible with the environmental principles and prevent renewable and non-renewable resources from destruction and depletion. It is required to have macro and systematic views in this regard and to develop infrastructure in conformity with environmental regulations to solve the environmental problems in a manner that protects the health and welfare of society. The purpose of an EIA report is to identify the conditions for compliance with these requirements.

5.2 Methodology

A number of criteria were used to determine whether or not an adverse impact of the proposed project could be considered "significant" (that is, unacceptable). These are outlined with reference to specific environmental and social issues in this ESIA. In general, the evaluation of impacts is based on an assessment of their extent (local, regional, national), duration (short, medium, long-term) and reversibility (temporary or irreversible effects). Wherever possible, a quantitative assessment of the impacts was undertaken. In most cases, this was not possible, in which case a qualitative assessment of impacts was undertaken, based on existing information and experience with other similar projects. The ESIA covers the direct impacts and any indirect, secondary, cumulative, short-term medium-term, and long-term, permanent and temporary, reversible and irreversible, beneficial and adverse impacts of the proposed rehabilitation works.

Where relevant, the anticipated impacts were compared against applicable legal requirements and standards. In many or most cases, no such standards exist, so the assessment required interpretation and the application of professional judgement. The assessment of significance in all cases took into account the changes that would occur to the established baseline conditions, considering the sensitivity of the environment.

5.2.1 Methodology for Assessing Environmental Impacts

A general method for grading the significance of environmental impacts was adopted to ensure consistency in the terminology of significance, whether for a beneficial or an adverse impact. The two principal criteria used to determine significance were the sensitivity of the receptor and the magnitude of the change arising from the scheme, as shown in Table 13.

The table shows that the significance of impacts was classed as major, moderate, minor, or none; and either positive (beneficial) or negative (adverse). This categorization is widely recognized and accepted in the field of environmental impact assessment. Where appropriate, topic-specific assessment methods and criteria for determining significance are described.

Table 13. Determination of environmental impact significance

Magnitude of change/impact	*Sensitivity of receptor*		
	High (e.g. international, national protection, rarely found)	*Medium (e.g., regional, local protection, uncommonly found)*	*Low (e.g. no protection, common, nuisance)*
High *All or significant proportion affected*	Major (H,H)	Major (H, M)	Moderate (H, L)
Medium *Substantial amount affected*	Major (M, H)	Moderate (M, M)	Minor (M, L)
Low *Relatively small proportion affected*	Moderate (L, H)	Minor (L, M)	Negligible (L, L)
Very Low *Very small amount affected*	Minor (VL, H)	Negligible (VL, M)	Negligible (VL, L)
No Change	None (NC, H)	None (NC, M)	None (NC, L)

Another consideration was the duration of the impact -- whether the impact would be temporary or permanent -- and if they were temporary whether short-, medium-, or -long- term. It is recognized that defining the duration of an impact can be subjective, depending on the receptor. For instance, an accident during construction can result in impacts (injuries, damage) that can last for much longer than the project, and can even be permanent. Although in absolute terms the period of impact may not be a long time, for the people who are injured or whose property is affected, the period could be significant in relation to their lifetime, and could therefore be considered essentially permanent. Similarly, a person's initial reaction to a nuisance impact such as noise or dust could be very negative, but over time the reaction would be subdued until there was little or no reaction at all. Table 14 sets out how the duration of impact was defined. In general, shorter-term impacts were considered to be less significant and longer-term and permanent ones to be more significant.

Table 14. Duration of impacts

Nature of change	*Duration*	*Definition/ Description*
Temporary	Short-term	Impact continues during construction (1-4 years) and up to 1 year following construction
	Medium-term	Impact continues 1-5 years following construction
	Long-term	Impact continues 5-10 years after construction
Permanent	-	Due to the length of time period for human beings, impacts over 15 years are considered permanent.

5.2.2 Methodology for Assessing Social Impacts

The objective of the social impact assessment was to identify major risks to social and economic conditions in the area of Nurek HPP and to assess the impacts of construction and operation on those conditions. As with environmental impacts, the impacts could be direct or indirect, intended or unintended, positive or negative. For significant impacts, Pamir Energy will be required to implement a variety of mitigation measures, and these are discussed in Chapter 8.

Generally, the social impact assessment process involved the following major tasks:

- Identifying types of adverse and beneficial impacts of the rehabilitation works
- Assessing the level of socioeconomic risks in terms of probability (how likely is it to happen), frequency, and consequences
- Assessing the acceptability of the risks, including compliance with standards
- Introducing mitigation measures to reduce risks to acceptable levels.

As with environmental impacts, a general method for grading the significance of socioeconomic impacts was adopted to ensure consistency in the terminology of significance, whether for a beneficial or adverse impact. The two principal criteria used were the nature of the impact and the magnitude of the change arising from the scheme, as shown in Table 15.

Table 15. Determination of social impact significance

Magnitude of change	*Nature of impact*		
	Avoidance	*Disruption/Habituation*	*Permanence*
Negligible	No avoidance needed	Not noticeable under normal conditions	Not noticeable
Minor	Mitigation or design change prevents impact(s)	Possible initial change on daily life/routine, rapid habituation reduces to below nuisance level	Ephemeral: <1 year
Moderate	Mitigation or design change reduces impact	Definite change to daily life, habituation reduces disruption over time	Temporary: recovery to pre-existing conditions after one

Magnitude of change	*Nature of impact*		
	Avoidance	*Disruption/Habituation*	*Permanence*
			or a few years (e.g., after construction)
Major	Mitigation or design change cannot significantly reduce impact(s)	Requires major change to daily life or routine activities	Permanent: >15 years

5.2.3 Environmental and Social Impact Mitigation and Enhancement

Where potential impacts could be significant (that is, moderate or major), measures to avoid, reduce, or mitigate the impacts were developed by applying the mitigation hierarchy, as outlined in the text box at the beginning of this chapter. These measures are intended to avoid, reduce, compensate, and/or remediate adverse impacts, or to enhance potentially beneficial impacts. Wherever possible, mitigation is undertaken was part of the project design, including the design of work activities, so the measures could feed back into impact assessment.

The mitigation and enhancement which should be undertaken as part of the project are set out as an Environmental and Social Management Plan which can then be applied in order to manage different phases of the project. For this project, the plan is presented in Chapter 8.

Table 13 and Table 15 show that impact significance has been classed as major, moderate, minor, or negligible. As noted, impacts can be either positive (beneficial) or negative (adverse). Where appropriate, topic-specific assessment methods and criteria for determining significance are described in relevant sections of this chapter.

5.2.4 Environmental and Social Monitoring

The success of most mitigation measures is necessarily uncertain and must be monitored to verify it is being implemented and is working as planned. Various monitoring results will need to be reported by the contractor to the Project Management Consultant, by the Consultant to Nurek HPP and Barqi Tojik, by Nurek HPP to Barqi Tojik, and by Barqi Tojik Tajikistan authorities, the World Bank, and others. The Environmental and Social Monitoring Plan for this project is presented in Chapter 8.

5.3 Identification and Evaluation of Potential Impacts

Stakeholders identified a number of concerns about potential impacts from the Nurek HPP rehabilitation project, and others potential impacts were identified based on experience at other HPPs and other construction projects. Potential impacts evaluated in the ESIA are identified in Table 16 and discussed in the following subsections.

Table 16. Potential impacts of primary concern

Impact No.	*Source of impact*	*Impact No.*	*Impact Description*
1	Changes in downstream flow regime of Vakhsh River	7	Worker health and safety

Impact No.	*Source of impact*	*Impact No.*	*Impact Description*
2	Change in Nurek HPP reservoir management	8	Other impacts on workers
3	Floods during rehabilitation and operation	9	Community health, safety, and welfare
4	Wastes	10	Improvement of dam safety
5	Water pollution	11	Increase in operational issues
6	Asbestos exposure	12	Climate change

Although the ESIA addresses potential impacts from Phase 2 activities, the performance under Phase 1 is relevant in that the same types of issues could arise during Phase 2. In summary:

- There have been two no major environmental impacts. Asbestos and other hazardous wastes that are being removed from the powerhouse are being removed from the site and properly disposed in the Vakhsh landfill, in coordination with the Committee for Environmental Protection. There have been no major spills or incidents, and minor issues have been dealt with quickly and adequately. Early in Phase 1, there were issues concerning labeling of containers of different types of wastes, but this was resolved without incident.
- There has been on worker injury, which occurred when a plate being dismantled fell and injured the worker.
- There have been no traffic accidents or other incidents that involved community members, and there have been no community grievances. One incident occurred when a truck damaged the gate to the site.

5.3.1 Potential Impacts Due to Changes in Vakhsh River Downstream Flow Regime

The downstream river has adapted to the altered flow regime imposed by Nurek HPP but supports relatively limited biodiversity except farther downstream, below other dams that have much more effect. The use of water for irrigation in Tajikistan and in downstream riparian countries, however, makes it important that adequate flow from Nurek continues in spring and summer seasons. Sensitivity of environmental resources downstream of Nurek are considered to be low to medium, given their adaptation to the modified flow regime. Populations downstream are considered to be highly sensitive, however, due to their reliance on irrigation made possible by the current flow regime established by Nurek.

The impact of the project on the downstream flow regime could occur during two periods: during the rehabilitation, when one unit is taken out of service for rehabilitation, then another, and so on; and during operation after rehabilitation, when the available capacity of the power plant has been restored and improved. It is important to note the operating rules and principles that have guided HPP operation in the past will continue to be followed during and after rehabilitation.

From the perspective of the downstream total discharge (power plant and spillways), the operating rules and principles imply the following during and after rehabilitation:

- ***In winter:*** energy production is limited by available water (low inflows + some amount of stored water). The discharge is controlled by the necessity of spreading out the usage of the stored water volume over the winter period in order to generate electricity. The power plant is therefore used far below its rated power capacity.
- ***In summer:*** high inflows are used for generation of electricity and to fill the reservoir. The filling of the reservoir is controlled by an operating rule for limiting the speed of filling. When the maximum daily filling is reached and the plant is functioning at full capacity, further inflows have to be discharged through the spillways. In these circumstances, the rate of filling is controlled throughout the season in its upper limit by the limit of filling rate and in its lower limit by the necessity to fill the reservoir by the end of September. The summer downstream discharge and its distribution from April to September remains therefore in these limits whatever the available capacity of the plant.

5.3.1.1 During Rehabilitation Works

Under the base case scenario where the units are taken out of service one at a time for rehabilitation, the works will start with Unit 8, which has been out of service since 2011. This would increase power plant capacity and ensure that rehabilitation of later units will not result in even temporary decreases in generation capacity.

During rehabilitation of Unit 8, in winter and summer, enough units remain available for energy generation. Rehabilitation of Unit 8, currently out of order, will not modify the current situation. In summer, when rehabilitation of the first unit is completed (Unit 8), the increase of available capacity allows for the same production when subsequent units are taken out of service, thus allowing an additional volume of water to be used for energy production that would otherwise have been spilled. Since operating rules will remain the same, this will not result in a change in downstream flow, simply a change in the discharge point from spillway to tailrace.

5.3.1.2 Post-rehabilitation

After rehabilitation, the powerplant capacity will have been increased to 3,015 MW, 3,116 MW or 3,214 MW. In winter, since electricity generation at present does not approach capacity due to the limited available volume of water, the increased capacity due to placing Unit 8 in service and rehabilitating other units will have no impact on energy production, and thus no change in downstream discharge.

In summer, the increased capacity would allow an additional volume of water to be used for production rather than being discharged via spillway. The total downstream discharge (power plant + spillways) would not be affected.

5.3.1.3 Summary of Impacts on Downstream Flow

In summary, rehabilitation of the turbines and other generation facilities and then continued operation of the HPP will not result in changes to the downstream flow regime so long as the current international agreements continue to be in place. Therefore, there will be no impacts.

5.3.2 Potential Impacts Due to Changes in Nurek HPP Reservoir Management

As described previously, the reservoir is carefully managed to allow power generation during winter and irrigation during summer, with specific guidelines for the amount of water that must be released.

The principles are part of the international agreements described in Chapter 2 that control water in the Amu Darya basin, and the amounts of water and flow regime are based on these agreements.

Changes in reservoir management could have effects on fisheries and other uses of the reservoir and its water, but any future change would probably not approach the impacts already felt by the relatively large variation in water levels that occur over the course of each year and from year to year. Sensitivity of the reservoir is considered to be medium-high because of its value in storing water to allow irrigation in summer and power generation year-round. In order for there to be any change in reservoir management, the current operating rules would need to be changed, which in turn will not occur while the international agreements are in place.

The operating rules will remain the same, and the international agreements will remain in place, so there will be no impacts on the reservoir level due to HPP rehabilitation.

5.3.3 Potential Impacts Due to Floods During Rehabilitation and Operation

As presented in Chapter 4, the peak inflows to the reservoir corresponding to a flood with a 10,000-year return interval (the so-called 10,000-year flood) has been assessed at 5,690 m^3/s. This flood can be evacuated only if both spillways are opened and all nine turbines are operating at full capacity. At present, one turbine out of service, and the cumulative malfunctioning of the eight other turbines is equivalent to having another turbine out of service as well. Thus, the occurrence of flows that approached the 10,000-year flood at a time when the reservoir was already full would present a risk to the dam itself, since all the water could not be discharged in a controlled manner. Thus, there is currently a significant flood risk, although the probability is very low that it would occur in any given year.

As described previously, rehabilitation works will not change the current flow through the turbines significantly, since Unit 8 will come online and other turbines will be taken out of service in sequence while being rehabilitated or replaced. Therefore, the rehabilitation itself will not result in any additional flood risk. During operation, with all nine turbines operating and spillways in full operation, the flood risk will be reduced from its current state since the dam will be able to pass flows from the 10,000-year flood.

During both rehabilitation and operation, there could be involuntary shutdowns of one or more turbines due to electrical perturbation or other unexpected events (this is Impact 11 in Table 16, “Increase in operating issues”). This would result in a reduction in flows through turbines, and thus less ability to handle extreme flood events. However, it is important to note that the rehabilitation project is expected to increase the reliability of the generating units and other infrastructure, and thus reduce the number of shutdowns. This in turn would reduce the risk of impacts from major flooding.

The downstream area would be highly sensitive to large floods, but less sensitive to medium or small floods due to the highly-variable water management and thus seasonal flows. Given the very low probability of floods caused by or contributed to by the project, and the relatively small contributions to the flooding, the potential impact is considered to be moderate. This will be balanced by the mitigation of floods due to improved efficiencies, so the overall impact should be minor.

5.3.4 Potential Impacts Due to Waste Management

Waste is any solid, liquid, or contained gaseous material that is being managed by disposal, recycling, burning, or incineration. It can be a by-product of a manufacturing process, an unused product that

can no longer be used for intended purpose, or unusable material that remains after construction or demolition activities. If a waste or other material possesses physical, chemical, or biological characteristics that may pose a potential risk to human health or the environment if not properly managed, they are considered hazardous. They can be classified according to the hazard as explosives; compressed gases, including toxic or flammable gases; flammable liquids such as fuels; flammable solids; oxidizing substances; toxic materials; radioactive material; and corrosive substances. Nonhazardous materials and wastes are wastes that are generally inert and do not present a hazard, and include such things as metal and concrete scrap, empty containers that did not contain hazardous materials, plastics, etc.

During the rehabilitation process, the main hazardous wastes will include asbestos that is contained in old equipment and structures, which is described in section 5.3.6, and oils contained in turbines, transformers, and other devices of the powerhouse and substation. In addition, smaller quantities of other hazardous materials and wastes will be used and/or generated, including lubricants and solvents, spent solvents and oily rags, paint and empty paint cans, treated wood, chemicals and their containers; used lubricating oils, and diesel and other petroleum-based products. There are no oils that contain polychlorinated biphenyls (PCBs) that will require special handling.

If these materials are not stored and used as designed, and these wastes are not managed (that is, dismantled, generated, stored, transported, and treated/recycled, and/or disposed) properly, they can be released to the environment and result in significant impacts on workers, the community, and the environment. The quantity of hazardous materials and wastes will be much higher during rehabilitation, so the potential impact would be higher than during operations.

Mismanagement of nonhazardous materials and wastes can also contribute to significant impacts; this could include (for examples, improper wood or paper storage could result in fire). Without controls, potential impacts (primarily to workers, who are considered medium- to highly-sensitive receptors) could be major and could affect the community through water or soil pollution (considered to be low to medium sensitivity). Metals will be recycled whenever possible, as will untreated wood.

Temporary storage areas have been set aside at the HPP for storage of hazardous materials and wastes until they can be removed to the Vakhsh landfill, which is designated for special landfill, in coordination with the Committee for Environmental Protection. These areas and the Vakhsh landfill will continue to be used during construction and operation.

Common-sense precautions by workers and managers would prevent most impacts, but further controls are needed beyond such informal measures. Before the contractor is authorized to begin rehabilitation works, they will be required to develop a Materials and Waste Management Plan that identifies the materials that will be used and encountered and the wastes that will be generated, and that describes how the materials and wastes will be managed, including how they will be handled, stored, recycled or reused (if any), transported, and disposed. This Plan, and the Occupational Health and Safety Plan (see section 5.3.7), will include strict requirements for job performance to minimize exposure to hazardous materials and wastes. The Plan must be approved by the Project Management Consultant before the contractor is authorized to mobilize and begin work. Without these controls, potential impacts could be major. With proper controls, impacts should be negligible to minor during both rehabilitation and operations.

5.3.5 Potential Impacts of Water Pollution

Rehabilitation activities will generate a certain amount of wastewater, including runoff from storage areas and camps, water from washing equipment and surfaces, and sanitary water from accommodations and toilets and kitchens. In addition, there could be spills of fuels, oils, or chemicals that enter the reservoir or the downstream river. Pollutants in industrial wastewater may include acids or bases (exhibited as low or high pH), soluble organic chemicals, nutrients (phosphorus, nitrogen), heavy metals (e.g. cadmium, chromium, copper, lead, mercury, nickel, zinc), cyanide, toxic organic chemicals, oily materials, petroleum compounds, and volatile materials. Any or all of these materials may be present on site.

The potential degradation of water quality may lead to the deterioration or loss of aquatic habitats and fauna (fish, fisheries) in the reservoir or for some distance downstream of the dam. The water environment is considered to be of low- to medium-sensitivity. There would be no effect on the nearest protected area, the Tigrovaya Balka National Reserve, since it is sufficiently far downstream that any pollution event would be sufficiently diluted as to prevent damage.

The amount of any pollutant that could be released would be relatively small given the flow in the river, so the potential impact on water quality would range from moderate immediately below the dam to negligible after some distance (probably on the order of several kilometers). To prevent the likelihood of any such event, the contractor will be required to develop and implement three key management plans:

- The Materials and Waste Management Plan described above will describe how materials will be identified, stored, used, and otherwise managed to prevent spills
- The Emergency Preparedness and Response Plan will include detailed requirements for cleaning up spills and other incidents that could result in releases of pollutants
- The Training Plan will identify how workers will be trained on how to do their jobs safely, and what their responsibilities are under each of the other Management Plans.

These plans, and all other Management Plans, will need to be approved by the Project Management Consultant prior to the contractor beginning work at the site. With proper implementation of the controls embedded in these Plans, overall impacts will be negligible to minor.

5.3.6 Potential Impacts from Asbestos Exposure

Asbestos is a fibrous mineral commonly used as a component in many materials because of its strength and heat-resistance properties. It was widely used in a variety of building materials until 1987. All types of asbestos have been confirmed to cause cancer, primarily through inhalation of asbestos fibers, which may result in asbestosis, a progressive fibrosis of lung tissue or mesothelioma. Diseases caused by asbestos may not manifest themselves for 15 to 50 years after exposure.

In the case of Nurek HPP, asbestos is present in the power station in sizeable quantities, including the generators (braking pads, stator insulation, rotor insulation), in some electrical equipment cubicles, and in cable trays. During the rehabilitation works, asbestos-containing equipment may be dismantled and asbestos may be exposed in buildings or other places. This in turn will present a risk to workers who are involved in the rehabilitation or who perform tasks in areas where asbestos is exposed.

Given the length of the rehabilitation project (several years), some workers could be exposed for extended periods of time, increasing the risks. If asbestos is not promptly removed and disposed properly, it can continue to present a risk to workers over even longer periods (if stored improperly in an area where work is performed, for example). In general, workers are considered highly sensitive. Without controls, the impact could be major on individual workers.

To reduce the potential impact, contractors will be required to develop and follow the requirements of several management plans, including:

- A project-specific Asbestos Management Plan will require surveys to identify and mark asbestos-containing equipment and areas, procedures for safe removal and storage of asbestos, procedures for handling and transporting asbestos, and requirements for safe and secure disposal.
- An Occupational Safety and Health Plan (see next section) will include specific requirements to reduce risks for workers who may be exposed to asbestos (such as training in reducing exposure and risks, proper use of personal protective equipment, rules for handling and managing asbestos, etc.).
- The Emergency Preparedness and Response Plan will include procedures for responding to spills or releases of asbestos that could lead to worker or community exposure.

All Plans will be consistent with and incorporate the requirements of the World Bank 2009 Good Practice Note *Asbestos: Occupational and Community Health Issues*. The main construction contractor has submitted its Plan (as part of its Contractor's Environmental and Social Management Plan, or C-ESMP) for approval by the Project Management Consultant, and the Plan has been approved for ongoing operations. Other contractors will similarly develop and submit their Plans for approval.

With proper implementation of the plans, the actual impact should be minor or even negligible.

5.3.7 Potentials Impacts on Worker Health, Safety, and Welfare

Perhaps the most significant potential risk that will be presented by the rehabilitation project will be the potential for adverse impacts on to workers, with lesser risks for visitors and community members. Protection of workers is increasingly recognized as being extremely important, as witnessed by the World Bank's adoption in 2018 of Environmental and Social Standard 2, "Labor and Working Conditions" and the enhancement of Tajikistan safety standards in the 2016 Labor Code. In general, sensitivity of workers is considered high, as all would be exposed to hazards.

All construction sites and activities are inherently dangerous, and the aging Nurek facilities present even more hazards. As noted above, workers and others could be exposed to chemicals or other hazardous materials or wastes in case of accident. Other hazards would include such things as falling from heights or stairs, working in confined spaces, working with electricity, working with heavy equipment and machinery, working with hand tools, and tripping and falling. In addition, the aging facilities at Nurek may have inadequate lighting and concrete or other flooring materials may be worn or degraded, which may increase the hazard. Exposure to such hazards may result in a wide range of injuries, from those requiring only minor medical aid to those that can be disabling or even fatal. Multiple events over prolonged periods can result in disabling injuries of comparable significance and consequence.

There will be additional risks to operating staff of Nurek HPP during rehabilitation because individual generating units will be rehabilitated by the contractor while Nurek staff are operating other nearby units. The extra people in the powerhouse can result in additional or more severe health and safety risks due to limited space for the contractor's team working on rehabilitation and Nurek HPP staff conducting regular operations. This risk will be mitigated through preparation and implementation of a clear operational plan that accounts for all ongoing activities, which will include safe operation instructions for both the Contractor and Nurek HPP operations staff. Implementation of this Plan will be supervised by the Project Management Consultant. Safety procedures for HPP operation are part of the overall operating procedure, which has not been updated for many years. A Safety and Health Audit will be performed by one or qualified safety professionals to identify the risks to which workers could be exposed during operation and to identify actions that are needed to reduce the risks to acceptable levels. The results of this audit will inform a new Safety and Health Plan for Nurek Operations that will be implemented throughout operations.

The following discussion is organized by several of the potential impacts that could occur:

- Rotating and moving equipment
- Noise
- Electrical hazards
- Welding/Hotworks
- Traffic
- Work at Heights
- Working with hazardous materials
- Electromagnetic fields
- Other impacts

To ensure workers are prepared to perform their jobs safely, contractors are required to develop Occupational Health and Safety Plans (OHS Plans) that describe the risks of performing the various tasks and the measures that must be taken to avoid, control, or otherwise mitigate those risks. These Plans will be submitted to the Project Management Consultant for approval prior to work being performed. The primary contractor currently on site has previously submitted its OHS Plan as part of its own Contractor's Environmental and Social Management Plan (C-ESMP), and the Plan has been reviewed and approved by the Project Management Consultant.

5.3.7.1 Potential Impacts Due to Rotating and Moving Equipment

Injury or death can occur from being trapped, entangled, or struck by machinery parts due to unexpected starting of equipment or unexpected movement during operations. In addition, very large pieces of equipment (turbines and parts, transformers, various machinery) will be moved into and out of the powerhouse and substation, and workers can be injured or killed through accident or carelessness. The risk will be most significant during construction, but there will be continue to be some risk during operation since workers will continue to work with machinery and heavy equipment. The risk would be to workers, but not community members.

The risks from each of these tasks will be evaluated by the contractor and procedures will be developed and included in the Occupational Safety and Health Plan (for construction) and the Nurek

Safety and Health Plan (for operations) to minimize the risks. If the Plan is properly implemented, risks would be considered minor to moderate.

5.3.7.2 Potential Impacts Due to Noise Exposure

Noise can be defined as unwanted sound. The noise emitted from any activity and how it is heard by receptors depends on a number of factors, including the sound pressure level, the frequency spectrum, the duration of the noise, the time of day, the activity causing the noise, and the attitude of the receiver. All these aspects must be taken into account in assessing the impact of noise.

Noise levels in the project area are typical of urban areas, probably on the order of 50-70 decibels (dB) in daytime and lower at night. generally low, generally in the range of 30-50 decibels or even lower. Levels are higher near roads when vehicles pass.

Various standards exist for noise, including most importantly those that were developed by the World Health Organization (WHO), which are shown in Table 17 and are also the same as standards established by Tajikistan.

Table 17. Noise level guidelines

Location	*General effect*	*Noise level, LAeq [dB] (Time base, hours)*	
		Daytime (0700-2200)	*Night (2200-0700)*
Residential	Annoyance when outdoors	55	45
Industrial, commercial	Interference with hearing	70	70
Source: WHO 1999 and World Bank Group EHS General Guidelines 2007. Tajikistan limits match WHO: Sanitary Rules of the Republic of Tajikistan CH 2.2.4/2.1.8.562-96.			

In general, the Industrial standard of 70 dB would apply at the project boundary and throughout the HPP site property, and the Residential standard of 55dB daytime and 45dB nightime would apply at receptor locations outside the site boundary. The rehabilitation work in the confined environment of the powerhouse and even at the substation will result in relatively elevated noise levels while work is going on. When rehabilitation is complete, noise levels will return to the normal operating level. Construction noise should be confined to the powerhouse and HPP/substation area and thus would mostly affect workers but not community members. There would be some increased noise at work camps and storage areas but this should be relatively low-level at locations outside their boundaries. Without controls, the impacts on workers would be considered moderate to major, and on community members would be considered negligible to minor.

To control noise levels, the contractor will be required to develop a Noise Control Plan or to include appropriate provisions in the Occupational Safety and Health Plan. The Plan will require the contractor to:

- Maintain vehicles and machinery according to manufacturers' specifications to reduce their noise levels
- Measure noise levels periodically in various workplaces by the contractor, and take actions to reduce noise if levels consistently exceed 70 decibels (dB). Such actions could

include shielding or placement of noise-dampening materials. In addition, if noise is not temporary, the contractor must provide and require the use of hearing protection by all workers who would be exposed to frequent or constant noise over 85dB.

- Measure noise levels on a weekly basis at least weekly at the HPP property boundary, and at camp boundaries, and take corrective measures to reduce noise if levels exceed 70dB in daytime or 55dB at night if there are night works.
- Monitor noise at the location where complaints are made of excessive noise by residents or others who are near project activities, and take noise reduction measures as needed to reduce noise from the site to acceptable levels.

Nurek HPP will also need to have procedures in place to control noise during operation. These procedures will be in the Nurek Safety and Health Plan. The procedures will require Nurek HPP to measure noise levels in the powerhouse and in shops at least monthly and to take measures to reduce noise levels if they exceed 70dB. Workers will be provided with hearing protection and will be required to use this protection if frequent or constant noise levels exceed 85dB. Details of noise control and noise monitoring will be in the contractor's Occupational Safety and Health Plan and in Nurek's Safety and Health Plan. These measures will reduce the overall impact due to noise to minor.

5.3.7.3 Potential Impacts Due to Electrical Hazards

Exposed or faulty electrical devices, such as circuit breakers panels, cables, cords and hand tools, can pose a serious risk to workers. Overhead wires can be struck by metal devices, such as poles or ladders, and by vehicles with metal booms. Vehicles or grounded metal objects brought into close proximity with overhead wires can result in arcing between the wires and the object, without actual contact. This risk can occur during nearly all rehabilitation tasks, and will continue during operation. Some Nurek facilities are old and in poor condition, which increases the risk.

During both rehabilitation activities and then during operation, the potential impacts would be significant if not controlled. The rehabilitation works will correct many current deficiencies and reduce the potential impact during operations but it would remain at a moderate level simply because many workers will need to be working with electrical generators, powerlines, and equipment during operations. There would be no risk to community members if they remain outside Nurek property. The contractor's Occupational Safety and Health Plan and Nurek's operating safety plans will include measures to reduce the risk, including lockout-tagout procedures, the use of hot sticks, maintaining safe distances, marking all energized devices and lines, using double-insulation damp or wet conditions, protecting energized cables and lines from foot and vehicle traffic damage, operating rules for hand tools, and appropriate personal protective equipment (insulated mats, locked boxes, insulators, signage, etc.). Nurek HPP will be required to review and update their operating procedures to reflect Good International Industry Practice for electrical safety, and the Nurek Safety and Health Plan will include specific measures that workers will take to protect themselves from electrical hazards.

These measures are expected to reduce the overall impact due to exposure to electricity to minor.

5.3.7.4 Potential Impacts Due to Welding / Hot Work Hazards

During dismantling of turbines and generators, and then during rehabilitation, there will be a need for welding, which can present risks to welders and others who are nearby. Welding creates an extremely bright and intense light that may seriously injure a worker's eyesight and in extreme cases can cause blindness. Welding may also produce noxious fumes to which prolonged exposure can cause serious chronic diseases and the flame and materials and cause fires. Ina addition, cylinders and tanks with flammable high-pressure gases can present explosion risk if they are not stored and used properly. Without proper controls, the potential impacts are considered moderate.

Proper controls would include such things as helmets, welder goggles and/or full-face shields, barrier screens, proper ventilation, fire prevention and control measures, and body protection (e.g., leather aprons) for welders and support staff, respirators and dust masks in confined spaces, exclusion zones around welding operations, proper marking and storage of full and empty gas tanks. In addition, welders and helpers will need to be trained and certified for the type of work they will perform. Contractors will need to have approved procedures for all welding operations, and to train and certify all workers involved in welding operations. The contractor's Occupational Safety and Health Plan and Nurek's Safety and Health Plan will need to include appropriate requirements for protective measures, personal protective equipment, and training. With these controls, potential impacts should be minor.

5.3.7.5 Potential Impacts Due to Project Traffic

Throughout the rehabilitation process, heavy trucks will transport equipment and machinery to the site. Because the bridge at Nurek is presently out, traffic will have to use the main bridges in Nurek City. The number of trucks would not be extremely high, perhaps numbering in the hundreds in any year. The risk of collisions with other traffic or property would be considered moderate. The contractor will develop and implement a Traffic Management Plan or procedure, and this plan will require that all vehicles be properly licensed, that drivers be trained, and that vehicle safety features (lights, gauges, seat belts, horn, backup alarm, tires, etc.) be inspected daily and be in a safe condition before the vehicle is used. In addition, the Plan will call for trucks and other vehicles to follow routes designed to avoid sensitive areas such as hospitals and schools, and to avoid rush hours and night travel.

During rehabilitation, workers will need to be transported to the site. If contractors provide busses or other transportation, they will have to be licensed and inspected, and safety requirements (use of seat belts, limits on numbers) will be enforced; if workers during either rehabilitation or operation are responsible for their own transportation, neither contractors nor Nurek HPP will have any responsibility.

Because the changes and increases in activities on the HPP site will modify the existing organization of the site, traffic patterns will change. This will need to be agreed between Nurek HPP and the contractor, and the new traffic patterns will need to be marked clearly with signs and surface markings, and pedestrian routes will be separated from traffic. With proper controls, the potential adverse impacts to community and workers would be considered minor.

Following the rehabilitation process, traffic will return to its current level and so there will be no additional impacts from traffic during operations.

During rehabilitation, the powerhouse will have many extra workers, probably several hundred at some times. This will make it necessary for some planning of pedestrian traffic control, through

marking surfaces and placing signs to direct foot traffic (and equipment traffic near workplaces) along specified pathways. This will be part of the Occupational Safety and Health Plans developed by the contractor and by Nurek HPP.

5.3.7.6 Potential Impacts Due to Working at Height

In several phases of this rehabilitation project and then occasionally during operations, workers will be required to work at some height above the floor or ground surface. They would be at risk of falling, and those below could be exposed to falling tools and materials. and will be exposed to falling hazards. This risk would be significant if no mitigation measures are required.

Mitigation measures will be incorporated into the contractor's Occupational Safety and Health Plan that will be approved by the Project Management Consultant. Such measures will include fall prevention measures that complies with Good International Industry Practice and the Labor Code for all work that is over two meters above the surface or above machinery. These measures could include such things as proper scaffolding with guardrails (with proper toeboards and midrails), sturdy nonconducting ladders, and the provision and enforced use of fall protection measures and personal protective equipment (harnesses, lanyards ropes, etc.) in good repair. In addition, Nurek HPP's Safety and Health Plan will be updated to include requirements that comply with the 2016 Labor Code and Good International Industry Practice.

These measures will reduce the potential impact on workers due to working at heights to minor.

5.3.7.7 Potential Impacts Due to Exposure to Hazardous Materials

As noted in section 5.3.4, the contractor will prepare a Materials and Waste Management Plan that will reduce the risks from exposure to hazardous materials and wastes. As with other management plans, this will be submitted to the PMC and approved before the contractor begins rehabilitation works. Nurek HPP will also include similar requirements in its own Materials and Waste Management Plan.

The Plans will call for identifying all materials and wastes that will be used or generated during rehabilitation and operation, posting Material Data Safety Sheets (MSDSs) in places that hazardous materials will be used or stored and in the language(s) of workers, using MSDSs to develop proper handling and management procedures, developing emergency response procedures in case of spills or accidents, and training workers in tasks that require the use or potential exposure to hazardous materials and in responding to emergencies.

Of particular concern will be potential exposure to asbestos during removal operations, when asbestos will be handled and moved. The Materials and Waste Management Plans will include special provisions for this activity and for these areas of the HPP, and for disposal of the asbestos in the Vakhsh landfill. During operation, the primary wastes will be sanitary wastes (sewage, gray water) and household waste (paper, cardboard, containers, etc.). The only hazardous wastes would be lubricating oils used for turbines and other equipment, leftover paints and other petroleum-based materials, and similar materials. These will be generated in relatively small quantities and disposed in the Vakhsh landfill by Nurek HPP, in coordination with the Committee for Environmental Protection.

5.3.7.8 Potential Impacts Due to Exposure to Electromagnetic Fields

Both construction workers and power plant workers in the powerhouse and the substation will be exposed to electromagnetic fields (EMF), which are invisible lines of force emitted by and surrounding any electrical device (e.g., electrical generators, power lines, switching equipment, transformers, etc., as well as household appliances and other uses of electricity). Electric fields are produced by voltage and increase in strength as the voltage increases. Electric field strength is measured in volts per meter (V/m). Magnetic fields result from the flow of electric current and increase in strength as the current increases. Magnetic fields are measured in units of gauss (G) or tesla (T), where 1T equals 10,000G. Electric fields are shielded by materials that conduct electricity, and other materials, such as trees and building materials. Magnetic fields pass through most materials and are difficult to shield. Both electric and magnetic fields decrease rapidly with distance. Power frequency EMF typically has a frequency in the range of 50 – 60 Hertz (Hz), and is considered Extremely Low Frequency (ELF).

The International Commission on Non-Ionizing Radiation Protection (ICNIRP) is a nonprofit international body that assesses the risk of exposure to EMF and provides guidance for public and occupational exposure. There is no conclusive that exposure to electric and magnetic fields (EMF) can cause adverse health effects. Because some workers are exposed to high levels of EMF for extended periods of time, ICNIRP has concluded that the evidence justifies actions to reduce exposure and recommended limits for occupational exposure to EMF, as shown in Table 18.

To reduce the risk to workers involved in the rehabilitation works and in normal operation of Nurek HPP, the occupational safety and health plans (contractors' plans for construction, Nurek HPP's plan for operation) will include requirements to reduce the potential risk. These requirements will include:

- Surveying exposure levels in the workplaces of Nurek HPP workers and of construction workers and taking steps to prevent exposures over the guidelines (see below)

Table 18. ICNIRP limits for occupational exposure to EMF

Frequency	*Electric Field*	*Magnetic*
50 Hz	10,000	500
60 Hz	8300	415
Source: "Guidelines for limiting exposure to time-varying electric, magnetic, and electromagnetic		

- Identifying and establishing safety zones where expected elevated EMF levels may approach guidelines and limiting access to properly trained workers.
- Providing workers in areas with elevated EMF levels with personal exposure monitoring equipment that will warn when exposure levels exceed about 50 percent of reference levels.
- Train workers in the identification of occupational EMF levels and hazards.
- As needed to limit exposures, establish work rotations to decrease workers' time of exposure, increasing the distance between the source and the worker, using shielding materials, or other measures that can reduce levels or exposures.

With these precautions, the risk to workers during both construction and operation will be reduced to minor or negligible.

5.3.7.9 Other Potential Impacts on Workers

Measures to improve working conditions other than safety measures are increasingly recognized as being extremely important, as witnessed by the World Bank's adoption in 2018 of Environmental and Social Standard 2 (ESS2), "Labor and Working Conditions" and the enhancement of Tajikistan safety standards in the 2016 Labor Code.

Actions that could cause potential impacts and mitigation measures would include:

- *Poor labor management practices* by the contractor and/or subcontractors could lead to situations where workers are exploited or taken advantage of. This could happen if the contractor did not have written labor management procedures or did not to enter into written contracts that inform workers of compensation, work hours and leave, and other information required by Tajikistan law. This can lead to problems between workers and employers, which in turn can put work and schedules at risk, not to mention the effects on the workers. Barqi Tojik has developed a Labor Management Procedure (LMP), which sets out the general principles that will govern the management of project workers by the contractor and subcontractors as well as the Project Management Consultant. The procedure is based on Tajikistan legislation and World Bank's ESS2 and includes a requirement for written employment contracts. It also requires contractors to include equivalent provisions in subcontracts and to enforce compliance. Barqi Tojik and the Project Management Consultant will also monitor working hours to ensure that daily and weekly hours do not exceed legal limits and do not place fatigued workers in high-risk situations near the end of their workdays and workweeks. The need to limit working hours, especially when completing high-risk tasks, will also be emphasized in induction training and toolbox talks.
- *Not giving workers to opportunity to express concerns* can lead to worker dissatisfaction and affect productivity. Equally importantly. it can lead to missed opportunities to identify unsafe conditions that workers are in the best position to recognize. When workers are allowed to freely express opinions and to make their grievances known to management, with the knowledge that management will take action as needed, it can lead to more efficient and safer working conditions and also increase worker satisfaction. Barqi Tojik has a grievance redress mechanism in place for its workers and will require contractors to adopt this mechanism or develop and implement their own mechanism by which workers can submit, including anonymously, their opinions and grievances, and to take action in response to all such submissions. The contractor will also make the mechanism available to subcontract employees, and ensure their grievance are addressed. Further, the contractor will be required to include in their monthly reports to the Project Management Consultant a summary of grievances, and how they were resolved, and the Project Management Consultant will include relevant information in their own reports to Barqi Tojik.
- *Substandard accommodations* can lead to illness or disease among workers, which in turn can result in increased turnover as well as reduced productivity. At present, it is not known if the contractors will provide accommodations for workers, but if they do, they will be required to comply with Good International Industry Practice for accommodations, as

recorded in the IFC/EBRD Guidance Note on "Workers' Accommodation: Processes and Standards".

- *Inadequate water and/or sanitation* can affect workers' health, contaminate soil and surface water, and lead to worker illness or disease. Contractors will be required to provide workers with potable water, at no cost to the workers. Contractors will also have to provide appropriate sanitary facilities, including portable toilets in remote areas, and to enforce the Code of Conduct's (see section 5.3.9.5). These requirements will also apply to Nurek HPP throughout rehabilitation and during operations.
- *Exposure to disease*, in particular the novel coronavirus COVID-19 that has been pandemic in the late winter and spring 2020. Workers will move between the community and work sites on a daily basis, and workers may be coming from Dushanbe or elsewhere in Tajikistan or from other countries where there have been outbreaks. Barqi Tojik, Nurek HPP, the Project Management Consultant, and contractors will all follow guidance and legal requirements promulgated by Tajikistan authorities, and will also consider the protective measures described in the World Bank's *Advisory Note on Contingency Planning for Existing Operations*. To date, the Phase 1 contractor has developed and is implementing a site-specific COVID-19 management plan, which has involved providing masks and training for workers, providing sanitizers, and measuring workers' temperatures daily. Barqi Tojik and Nurek HPP are taking the following measures:
  - Measuring temperatures daily at the HPP entrance
  - Mandatory wearing of medical face masks
  - Observance of social distance wherever possible
  - Installation of antiseptic materials on each floor
  - Weekly disinfection of rooms and other areas.

  Other measures that may be implemented if necessary, would include:

  - Self-isolation for up to 14 days if workers come to the site from areas with outbreaks, which may mean preparing special isolation accommodations and providing personal protective equipment for the worker and for others who may need to come into contact with the workers
  - Extra hand-washing stations
  - Providing barriers between work stations where feasible
  - Contingency planning for isolation, care and treatment, and ensuring adequate supplies,
  - Contingency planning for protecting workers from outbreaks in the community
  - Arrangements for managing medical waste, which could be expected to increase in volume when precautions are being taken (it is noted that some normal wastes may need to be treated as medical waste if there is a local outbreak).

Special attention will be given to the issues related to gender equality. Taking into account the nature of the project, the number of women workers who will be employed for construction and operation of the hydropower plant is likely to be relatively low. There are many reasons for this, including the historic absence of women from employment in general and hard labor in particular. It is not expected that many women would be employed on construction crews, although some could be involved in

engineering designs and in technical teams. In addition, women would be likely to fill support roles at offices and camps. During selection of the contractors, Barqi Tojik will consider their labor management policies, including gender nondiscrimination policies, and will require contractors to establish and achieve realistic goals for hiring women in different positions.

5.3.8 Potential Impacts of Safety Improvements During Operation

Nurek HPP has suffered from underinvestment for decades, and some elements of the HPP have deteriorated significantly and consequently raise the risk of injuries to workers, degradation of the electricity grid, and even the risk of downstream impacts due to dam failure. All these receptors are considered highly sensitive. The rehabilitation of the Nurek HPP powerhouse, the use of new devices and new technologies, and the installation of modern control protection and monitoring systems will lead to the improvement of health and safety work condition of the workers during operation. In general, rehabilitation will provide workers with a workplace that meets up-to-date health and safety requirements, will decrease instabilities in the electrical supply, and reduce the risk of downstream impacts.

For example, in tunnel and galleries the installation of proper ventilation, lighting and railings for stairs, improvements of ladders and worn surfaces, and other measures will significantly reduce health and safety risks for workers. To identify the specific improvements that are needed, qualified safety professionals from Barqi Tojik, Nurek HPP, or a qualified independent consultant will conduct a comprehensive audit of workplaces and work conditions for the entire Nurek HPP physical plant, including a detailed review of current operating protocols and practices. The corrective actions identified in this audit will then be addressed in an update of relevant operating procedures, which will include the Safety and Health Plan for Nurek Operations. All workers will be trained in the requirements of this Plan, and the new requirements will be enforced by the Nurek safety program and work supervisors in order to ensure that workers adopt the new procedures. This could be a difficult process to overcome many years of less safe practices and conditions, but will be critical to ensure the safety of workers.

Overall, the rehabilitation project will have a major positive impact on workers and the grid, and will substantially reduce the potential for adverse impacts downstream.

5.3.9 Potential Impacts on Community Health, Safety, and Welfare

Some measures to reduce the risk to the community of many hazards from the rehabilitation activities (traffic, noise, etc.) are described in previous sections. This section evaluates other potential impacts on communities and identifies mitigation measures where necessary. Once rehabilitation is complete, operations will return to what has been in place for decades, so there will be no additional impacts on communities during operation.

The potential impacts the rehabilitation project and further operation of the HPP include the following, which are addressed in separate subsections below.

- Exposure to potential water pollution
- Traffic and pedestrian safety
- Exposure to hazardous materials
- Downstream flooding

- Risks due to the influx of workers
- Exposure to electromagnetic fields

5.3.9.1 Potential Impacts Due to Exposure to Potential Water Pollution

Oil, hazardous materials, and others wastes generated by rehabilitation works can be sources of water pollution if not managed properly, degrading surface and potentially subsurface water quality, given the significant duration (one to four years) of the project. Water quality in the river upstream of Nurek HPP is relatively good, especially when compared to the water quality of the Amu Darya River farther downstream from the dam, with the primary concern being salinity. Although the Nurek HPP and its reservoir have contributed to the human-related impacts to the area and modification of downstream water quality, the rehabilitation will not change any impacts since the reservoir will be managed in the same way.

The only impacts on reservoir or downstream water quality would be from spills of hazardous materials or the release of sanitary wastes. The risk of such potential impacts is considered to be minor if hazardous materials and wastes are managed properly and sanitary water is controlled and treated. These are described in sections 5.3.4 and 5.3.5.

5.3.9.2 Potential Impacts on Community Traffic and Pedestrians from Project Traffic

As noted previously, the project will cause an increase in traffic as equipment and materials are brought to the site, scrap and waste is removed from the site, and as workers are transported to and from the site. This will result in an increase in risks due to traffic accidents during rehabilitation. The risk of collisions and bodily accidents involving workers or the local population will increase slightly. As described in section 5.3.7.5, the risk will be controlled by the contractors' preparation and implementation of a Traffic Management Plan. As noted, this will include requirements that routes through Nurek City be planned to avoid sensitive areas such as hospitals and schools, and that traffic avoid rush hours. With these controls, the potential impacts are considered to be minor. When rehabilitation is complete, traffic will revert to the level currently experienced, so there will be no impact during operations.

5.3.9.3 Potential Impacts from Community Exposure to Hazardous Materials

There would be essentially no risk of community exposure to hazardous materials on the project site, but such exposure could occur during transport of the materials and wastes (primarily asbestos waste, fuels, etc.) and incidents such as spills, fire, explosion, leakage, loss, theft, etc., could lead to the release of such materials. The Traffic Management Plan (section 5.3.7.5) will reduce the risks during transport, and the Materials and Waste Management Plan (see section 5.3.4) will reduce the risks during normal rehabilitation activities. In addition, the contractor will prepare and implement an Emergency Preparedness and Response Plan for the rehabilitation process. Following the Safety and Health Audit described above, Nurek will update its own emergency plan for operations. These Plans will describe the measures that will be taken to limit exposure (of workers and community members) if a release of hazardous substances or wastes occurred. This should reduce the potential impacts to minor or negligible.

5.3.9.4 Potential impacts from downstream flooding

As described in Chapter 2, the project includes significant reductions in risks of dam failure due to extreme floods. As noted there, the restoration of turbines to their rated capacity will allow them to

pass more water during floods than is possible now, the repairs and improvements to the two spillways and the tunnels will reduce the likelihood of their partial or complete failure and allow the passage of flows from the newly calculated 10,000-year flood, which is now more than 10 percent higher than the originally calculated 10,000-year flood (the increase in calculated flow rates is presumably due to climate change since the average number of days the reservoir has been at Full Supply Level has increased over the years).

Even with the rehabilitation, the dam would still be considered at risk of overtopping and potential failure from the Probable Maximum Flood (PMF), which is the international standard for major dams. Tractebel's Techno-Economic Study determined that this would be an acceptable solution, however. In the longer term (over a decade or less), the completion of Rogun Dam and hydropower complex will make the inflow to Nurek reservoir under Rogun's control, and the much larger reservoir Rogun reservoir will provide more flexibility for holding large floods. In the shorter term, however, Nurek will need to take the following actions in order to reduce the risk of dam overtopping from "moderate" to "minor" during the period before Rogun comes online:

- Continue maximum operation of turbines during floods rather than shutting down during major floods. This would allow Nurek to pass 90 percent of the PMF, which corresponds to an event with a return interval over 100,000 years.
- Implement an advanced flood warning system for the Vakhsh River
- Update of the Nurek operating rules to accommodate input from the flood warning system and the other monitoring systems that will be put in place and/or rehabilitated as part of the project.

5.3.9.5 Potential Impacts from Influx of Workers

Nurek City has a population of nearly 20,000, and there are several smaller communities in the immediate area as well. As noted in Chapter 4, the rehabilitation project will employ a total of 300-500 workers, most of them from Nurek City and the surrounding area. However, a few hundred workers (possibly as much as 250) would be introduced from outside the area for up to three or four years. When rehabilitation is complete, the longer-term operation of the HPP will continue to employ approximately the same number as at present, all from Nurek or the surrounding area. During construction, he introduction of workers from outside a relatively remote area can lead to several adverse impacts. These would include:

- *Poor behavior by workers* from outside the region can lead to disruption of local community cohesion. This is especially of smaller communities than Nurek City but cold also occur there. This can occur through unaccustomed or violent behavior, including gender-based violence, and/or an increase in communicable diseases. This will be controlled by requiring workers to abide by a Worker Code of Conduct that will require certain behaviors and forbid others; the contractor will be required to enforce the Code, with penalties leading up to dismissal. In addition, Barqi Tojik, the Project Management Consultant, and the contractor will consult with local authorities and community leaders, and this will ensure they (that is, project managers) are aware of incidents and can take appropriate action if an issue arises. Finally, Barqi Tojik (through the Project Management Consultant) and the contractor will establish communications with the nearest law enforcement authorities so they are aware of the influx of workers, including where they will be working and where they will reside, and can take appropriate precautions. As

noted, it is likely that the majority of the workforce will be sourced from Nurek City and surrounding communities. The risk of gender-based violence (GBV) under this project is assessed to be low given the size of Nurek City and the relatively small number of workers from outside, and the lack of evidence that indicates such risks are prevalent in Tajikistan—there have been no incidents during Phase 1 of the project. Nevertheless, a number of mitigation measures will be taken to prevent risks due to GBV or sexual harassment, such as sensitization for project employees and communities and the adoption and monitoring of Codes of Conduct for all project workers. This should reduce the potential impact even further, to minor or negligible.

- *Increased demand on community services*, such as medical and law enforcement, due to use of the services by project workers from outside the region could leave fewer services for community members. The relatively low number of workers and the requirement for the contractor to consult and coordinate with community leaders and law enforcement will ensure that added demand for community services will not cause significant reductions in services available to the community. Most community services would be provided in Nurek City, which has sufficient services to be able to accommodate slightly increased demand. The overall impact is expected to be negligible.
- *Increase in HIV/AIDS and/or other communicable diseases* could occur due to the increase of male construction workers into rural communities and an increase in prostitutes or other sex workers who came to serve them. The relatively low numbers of nonlocal workers (likely to be no more than 200-250) who are employed would reside in accommodations at contractor camps or rented quarters in Nurek City. If ongoing engagement with community leaders or others suggest there may be problems of this sort, the Project Management Consultant and contractor will enhance training on the Code of Conduct, monitor worker behavior more closely, and dismiss offending workers. This should reduce the potential impact to minor or negligible. In addition, workers from outside the region could introduce COVID-19 to the community. The precautions described above in section 5.3.7.9 are intended to prevent any such introduction.

5.3.9.6 Potential Impacts from Exposure to Electromagnetic Fields

Rehabilitation of the HPP electromechanical infrastructure will take place entirely on Nurek premises, so there will be no exposure of community members to EMF. IF there is community concern over EMF due to the project, Nurek HPP will measure the strength of the fields at the nearest point to any area of concern and take action if potential exposure exceeds the international guidelines in Table 19.

Table 19. ICNIRP limits for General Public Exposure to EMF

Frequency	*Electric Field (V/m)*	*Magnetic Field (μT)*
50 Hz	5000	100
60 Hz	4150	83
Source: "Guidelines for limiting exposure to time-varying electric, magnetic, and electromagnetic fields (up to 300 GHz) (ICNIRP 1998)		

5.3.9.7 Other Socioeconomic Impacts

The project will have a generally positive effect on the economy of Nurek City and Tajikistan. These will include:

- *Increased employment opportunities* for local workers, including both skilled and unskilled workers. Up to 400-500 workers will be employed by contractors for periods up to three or four years, and half or more of the workers are expected to be residents of Nurek City or nearby communities. Their wages will increase economic activity and in Nurek City through purchases of food, accommodations, entertainment, and good required for everyday life. It is important to note that contractors will be encouraged to employ local workers, with a goal of at least 50 percent.
- *Development of economic opportunities*, such as rooming houses, restaurants and food suppliers, fuel suppliers, and providers of other goods needed for everyday life.
- *Increased electricity production*. As noted earlier, one of the nine turbines is currently out of service and the reduced efficiency due to the age and condition of the remaining turbines is the equivalent of another turbine out of service. Rehabilitation will return all turbines and generators to full efficiency, so electricity generation could increase by 10 percent or more during periods of high flows in summer.

During rehabilitation, the potential positive impact of the rehabilitation project would be moderate, while long-term operation of the improved HPP will have a minor to moderate effect.

5.3.10 Potential Impacts of Improvements of Dam Safety

As described in Chapter 3, a significant portion of the rehabilitation project is intended to improve dam safety. Specific improvements to be undertaken depend on the results of recent and ongoing and studies and could include the following activities, among others:

- Rehabilitation of spillway tunnels, refurbishing spillway gates/hoisting system, protection of the permeable zone of the embankment dam above the core zone crest, seismic belt rehabilitation, etc.
- Refurbishing and upgrading monitoring instruments and management system to improve the collection and analysis of dam safety monitoring data
- Updating the Emergency Preparedness and Response Plan, the Operation and Maintenance Plan, and the Instrumentation Plan
- Installing an advanced flood forecasting/warning system and preparing optimized reservoir operating rules to enhance the flood-handling capacity of the dam
- Engaging a Panel of Experts to review and advise Barqi Tojik on matters relevant to dam safety and other critical aspects of the dam, its appurtenant structures, the catchment area, the area surrounding the reservoir and downstream areas, among others.

These actions will reduce the risk due to dam failure or other related event and thus the potential impacts would be major and positive.

5.3.11 Potential Increase in Operational Issues During Rehabilitation

During rehabilitation works, errors in work procedures may cause the unexpected stoppage of one or several generating units. This kind of event can occur when working in interface zones of two or more units. Depending on the event, this stoppage can last several hours. Such event would temporarily reduce the spillage capacity at Nurek. This loss in spillage capacity would be negligible (and at most minor) compared to the volume of water that is normally routed through the turbines and spillways. Furthermore, Nurek remains protected using the evacuation capacity of the two independent spillways. As noted in section 5.3.3, the only time there would be any impact would be during the maximum flood for which the dam is designed, which would be a flood with a return interval of 10,000 years or the Probable Maximum Flood. This is extremely unlikely to occur. Unexpected removal of a turbine or generator from service could also reduce electricity production and cause an energetic fluctuation (tension) in the electricity grid. Following establish protocols and work schedules for taking generators out of service for rehabilitation will reduce the risk to minor or even negligible.

5.3.12 Potential Impacts on and from Climate Change

5.3.12.1 Potential Impacts on Climate Change

It is likely, but uncertain, that the Nurek Reservoir has had some impact on the local climate, including higher humidity and some temperature moderation. These would be very local and would have stabilized over the decades the reservoir has been in place. As noted in sections 5.3.2, reservoir management will stay the same during and after rehabilitation, so there will be no changes to reservoir impacts on the local climate due to the project.

Sulfur hexafluoride (SF6) is a powerful greenhouse gas that is used in gas-insulated equipment, including use as an insulator for electrical switching equipment and in cables, tubular transmission lines, and transformers. If gas-insulated equipment is installed and used at the substation, it could lead SF6 into the air. SF6 is a powerful greenhouse gas (almost 24,000 times the global warming potential as CO_2) that must be managed carefully to avoid leaks and emissions.

Barqi Tojik will include the cost and practicality of SF6 management in the analysis of options for dielectric equipment selection. If equipment to be installed as part of the rehabilitation uses SF6 as an insulator, Barqi Tojik will require the contractor to install and use only equipment with low leakage rate (>99% control) and to ensure equipment is properly labelled/marked. Nurek HPP will train staff in proper inspection and maintenance to prevent leakage, and manage decommissioning to minimize SF6 leakage.

5.3.12.2 Potential Impacts Due to Climate Change

The changing climate in central Asia could have an effect on the Nurek HPP, however, primarily by influencing water availability, both the absolute amount and the seasonality of supply. Glaciers occupy about six percent of Tajikistan's territory and the country is considered the main glacial center of Central Asia[19]. These glaciers retain water and control flows in major rivers, including the Vakhsh River, and also have a role in regulating the climate. In the twentieth century, ice volume in glaciers, particularly smaller ones, declined about 2.5 percent. Continuing higher or more variable

19 United Nations Development Program, Climate Change Adaptation, Tajikistan. https://www.adaptation-undp.org/explore/central-asia/tajikistan

temperatures and accelerated melting, exacerbated by changes in precipitation patterns so that more is falling in late winter and spring (with higher snowmelt also), will cause earlier peak flows in rivers as well as more and more intense flash floods, landslides, and mudslides. Modeling suggests that increases in air temperature and the consequent increase in snow/ice melt rates will result in higher annual mean river discharges through about 2080, including 100-year return interval floods, after which flows will decrease as small glaciers that feed various basins begin to disappear (Kure, *et al.* 2013). More mountainous areas and prime agricultural valleys are considered the most vulnerable to climate change (Heltberg and Bonch-Osmolovskiy 2011).

Changes in climatic conditions would have several implications for Nurek. These implications are relevant to Nurek HPP but not specifically to the rehabilitation project. Primary impacts would be on the project itself, with some increase in effects (e.g., floods) on people as well.

- The dam will need to withstand more intense floods. The resilience of the dam and its operation are being improved by the inclusion of dam improvements and repairs to the project. The effect of the project will be positive in that the dam will be returned to the capability to withstand a flood with a return interval of at least 1000 years, far beyond the expected life of the project and of the dam itself.
- The reservoir is large and is able to hold small floods, and any such flood would not cause additional flooding upstream or downstream of the dam. As noted in section 5.3.3, only if a flood larger than the 10,000-year flood occurred when the reservoir was near 100 percent capacity would there be risk to the dam itself; the project would not affect this risk other than by improving the ability of the dam to withstand floods. Thus, the impact of the project would be positive.
- The dam's expected life of up to about 40 years is too short for future decreases in flow caused by glacial melting to have an effect on power generation.

Carbon emissions resulting from the project, including the construction phase, will be insignificant and could have no role in future climate change. Carbon emissions avoided as a result of the rehabilitation project would be substantial (from 1,126,000 to 2,435,000 tonnes of CO_2-equivalent if Nurek's increased generation replaced generation by gas-fired plants, or from 5,175,000 to 6.697,000 tonnes if it replaced generation by coal-fired plants) but would be negligible to minor on a global scale.

5.4 Summary of Potential Impacts

Although some short-term adverse impacts are foreseeable, the overall impact of the rehabilitation project would be overwhelmingly positive. An overview of the significance of impacts discussed above is presented in Table 20. As can be seen, all adverse environmental and social impacts can be reduced so they are minor or negligible with the implementation of appropriate mitigation measures, and positive impacts will be major. The measures are summarized in Chapter 9.

Table 20. Summary of potential impact significance

Source of potential impact	*Type of impact*	*Significance of potential impact*			
		Rehabilitation		*Operation (see note)*	
		Without mitigation	*With mitigation*	*Without mitigation*	*With mitigation*
Changes in Vakhsh River downstream flow regime	Positive or negative	No change		None (no change)	
Change in Nurek Reservoir management	Positive or negative	No change		None (no change)	
Floods during rehabilitation	Negative	Major	Moderate	n/a	
Floods during operation	Positive	No change		n/a	Major
Wastes	Negative	Major	Minor	Minor	Minor-negligible
Water pollution	Negative	Moderate	Minor	Minor	Negligible
Asbestos exposure	Negative	Major	Minor	Major	Minor
Worker health and safety	Negative	Major	Moderate	Moderate	Minor
Other impacts on workers	Negative	Major	Minor	Major	Minor
Safety improvements during operation	Positive	n/a	Major	Minor	Major
Community health, safety, and welfare	Mixed	Moderate	Minor positive	Minor to moderate	
Improvement of dam safety	Positive	n/a		None (no change)	Major
Increase in operational issues during rehabilitation	Negative	Minor to moderate	Minor	n/a	
Risks from climate change	Negative	Negligible		Moderate	Minor
Note: due to the nature of the project, which is intended to improve the safety of the dam, improve efficiency of electricity generation, and improve safety of the facilities, mitigation for “Floods during operation”, “Safety improvements during operation”, and “Improvement of dam safety” would be completion of the rehabilitation project itself.					

6 Cumulative Impact Assessment

6.1 Objectives

This Cumulative Impact Assessment is intended to identify impacts that may arise from the Nurek rehabilitation project, in combination with impacts of existing projects and planned human activities and natural processes, especially those impacts that could jeopardize the overall long term environmental, social, or economic sustainability of the watershed. In addition to a Rapid Cumulative Impact Assessment (RCIA) of the HPP project itself that is presented in section 6.2, the cumulative impact of Nurek HPP in combination with other HPPs on the Vakhsh river is discussed in section 6.3. It is noted that these impacts are not and will not be changed by the rehabilitation project.

6.2 Cumulative Impacts Due to Nurek HPP Rehabilitation Project

6.2.1 Definition of Boundaries

Geographical Boundary. One logical geographical boundary of the RCIA would be the whole Vakhsh River watershed downstream to its confluence with the Amu Darya. However, since the Nurek dam is part of a cascade of dams, the analysis in this section is confined to the Vakhsh River between the location of the Rogun HPP upstream, and the Baipasa HPP downstream. Section 6.3 discusses the entire cascade of hydropower projects.

Temporal Boundary. The environmental impact assessment of the Nurek rehabilitation project has concluded there will be no additional adverse impacts during the operation and maintenance phase (see Chapter 5). Therefore, the temporal boundary of the RCIA is the rehabilitation phase.

6.2.2 Impacts of Upstream Water Releases

The Rogun HPP is under construction upstream of Nurek and will have a higher dam and even larger reservoir. The Government's intent is to fill the Jusing part of the reservoir with the share of water allocated to Tajikistan under current agreements and practices, not all of which is currently being used. This hitherto unused share would be sufficient to fill the reservoir over a period of 16 years, and this will allow flows to remain sufficient for the shares of downstream riparian countries. For the operational phase of the Rogun project, it is the Government's intent to limit the transfer of water during the farming season inflows at Rogun to the nonfarming season releases downstream of Nurek to 4.2 cubic kilometers, which is the quantity currently transferred by the operation of the Nurek reservoir utilizing its present live storage capacity. The simulations are based upon this operating regime, which would not change the current downstream flow pattern.

The technical and environmental studies conducted for Rogun HPP demonstrate that it is possible to operate the Vakhsh River cascade with Rogun in a way that the river flow pattern downstream of the cascade will remain unchanged, and as noted in Chapter 5, the flow pattern downstream of Nurek will not change during Nurek rehabilitation or operation.

6.2.3 Selection of Valued Environmental and Social Components

Considering the distance between Nurek and Rogun (upstream) and Baipasa (downstream) HPPs, the only potentially significant adverse impacts generated by the Nurek rehabilitation project will be localized and confined to workers and their workplaces. Impacts that would reach downstream would

be positive, by reducing the potential for flood due to dam failure or malfunction. No adverse cumulative impact is then expected as a result of the Nurek project. During the course of public consultations and stakeholder meetings that have been conducted to prepare this ESIA (see Chapter 7), a number of Valued Environmental and Social Components (VECs) were identified. Table 21 shows the VECs identified by stakeholders that could be affected by cumulative impacts contributed by the Nurek rehabilitation project.

Table 21. Valued environmental and social components

Water quality in the Vakhsh River (good compared to Amu Darya, but already modified by existing Nurek operations)
Terrestrial fauna and flora conservation
Fish populations and fisheries upstream and downstream (already affected by existing by the presence of the dam and reservoir)
City and villages crossed by access road or near Nurek HPP (Nurek city)
Nurek HPP energy production
Nurek HPP work environment
Domestic and industrial water use
Downstream community safety

For this RCIA, the above remaining impacts and environmental issues are combined as shown in the Table 40. The corresponding Valued Environmental and social Components (VECs) are assessed for cumulative impacts in continuation.

6.2.4 Cumulative Impact Assessment Over Selected VECs

6.2.4.1 Water Quality

As noted in Chapter 5, the only change in water quality that could occur as a result of the result of the Nurek rehabilitation project would be spills or improper release of wastewaters (sanitary or other collected process water. The amount of water that could be released through spills or improper treatment would be a very small, inconsequential in relation to the discharge through turbines and spillways. This would have no effect even in combination with other pollution events, such as wastewater from Nurek City or industrial discharges, spills from industries or HPPs, or from any other sources. There should be no cumulative effect.

6.2.4.2 Housing Area – City and Villages Intersected by Access Road or Near Nurek HPP

This VEC can be affected by the Nurek rehabilitation project in multiple ways:

- Traffic and pedestrian safety
- Transport of hazardous materials
- Socioeconomic tensions.

The potential impacts of each of these risks, if controls described in Chapter 5 and 9 are implemented as required, will be insignificant.

6.2.4.3 Energy Production

This VEC can be affected by energy fluctuation on the electrical grid due to involuntary stoppage of one or several units at Nurek HPP due to issues during rehabilitation works, in particular when working on elements of the balance of plant common to various units. Cumulative impacts in terms of energy fluctuation on the network may occur in the following scenarios:

- Occurrence of an involuntary shutdown in another source of the network, but it is highly improbable that both events would be concomitant
- Specific operations are carried out in another source of the network which induce energy fluctuations: for example, the commissioning of Rogun turbines for early generation. However, such operation will be performed in full coordination with the network operator. Cumulative impacts of such simultaneous events would therefore be mitigated by avoiding that rehabilitation works on common parts of the powerhouse at Nurek be carried out at the same time as the commissioning phase at Rogun (in this example). The overall work permit procedure (see section 9.4.4) will require coordination with the network operator for activities identified as presenting a risk of involuntary shutdown at Nurek.

With this mitigation, the risks of cumulative impact are considered minor or negligible.

6.2.4.4 Fisheries

Only if there is a major spill of a hazardous material would fisheries be affected, and this will be prevented as described in Chapter 7. There will only be small amounts of hazardous materials that could affect water quality, as noted above in Chapter 5.

6.2.4.5 Domestic, Agricultural and Industrial Water Uses

This VEC can be affected by the Nurek rehabilitation project due to a risk of exposition to water pollution. As already seen in section 6.4.1, any impact on water quality would be minor or negligible, and is considered highly improbable.

6.2.4.6 Community Safety Downstream

As regards this VEC, it was described in Chapter 5 that an involuntary shutdown of one or several units due to issues during rehabilitation works would induce temporarily a reduction of the Nurek spillage capacity. However as regards protection against floods, this loss in spillage capacity (some units during a day or less) is considered negligible or minor compared to the volume of water to be routed during a flood event. Even more importantly, the day safety improvements (and associated mitigation measures) described in Chapters 5 will significantly reduce the potential for overtopping the dam during extreme events, which would cause downstream flooding. In the very short term, there could be a minor increase in risk, but only if an extreme flood event occurred during the construction period. In the longer term, there would be a significant reduction in risks and potential impacts.

6.2.5 Conclusion

No significant adverse cumulative impacts have been identified with regard to the identified Valued Environmental and Social Components for the Nurek HPP Rehabilitation Project.

6.3 Cumulative Impacts of Vakhsh River Cascade

As noted above, the rehabilitation will enable Nurek HPP to operate at full capacity and will improve dam safety. However, the rehabilitation will not alter the patterns or amounts of water releases and river flow. The difference would be that, when the plant could operate at full capacity, more water would pass through the turbines rather than over the spillways, but the amount of water released to the downstream river would not change. Similarly, the reservoir level will not change as a result of the rehabilitation project. Thus, the rehabilitation project itself will not result in any change to the cumulative impact of the cascade of hydropower projects on the river.

However, the establishment of the Nurek HPP in the 1970s and other HPPs on the river, culminating with the Rogun HPP upstream of Nurek, have had a profound impact on the Vakhsh River. This has ranged from increasing flows in winter to reducing floods in summer, both of which are made possible by the storage of water in the Nurek reservoir. This in turn allows electricity to be generated in a pattern that is not tied to absolute river flows. The addition to Rogun to the cascade of projects will improve the safety of the cascade by allowing floodwaters to be managed in two large reservoirs instead of one.

Because the water released from each HPP flows to the next HPP, however, each project has an influence on the downstream projects. It would be technically justified to have single Emergency Preparedness Plan for the entire Vakhsh cascade of HPPs rather than each HPP having its own Plan. A single Plan would be based on the detailed analysis of dambreak, flood routing studies, and other assessments. These studies have been undertaken for Nurek as a part of the rehabilitation project and should be extended to all the projects in the cascade. This would be a significant improvement over having single plans, and for that reason a single Emergency Preparedness and Response Plan for the entire cascade is required by the ESMP in Chapter 9.

7 Stakeholder engagement

7.1 Objectives

This section outlines the stakeholder identification and consultations undertaken for the Nurek HPP Rehabilitation Project ESIA. In all, a total of four public consultations were carried out on behalf of, or by, Barqi Tojik since 2016. A Stakeholder Engagement Plan was prepared for the project in 2016 and that provided a template for subsequent consultations. It has been updated in 2020 and has been disclosed along with this ESIA.

The objectives of the consultations were to provide information to interested parties, obtain an understanding of the environmental and social components of most concern, elicit reactions and feedback to the environmental and social impacts and related issues of the Project as identified in the ESIA report. The objective was to convey to stakeholders information about the project.

Stakeholder consultations for the 2017 ESIA were conducted in April 2016 by the Public Organization Kuhiston, on behalf of Barqi Tojik, in accordance with the World Bank procedures and the requirements of the national regulations for a project of this scale.

In November 2017, the LLC Infrasokhtor Mushovir conducted the second round of consultations to obtain feedback on the original ESIA. On September 16, 2019, LLC Infrasokhtor Mushovir conducted a third round of consultations. The objective of these consultations was to inform the wider public and key stakeholders about the progress of the project and its future plans, as well as to incorporate the comments and recommendations received during public consultations into the final ESIA. In addition, the consultation was intended to build the capacity of employees of the Nurek HPP and representatives of the Barqi Tojik Project Implementation Unit (PIU) through training on the procedures and methods for conducting public hearings and meetings for sharing the public information.

Stakeholder consultations for the current ESIA 2020 update report have been led by Dr. Malika Babadjanova on behalf of Barqi Tojik and a synopsis of the consultations is provided in the SEP, along with the summary reports of previous consultations.

Finally, project details were also shared with the riparian governments as required by the World Bank's Operational Policy 7.50. Specifically, at the request of the Government of Tajikistan, the World Bank sent a letter, dated December 12, 2016, signed by the Country Director for Central Asia to representatives of countries in the Amu Darya River basin. The letter contains description of the project development objective, project components, estimated cost of the project, and key conclusions from the ESIA regarding the downstream water releases.

7.2 Methodology for Stakeholder Engagement

The methodology for engaging stakeholders prior to and after the 2017 ESIA was based on the Stakeholder Consultation and Information Disclosure Plan that was developed during the preparation of the draft ESIA, and that has now been updated and renamed as the Stakeholder Engagement Plan (SEP). The results of this effort are presented in Table 22..

Public consultations were carried out in the form of meetings at the national, regional, and local levels. The process is described in the SEP. The consultations were informed by a stakeholder mapping exercise, which identified key stakeholders at the national, regional, and local levels.

The consultations in 2016 involved:

- An official announcement
- The preparation of an agenda (time and location for the consultations) and of presentation materials (leaflets) in Tajik and Russian
- A public information dissemination campaign through different channels (letters, jamoats, and mahalla heads).

The schedule of the 2016 consultations is shown in Table 22 and they represent the pattern followed by all subsequent consultations for the project. The results of the consultations are summarized in section 7.3.

Table 22. Stakeholder consultations in 2016

Stakeholder	Level (location)	Number of meetings	Number of participants		Date
			Total	*Women*	
Ministries, Agencies, State Committees etc. and national-level CSOs and NGOs, including environment-focused and forestry	National (Dushanbe)	1	16	8	08.07.2016
Khatlon Region Authorities, representatives, including women groups, farmers associations, WUAs, NGO/CSOs	Regional (Kurgan-Tyube City municipality hall)	1	38	14	21.06.2016
Jilikul, including administration of the natural reserve "Tigrovaya Balka", etc.	Regional (District community hall)	1	34	16	22.06.2016
Nurek City and Dukoni jamoat	Local (Nurek city library hall)	1	54	39	23.06.2016
Puli Sangin jamoat	Local (Community hall)	1	33	8	23.06.2016
Total		*5*	*175*	*85*	-

An additional round of scoping consultations was held in March and April 2020 to prepare for the updated ESIA and the bridge ESMP. Meetings were held in Dushanbe and Nurek, and involved over 100 participants, including representatives of Barqi Tojik, Nurek HPP, Nurek City, local housing administrations, and local communities. Issues raised during the scoping meetings were addressed in this updated ESIA and in the bridge ESMP. Following disclosure of the draft updated ESIA and ESMP, the coronavirus pandemic prevented further public meetings. However, as noted below, key documents were made available beginning in early May 2020 and stakeholders were notified for the purpose of receiving comments and concerns, which have been addressed in this final ESIA and the final bridge ESMP.

In addition to consultations concerning environmental and social documentation and planning, a key element of effective stakeholder engagement is providing a mechanism that stakeholders can use to submit comments or complaints concerning the project and be sure they will be received and addressed. The Stakeholder Engagement Plan describes the Grievance Redress Mechanism that Barqi Tojik will make available for stakeholders to submit complaints or comments.

7.3 Outcomes of the Consultation Process

7.3.1 Stakeholder Identification

Stakeholder identification remained consistent for all Nurek HPP Rehabilitation Project consultations (April 2016, November-December 2017, September 2019, March-April 2020, and May 2020). Depending on their influence ("power") and interest in the project, stakeholders can be placed into a particular category, as shown in Table 23. Stakeholders were identified at the National, Regional and Local levels as presented in Table, Table 25, and Table 25. In Table 23, each stakeholder was categorized based on: (i) their level of interest in the project (i.e., the extent the project would impact their lives); (ii) their ability to influence the project (positively or negatively); and (iii) the extent to which project managers needed to engage each group of stakeholders, i.e., from monitoring their interest and keeping them informed to managing their interests closely and ensuring that they are satisfied with project management's responses. The purpose of this classification is to allow outreach and consultation to be tailored to the interest and influence.

Table 23. Power/Interest matrix for stakeholders

High	**KEEP SATISFIED**		**MANAGE CLOSELY** – MEWR – Barqi Tojik – Nurek HPP – CEP – MHSPP/SES – MLME – All relevant local authorities – Bilateral and multilateral agencies/ donors (ADB, EBRD, IDB etc.)
Power Low	**MONITOR (MINIMUM EFFORT)** ALRI MoA		**KEEP INFORMED** – Communities of Nurek (the City and Dukoni and Puli Sangin jamoats) – Community based NRM organizations, WUAs, and farmers – TajCnet – Tigrovaya Balka Natural Reserve – CES – MEDT – SISPMC – Academy of science (Institute of water)
	Low	**Interest**	High

7.3.1.1 National Level

Table 24 identifies stakeholders at the national level.

7.3.1.2 Regional Level

Table 25 identifies stakeholders at the regional level.

7.3.1.3 Local Level

Table 26 identifies stakeholders at the local level.

7.3.2 Participation in Consultations

Participation in each of the consultations was relatively consistent: the participants represented different ethnic groups, including Tajik, Uzbek, Russians, and Turkmen. Hence, the languages used for the consultations were Russian and Tajik.

The age composition of the participants also varied, including elderly and youth. Representatives of the youth committees participating at the events reported they will be circulating the information among their peers during various events and meetings.

Participants at regional and local level included representatives of the diverse stakeholders, such as heads of the *mahalla* (communities), heads of women committees (informal and formal), healthcare workers, including Sanitary and Epidemiological Services, housing administrations, environmentalists, heads of educational facilities, representatives of the Housing and Utilities companies, private entrepreneurs, unemployed, disabled persons, road and transport department representatives, farmers, NGOs, employment departments, financial department, Nurek HPP personnel, and eventually representatives of local authorities at district and oblast (region) level, as well as jamoat. The meetings were also attended by elderly representatives from Nurek and Dukoni jamoat.

Consultations were held in an environment that enabled free and unintimidated exchange of ideas, concerns and recommendations, so everyone had a chance to speak. This was evidenced by the fact that women presented their concerns and shared their recommendations for managing the projects impacts.

The national level consultation participants represented NGOs, academia, including the Academy of Science, and universities, donor agencies, Institute of Water Problems, private consulting companies, Association of hunters, Committee for Environment Protection and the International Committee on Water Coordination.

7.3.3 Issues raised in 2016 Consultations

The issues raised during each of the consultations were consistent. The main issues raised in the April 2016 consultation are summarized in Table 27. The relevance of their treatment in the framework of the project is also indicated, with the corresponding explanations where appropriate.

Table 24. Stakeholders at national level

Stakeholder / sub-group	*Relevant functions*	*Role in the project*	*Power / influence*	*Perception of process / impacts*
Ministry of Energy and Water resources (MEWR)	– Regulates legal norms in the field of fuel power production, natural resources, including renewable energy sources in the industry, technical and technological field, construction industry, in the food and food processing industry; – Coordination, management and supervisory over relevant state services, State energy sector control service, and other organizations and enterprises under the Ministry.	Regulatory and coordinating role	High power	High interest in the project and its impacts
OJSHC Barqi Tojik	– Production transportation, transmission, distribution and sale of electrical and heat power energy mainly on the local market of the country – Deals with issues of country's power stations and grids operation, generation, transmission, distribution and sale of electrical and heat power energy mainly on the local market of the country – OJSHC "Barqi Tojik" as entrusted by the Government of Tajikistan as the major shareholder of the joint-stock companies in the energy sector and has the right to own, use, and dispose of property of the enterprises and entities under its management – Includes 24 joint-stock energy objects, including Nurek HPP. Employs over 12,000 persons.	Owns Nurek HPP and the Project	High power and influence	High interest in the project
Nurek HPP	– Produces 70 percent of Tajikistan's electricity supply – Is an Open Joint Stock Company managed by Barqi Tojik	Key beneficiary of the Project	High power and influence	High interest in improving its operation

Stakeholder / sub-group	*Relevant functions*	*Role in the project*	*Power / influence*	*Perception of process / impacts*
Committee on Environment Protection (CEP)	– Supervision over environment protection and environmental planning and compliance; – Drafting and implementation of scientific and technical policies in the area of environment protection; – State control over protecting lands, surface and ground water, air, flora and fauna, fishery resources.	CEP performs an independent function, mainly through monitoring, supervision, approval and authorization of actions within the subdivisions; Clearing the ESIA/EIA	High in providing clearance of ESIA	High interest in environmental impacts of the Project
State Investment and State Property Management Committee	– Has the following responsibilities in the area of investment and foreign aid: – Develop and implement measures aimed at improving the country's investment climate setting up legal and other provisions promoting investments – Take part in developing and implementing investment programs – Promote foreign investments for implementation of State programs and priority social projects, including international loans and grants – General coordination of aid mobilization, management and monitoring process, ensures implementation of plans and activities provided in the programs and strategies for mobilization, management and monitoring of foreign aid – Participates in drafting and concluding international agreements on investments in cooperation with other relevant ministries and agencies – Collaborates with interested agencies on accounting and records related to mobilization and management of investment and all types of external aid – Facilitates and manages appraisals of contracts and other documents related to investment projects	Conducts bids and tender openings for goods, works and services; monitors procurement; participates during loan negotiations etc.	Power low/influence might be high due to risk of delayed tendering/bid opening procedures and/or procurement	High interest in the project due to its strategic priority

Stakeholder / sub-group	*Relevant functions*	*Role in the project*	*Power / influence*	*Perception of process / impacts*
	– Ensures that all authorizations and permissions necessary for project implementation are in place – Monitors and controls implementation of investment projects and provisions of the contracts – Takes steps to ensure transparency, fairness and effectiveness of procurement of goods, works and services in the context of State Investment Projects – Organizes bid opening procedures for tenders on procurement of goods, works and services in the context of State Investment Projects – Monitors procurement activities in project coordination units (PIUs/PMUs)			
Ministry of Health and Social Protection of Population (MHSPP)	– Is key executive government body, responsible for drafting and implementing state policy and regulating legal norms of the activity in the field of healthcare and social protection of the population – Endorses the order for managing statistical reporting in the health and social protection sector – Caries out sanitary and epidemiological surveillance – Carries out activities on ecological and radiation safety, environment protection and sanitary protection of the country; – Develops proposals for improving the order of social support, particularly targeted social assistance and payment of benefits and compensation to the poor households	Sanitary and Epidemiological Service (SES) will be monitoring and controlling infectious diseases trend, including water borne diseases, coordinating/ cooperating on EMP implementation and compliance Regulating and implementing the targeted social assistance for vulnerable HHs.	High power and influence	Interest in Project and its impact high (with regards EMP implementation and compliance).

Stakeholder / sub-group	*Relevant functions*	*Role in the project*	*Power / influence*	*Perception of process / impacts*
Ministry of Labor, migration and employment of the Republic of Tajikistan (MLME)	– Develops draft normative acts and laws in the field of labor, migration, employment, livelihood level of the population, basic vocational education as well as plan of action and forecast indicators of the Ministry's activity and submits them to the Government – In collaboration with other relevant line ministries and agencies, develops proposals on priority directions of the state policy in the area of labor and population's livelihood level – Studies, analyzes and evaluates the living conditions of the population – Develops measures to stabilize and increase the level of population's livelihood based on forming of the income policy – In conjunction with relevant ministries and agencies prepares proposals on minimum salaries, allowances and stipends – Submits to the Government proposals on improvement of the system of allowances and compensations, as well as on protecting population's income from inflation – In cooperation with other relevant ministries and agencies, prepares proposals to improve the system of social partnership, carries out methodical guidance of the work on concluding regional agreements, sectorial (inter-sectorial), collective agreements, facilitates settlements of collective labor disputes, on issues pertinent to the Ministry's competence; – Participates in preparing the draft General Agreement between the Government of Tajikistan and Employers' Union of Tajikistan as well as representatives of the employees, submits proposals on action plan for implementation of this Agreement – Develops proposals on improvement of the workers' salary payment system in the frames of the tariff agreements and collective agreements	– Migration Service is in charge for issuing work permits for foreign workers, as well as for regular inspection of such permissions; – It also issues licenses for companies engaged in recruitment/ employment of foreign workers in Tajikistan	High power / low influence	High interest in the project and its outcomes, particularly in terms of employment/additional work places, compliance with the labor standards

Stakeholder / sub-group	*Relevant functions*	*Role in the project*	*Power / influence*	*Perception of process / impacts*
	– Carries out tariff setting for works, professions and positions, develops normative basis for regulating salaries – Endorses labor norms (standards), single tariff and qualification reference for works and professions, qualification reference book for positions, instructions, clarifications, recommendations on set up, regulation and payment of salary – Develops and submits to the Government a list of productions, works and professions with hazardous working conditions, entitled for additional leave, reduced workday, free medical and preventive food – Carries management of occupational safety and coordinates the work of ministries and agencies in this regard, develops inter-sectorial rules, organizational and methodical documents on occupational safety – Develops the list of hazardous professions where women and child labor are restricted and submits it for review to the Government, develops state statistics forms for reporting workplace accidents and incidents and professional diseases, the procedure for investigating accidents/incidents and professional diseases, norms of issuing work and foot-wear and other personal protection equipment (PPE) – Endorses the rules and norms on occupational safety, organizational, methodical and general technical requirements to implementation of occupational safety – Carries out the work related to analyzing, implementing, evaluating professional/vocational education, including adult education			

Stakeholder / sub-group	*Relevant functions*	*Role in the project*	*Power / influence*	*Perception of process / impacts*
Ministry of Economic Development and Trade (MEDT)	– Participates in developing of the state policy in all the socio-economic fields of the country – Develops short-, medium-, and long-term strategies, indicative plans and forecasts of socio-economic development and in conjunction with those, state programs on internal and external investments; – Coordinates sectorial and regional development programs – Coordinates and controls (executive state bodies' and economic entities') implementation of commitments arising from international legal acts, acknowledged by the Republic of Tajikistan and international agreements – Drafts proposal on concluding Tajikistan intergovernmental and international acts in the field of international economic relations, trade and economic and scientific and technical cooperation – Regulates prices (tariffs) subjects of natural monopolies, economic entities, having monopolistic market position on certain goods in the country	Participates in negotiating loan agreements, regulating tariffs etc.	Low power and influence	Interest in the Project high in view of increased income and improved energy generation potential of the country
Ministry of Agriculture (MoA)	– Develops and implements agricultural sector policy, facilitates international economic relations for enterprises and organizations, facilitates development of agricultural industry in the country, facilitates improvement of technique, technology and processing of agricultural crops	Seen as none at this stage, may evolve depending on the Project progress	Low power and influence	Interest low, despite the impact of flooding caused by water discharge on farming areas, affecting crop production etc. May represent farmers in this regard.

Stakeholder / sub-group	*Relevant functions*	*Role in the project*	*Power / influence*	*Perception of process / impacts*
Committee on Emergency Situations (CES)	– Central executive government body in charge for implementing state policy, legal and regulatory framework, providing state services in the area of disaster management and civil defense – Implements unified state policy in the field of preparedness and protection of the population, economic objects and country's territory from the emergency consequences – Coordinates an array of state legal and defense and other activities aimed at protecting population and economic objects and the country's territory from the emergency consequences both natural and man-maid	Seen as critical in coordinating the water discharge schedules and raising awareness/ preparedness when relevant among the downstream communities; Critical for coordinating the Emergency Management Plan with Nurek HPP (during the project implementation/ operation phases)	Medium-high power and influence	Committee for Environmental Protection
Agency on Land Reclamation and Irrigation (ALRI)	– Central executive government body in the field of land reclamation and irrigation 6 – Develops unified state policy, legal and regulatory environment in the field of land reclamation and irrigated lands, use and maintenance of water management infrastructure, supply and protection of water resources – Manages irrigation and drainage infrastructure, including repair works etc.	Its irrigation and drainage infrastructure receive water after the water discharge in Nurek HPP. The Consultation in Dusti district suggest that downstream areas suffer from flooding mainly due to lack of coordination on the schedule and/or inadequate maintenance of irrigation and drainage infrastructure/ uncleaned canals fail taking water.	Low power and influence	Interest should be high, because their infrastructure will be taking water at discharge, and will be affected by the flooding too. Need coordinating mechanism, as descried above together with CES, MEWR, BT/Nurek HPP, MoA, Committee for Environmental etc.

Stakeholder / sub-group	*Relevant functions*	*Role in the project*	*Power / influence*	*Perception of process / impacts*
Bilateral and multilateral agencies/ donors (ADB, BRD, IDB etc.)	– ADB is one of the largest donor agencies, funding infrastructure rehabilitation, including energy sector in Tajikistan. It financed rehabilitation works on Nurek HPP (switchyard), Golovnaya HPP, etc. – EBRD's portfolio accounts for 42% in energy sector in the country, including rehabilitation of Karaikkum HHP and energy loss reduction, but mainly in the Northern Tajikistan.	Interest in the project and its outcome, including its contribution to the energy loss reduction; interest is also from a perspective of the joint country partnership work.	High power and influence	Interest high
TajCnet	Network of NGOs active in the field of climate change, environment protection.	Interested in public monitoring of the project and its impact on social and environmental issues	Low power and influence	Interest high, particularly in the project outcome, including impact on climate change, downstream effect on natural reserves etc.
Institute of Water Problems, Hydropower Engineering and Ecology under the Academy of Science of Tajikistan	The Institute was established in 2002 based on the Department of Water Problems and Ecology of the Academy of Sciences of the Republic of Tajikistan and its mandate includes research in the field of water resource management, including transboundary water bodies, hydropower and ecology in existing six laboratories: (i) water resources and hydro- physical processes; (ii) Environment and Sustainable Development; (iii) power engineering, and resource-saving; (iv) climatology and glaciology; (v) water quality, hydro and biogeochemistry; (vi) modelling and information management.	Interested in project and its outcomes, particularly in relation to the rehabilitation of the dam and its safety provisions, environmental impacts on the downstream communities. Carried out research of the number of transboundary water bodies, and currently studies Amudarya/Pyanj river basin	Low power	High interest and potential for cooperation during project implementation, including by involving institute in design and planning and/or implementation.

Stakeholder / sub-group	*Relevant functions*	*Role in the project*	*Power / influence*	*Perception of process / impacts*
Private Sector	Private sector functions range from providing consulting services for various projects, including infrastructure/energy, design, implementation support to supply of goods and services.	Participating in the project in association with the International consulting companies and/or outsourced the public consultations and other activities, bidding for supply of goods and services, local business would benefit from increased number of foreign and local personnel during the project implementation, intensified traffic etc.	Low power	Have high interest in the project and in general positive perception of the project

Table 25. Stakeholders at regional level

Stakeholder / sub-group	*Relevant functions*	*Link with the project*	*Power / influence*	*Perception of process / impacts*
Tigrovaya Balka Natural Reserve	Unique wildlife reserve protecting rare species of tugay, or riparian forest, ecosystems (flora and wild animals).	The reserve suffers from lack of water in Vakhsh river, which affects the water levels in the numerous lakes of the reserve, which are habitat for unique and protected flora and fauna. The consultation in Dusti district suggests that the reserve also is adversely affected by the (seasonal) water discharge from Nurek and Baipaza HPP endangering the unique species	Low power and influence	Interest high, need to be included as part of the coordinating mechanism to regulate the water discharge schedule and/or ensure awareness raising/proper notification on the schedule, develop mitigation measures for minimizing flooding risk
Community based natural resource management organizations, WUAs, farmers	Farmers and users of water resources located downstream Vakhsh river, who are potentially impacted by the flooding risk and water discharge/modification of water flows	Have high interest in the project impact in view of its water discharge impact causing floods. This impacts their livelihoods, which relies on agriculture mainly	Low power and influence	High interest in project and its impacts on the downstream water resource/impact management patterns. Need to be closely consulted and informed throughout the project implementation.

Table 26. Stakeholders at local level

Stakeholder / Stakeholder group	*Relevant functions*	*Role in the project*	*Power / influence*	*Perception of process / impacts*
Communities of Nurek (the City and Dukoni jamoat and Puli Sangin jamoat	Local residents, including women, children, elderly, disabled, living adjacent to the only road connecting Nurek to the capital city and which will be using for transporting goods and materials during the project implementation	While the communities are also dependent on the electricity generated by the Nurek HPP, the HPP creates employment for the population; communities have range of concerns related to the project impacts, despite having a very positive attitude and perception about the project.	Low power and influence	Interest is high, for various reason, including improved power generation, positive socio-economic impacts of the Project. However, need to be intensively consulted throughout the Project lifecycle and beyond. Topic for next consultations should include topics such as traffic management plan, health and safety measures, including the data on correlation of cardiovascular diseases trend and a widespread myth on adverse impact of magnetic field generated by the Nurek HPP, job announcements/employment procedures, GRM etc.
All relevant local authorities	This includes local/city level SES, CES, Environmentalists, traffic police and City Municipality	Implementation level activities will be mainly dealt with the local level government stakeholders. It is important to involve them at the early stages of the Project to ensure efficiency and avoid possible delays	High power and influence	Interest is high in the Project and its impacts both positive and negative

In response to the issues raised, the ESIA was amended to include a Stakeholder Engagement Plan. The SEP was implemented by BT and involved regular consultations with key stakeholders. An updated SEP has been prepared for the updated ESIA.

7.4 November 2017 Consultations

A second round of consultations (a 'feedback' round) was conducted following disclosure of the 2017 ESIA in which:

- The status of the project and of the associated administrative procedures were explained
- The final ESIA will be made available to stakeholders and summary findings discussed
- Unresolved issues or unanswered questions raised during the first round of consultations will be addressed during next round of information sharing. Definitive answers or elements of reflection on the question will be provided. This next round of information sharing was held in November 2017.

The Consultant carried out five consultations in Nurek City, at Hukumat of the city, as well in jamoats Puli Sangin and Dukoni. The general consultation has been conducted in the hukumat of the city, and separate consultations for men and women were conducted in the jamoats. The total number of participants at all five consultations was 131 persons, of which 53 percent were women. The age range of participants (local residents) at the consultations were between 22 to 65 years old. The female participants were between 22 to 55 years old.

The participants in the consultations represented diverse target groups and included the following groups

- Heads of mahallas
- Jamoat staff from Dukoni and Pulis Sangin jamoats
- Project Consultant Representatives, Stucky company
- Contractor Representatives, Andritz Hydro Gmbh company
- PIU Representatives from Barki Tojik and Nurek HPP
- Nurek water and wastewater company
- Nurek Housing and communal services company
- PIU of Nurek water and wastewater rehabilitation and solid waste management
- Department of Women and Family Affairs
- SSE
- Department of Environmental Protection
- Housing management units (Associations of Apartment Owners)
- Residents of Nurek city, and Puli Sangin and Dukoni jamoat
- Pensioners/Retirees

Table 27. Main Issues raised during 2016 consultations

Key issue raised	*Relevance for the project*	*Proposed treatment of the issue*
Cardiovascular diseases caused by the magnetic field created by the Nurek HPP (mentioned several times)	EMF is an issue for HPP workers and project team, but there is no scientific proof of a link between the two facts. Besides, the Project will not modify the current working conditions on this point.	– This issue should be specifically highlighted in the second round of consultations. – Monitoring may be established to reassure the public of compliance with exposure values. An awareness campaign could be launched, but it's outside the framework of the project.
Use of alternative road to avoid trespass through the city while transporting goods and equipment during the construction stage. There is a bridge available and could be used for this purpose. However, the bridge needs rehabilitation.	Yes This option requires a specific techno-economic study. This study could be inserted into the Contractor's scope.	Further reflection on this issue should be one of the important points of the second round of consultations.
Nurek HPP causes disasters at discharging water from the reservoirs. Barqi Tojik and Nurek HPP should take into consideration that such discharges currently cause degradation and flooding of the banks in Tigrovaya Balka in particular, and in the downstream districts in general	– The project will be supporting introduction of improved flood forecasting and management system. This will ensure that the Nurek HPP dam is capable of handling 1 in 100,000-year floods vs. 1 in 10,000-year floods currently. Overall, the project has no impact on the downstream discharge at a daily time-scale (see section 5.3.1). – This is rather an issue of coordination between the Agency on Land Reclamation and Irrigation and Committee on Emergency Situations together with BT, where each institution would first communicate the plans, including the water discharge schedule, and works out the mitigation measures and awareness raising/notification for the downstream communities.	– Explanation in the second round of consultations. – It would be beneficial for the project that these stakeholders investigate this subject in order to come up with feasible and effective solution and provide an informed answer to the concerned populations.

Key issue raised	*Relevance for the project*	*Proposed treatment of the issue*
Traffic management plan should limit transporting heavy loads/carrier vehicles to avoid transportation during peak hours – 7:00-8:00 in the morning and 17:00 – 18:00 in the evening	Yes The traffic management plan will be prepared by the Contractor, and these constraints will be communicated to him.	– Explanation in the second round of consultations, whether or not these constraints have been taken into account (some work may require special schedules and specific measures). – This could be addressed simultaneously with the alternative route issue (see above).
Reinstating of any damaged assets/infrastructure	Yes This condition will be included in the requirements imposed on the Contractor.	– Explanation in the second round of consultations. – This could be addressed simultaneously with the alternative route and traffic management plan issues (see above).
Asbestos risk/hazard for population, including in a domestic framework	– Asbestos is identified as a high risk for the workers in the framework of the refurbishment project and will be treated accordingly. – On the other hand, domestic risk is not within the scope of the project.	Explanation in the second round of consultations.
Potential employment opportunities	Yes (see section 0)	Further explanation in the second round of consultations about staff requirements (number of people, types of work) and recruitment procedures and criteria.
Before and during project implementation local population in Nurek and adjacent jamoats should receive timely and updated information on any critical schedules of work and activities Will similar consultations be conducted again, when there will be updated information or the project starts?	Yes This is one of the major points of the SEP	Explanation in the second round of consultations.
Who will do the civil works?	Yes But the Contractor is not known yet.	Details about the Contractor will be included in the information delivered during the next round of consultations.

Key issue raised	*Relevance for the project*	*Proposed treatment of the issue*
Monitoring of the epidemiological situation and health conditions of population during the project implementation	– The global monitoring of the epidemiological situation in Nurek city and vicinity is not within the purview of the project. – But a monitoring of the physicochemical parameters will be ensured during the project in order to respect the exposure values	Explanation in the second round of consultations.
Siltation of Nurek HPP. Is it foreseen to clean the reservoir, for instance?	No The issue of siltation of the reservoir is not covered by the Project; however, the rehabilitation of the HPP will not contribute to siltation.	Explanation in the second round of consultations.
During Project implementation attention should be paid at gender issues, such as providing employment to women, access to information etc.	See specific issues above	

Consultations were conducted in locations that were safe, had adequate equipment/acoustic and lighting, and chairs and tables were available for convenience of the participants. It is important that while the Project is located in the heart of the Nurek city, which is surrounded by Dukoni and Puli Sangin jamoats, the consultations were conducted in three different locations, namely in the Municipality hall, and at jamoat hall in jamoat Dukoni, and at the hall of school #4 in jamoat Puli Sangin to ensure a wider outreach.

The issues raised in this round of consultations are presented in Table 28.

Table 28. Main issues raised in November 2017 consultations

Issues raised and suggestions made	*Response provided by the Consultant*
In Soviet times, we were paid 30% of the allowance for harmful side effects. Why this practice is canceled today?	The Consultant reiterated the information that has been provided during the previous consultations. That while there is a public and scientific concern over the potential health effects associated with exposure to EMF (not only high-voltage power lines and substations, but also from everyday household uses of electricity), there is no empirical data demonstrating adverse health effects from exposure to typical EMF levels from power transmissions lines and equipment. Considering that the project does not change the current exposure of people to this type of field, the ESIA does not consider EMF to be a risk to local residents.
The situation with employment in Nurek city is complicated and electricity prices are rising, is it possible to reduce electricity tariffs, at least for residents of the city as a subsidy to cover costs?	The issue of reducing energy fees is beyond the scope of this project. It is worth noting that subsidies have already been provided to cover energy costs for vulnerable groups.
Will electricity tariffs rise after the completion of the project?	This question is beyond the scope of this project, and we, unfortunately, cannot answer it. However, this issue will be reflected in the consultation report.
How many years will this project last?	10 years
What is implied by rehabilitation of the dam?	This implies undertaking analysis of dam's safety according to the World Bank OP 4.3 "Dam Safety", which requires: (a) inspection and assessment of the current state of safety of the dam, equipment and historical performance indicators; (b) review and evaluation of current operating and maintenance procedures; as well as; (c) submission of the findings and recommendations for any repair work or safety measures necessary to upgrade an existing dam to acceptable standards;
Will the units of the Nurek HPP be rehabilitated sequentially?	– Yes. The basic scenario envisages the sequential turn-off of each unit for repair; – The first phase includes modeling and design within 1.5 years; – Mobilization of the production facility will take around 3 months;

Issues raised and suggestions made	*Response provided by the Consultant*
	– Re-equipment of each turbine around 26 months. The work will be carried out for all 9 units; – - Work at the production facility will take from 9 to 11 months for each unit.
EMF significantly affects public health. Is it possible to open free medical centers for the treatment of various diseases caused by EMF?	No. Due to lack of empirical evidence proving the direct correlation between the EMF and health issues of local population (which are not peculiar to this particular area, but rather occur throughout the country), the project does not envisage establishment of new medical centers for possible EMF-caused diseases.
Have the rehabilitation works started yet, and who can we contact regarding the employment opportunities?	You may contact the Contractor.
According to the world practice, the budget of construction of large industrial enterprises envisages expenses to ensure the social protection of workers. As far as we are informed, large funds have been allocated for the rehabilitation of the Nurek HPP. Does the project envisage social protection of workers?	This project does not envisage covering the social expenses of the workers of Nurek HPP.
Participants' recommendations/requests:	
It would be good to protect the health of the population to provide us with dairy products	
It would be good if during rehabilitation of Nurek HPP, the latest technology was used to mitigate the harmful effects to the population.	

Since 2017, throughout Phase 1 of the rehabilitation project, additional consultations have been conducted by BT each year following the format of the consultations summarized above and engaging the same profile of stakeholders. Issues raised were consistent with those identifies above.

7.5 Consultations for 2020 updated ESIA, Nurek Bridge ESMP, and SEP

As described in Chapter 2, the World Bank developed and adopted new Environmental and Social Standards (ESSs) in 2018 and these standards apply to all projects approved since that time. Phase 2 of the Nurek rehabilitation project is pending approval in mid-2020 so it will need to comply with the new ESSs. Therefore, Barqi Tojik has prepared this updated ESIA to comply with ESS1 (Assessment and Management of Environmental and Social Risks) and Impacts and the updated SEP has been prepared to comply with ESS10 (Stakeholder Engagement and Information Disclosure).

As noted above, additional scoping meetings were held in March and April 2020 to identify additional stakeholder issues and concerns. Following disclosure of the draft updated ESIA, the Nurek bridge ESMP, and the updated SEP, Barqi Tojik sponsored additional consultations with key stakeholders, again to convey information on the project and to receive information and concerns from stakeholders. The documents were disclosed for public review and comment in early May 2020. No public meetings were held due to the COVID-19 pandemic, so the following steps were undertaken to consult with stakeholders during the first two weeks of May.

- Announcements were made on a local radio station about the availability of the updated Nurek HPP ESIA, the bridge rehabilitation ESMP, and the SEP at Barqi Tojik in Dushanbe, at Nurek City Hall, and on the Barqi Tojik website.
- The documents were made available for review at Barqi Tojik Headquarters, at Nurek HPP, and at the Nurek City Town Hall.
- With appropriate precautions due to COVID-19, meetings were held with representatives of key stakeholders to distribute copies of documents. Representatives then distributed the documents to others and placed them at signboards.
- Key representatives of stakeholder groups were called on the telephone to tell them the documents were available, to ask if they wanted paper copies, and to tell them how they could submit comments (email, telephone, or paper).
- Stakeholders were called again to determine if they would like to submit comments verbally.

Table 29 summarizes the issues raised by stakeholders in 2020.

Table 29. Issues Raised by Stakeholders in 2020

Stakeholder comments on Nurek HP rehabilitation	*Response*
Local people should be involved as workers to the construction	Contractors will be encouraged to hire local workers
Announce the availability of positions to be hired	Contractors will be required to advertise positions to be filled
Special protection measures should be applied during the transportation of construction materials to protect people from accidents	The ESMP requires a Traffic Management Plan
The project should consider following additional activities: – Carrying drinking water – Building of a sports arena – Construction of a school for primary school students – Construction of medical clinic – Construction of a library with a reading room – Asphalting of roads – Construction of children's playgrounds near residential buildings in housing operational administration #3	The recommendations are beyond the scope of this project but are suitable for government support
Assure the presence of a medical specialist on site	The ESMP requires proper medical personnel and care for workers

As required by the updated SEP, Barqi Tojik will continue its current practice of having consultations with local stakeholders at least annually, with additional consultations if needed to communicate with stakeholders. Following each meeting, Barqi Tojik will publish a report on its website that summarizes the discussions and actions.

8 Analysis of alternatives

The project alternatives to be studied consist of variations related to rehabilitation and the "no project" option.

8.1 Action alternatives

Nurek HPP is composed of nine units which are all currently limited in terms of power capacity due to vibration and temperature issues, and one unit (Unit 8) has been out of service for several years pending rehabilitation of runner and Main Inlet Valve (MIV) as well as transformer issues. As noted previously, the efficiency issues of the other eight units cumulatively represent another unit out of operation.

Currently, the realistic rehabilitation alternatives are the following:

- Recovering of the full installed capacity only, or increasing the power capacity by 4 percent, 8 percent, or 12 percent
- Working on one unit in at a time or two (or more) units simultaneously.

8.1.1 Rehabilitation with and without Power Capacity Increase

There are no adverse impacts for any of the power capacity alternatives under any alternative. There would be no change in water discharge or other external effects, and no impacts on workers on communities. On the other hand, there is a clear positive impact with a capacity increase: the higher the increase of the capacity, the higher the potentially available energy will be at times of peak production. The technical-economic study of the rehabilitation project includes an economic assessment.

8.1.2 Rehabilitation of One or Two Units Simultaneously

The benefit of refurbishing two units simultaneously is to speed up the overall rehabilitation program and thus speed recovery of the full capacity (or more) of the HPP. On the other hand, the available power capacity of the plant would be reduced in the first years of the project. In this case, there is a theoretical negative impact on the maximum generation. This is shown on Figure 26, which represents the winter/summer daily power duration curves in recent years of operation put in perspective of the current available capacity of the power plant (2,320 MW).

The immobilization of a second unit would make peak daily productions above an average of 2,000 MW (observed about five percent of the time in recent years) impossible. It would also mean that to achieve the same levels of production, all remaining seven units would stay in operation 60 to 70 percent of the time (at least from a daily time-scale perspective).

Beyond the reduction in power generation, this would also reduce the ability of the Nurek HPP to withstand very large flows. For these reasons, this alternative is not favored.

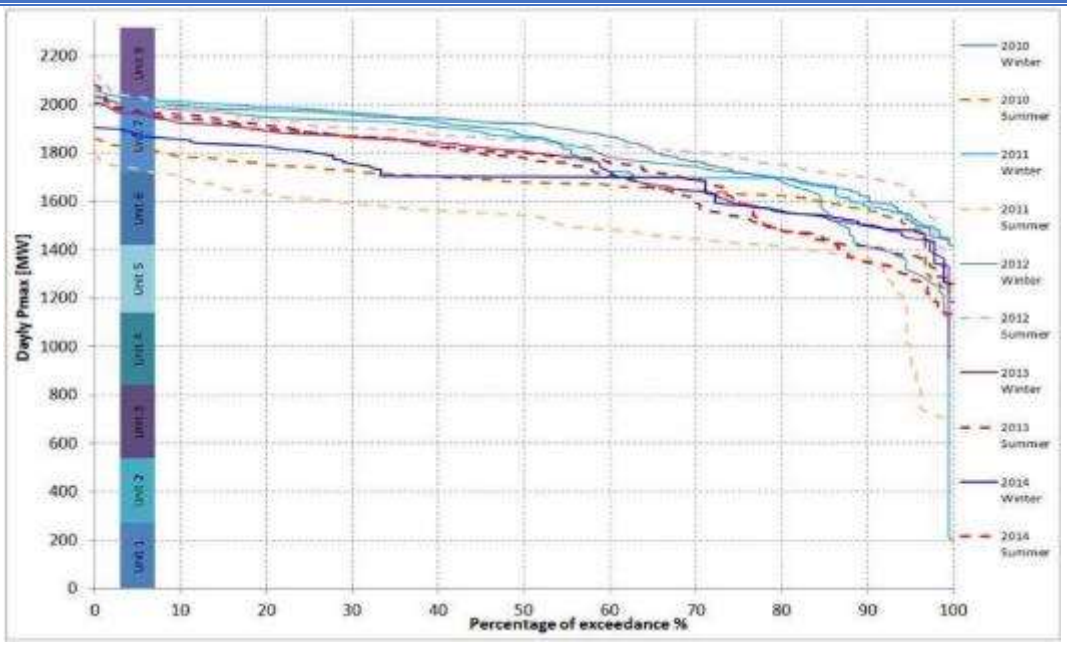


Figure 26. Winter/Summer power duration curves, 2010-2014

8.2 No Action Alternative

This alternative would lead to the continuation of the current trend, that is to say the gradual reduction of energy production by the degradation of electromechanical equipment and the continuing deterioration of the spillways and tunnels. This would increase the downstream flood risk with the reduction of the flood management capacity of the HPP, and also continue the risk to dam stability during extreme floods, which would also present a major risk to downstream populations. For these reasons, this alternative is not favored.

9 Environmental and Social Management and Monitoring Plans

The environmental and social impacts that could result from phase 2 of the rehabilitation of Nurek HPP are described in Chapter 5 and summarized in Table 16Table 20. As described in that Chapter, some activities during the rehabilitation and operations phases of the dam and power plant could have a moderate or even major adverse impact on specific environment and social resources if they are not controlled That makes it imperative for precautions to be taken to ensure that significant adverse effects are avoided, reduced, or otherwise mitigated. This will take a concerted effort by Barqi Tojik, the Project Management Consultant, and the contractors selected for design and construction to ensure that proper design, construction, and operating procedures are implemented throughout the procurement, project preparation, construction, and operation phases of the project, and that the mitigation measures proposed in the present Chapter are incorporated into requirements for bidding, selection of contractors, design, construction, operation, and maintenance of the dam and power station.

9.1 Environmental and Social Management Plan

Table 30 describes and outlines the Environmental and Social Management Plan for the project. It builds upon the mitigation measures described in Chapter 5 and identifies the measures that must be implemented to avoid, reduce, or otherwise mitigate potential moderate and major adverse impacts identified in the ESIA. It also identifies best management practices and other mitigation measures that will minimize, reduce, or eliminate many of the impacts of minor or even negligible significance, which could escalate to become more important if they are not handled properly. It is expected that mitigation measures will be sufficient to eliminate or reduce all risks to acceptable levels. In many cases, the ESMP requires development of detailed plans to manage specific risks and hazards and includes an overview of the relevant requirements of those plans. Primary responsibility for implementing mitigation measures during the rehabilitation phase will rest with the contractors, although Barqi Tojik and the Project Management Consultant will have responsibility for some of the actions. All works by the contractors, including implementation of mitigation measures, will be overseen and supervised by the Project Management Consultant (also known as the Consulting Engineer, Owner's Engineer, Supervising Engineer, or other names), with ultimate oversight and responsibility resting with Barqi Tojik. Operation of the HPP, which will continue throughout rehabilitation, will be the responsibility of Nurek HPP, which will also have responsibility for developing and implementing management plans.

It is important to note that Barqi Tojik, in part through its contractors and Nurek HPP, will also be responsible for complying with relevant requirements of Tajikistan law, the World Bank Environmental and Social Framework, the World Bank Group's General Environmental, Health, and Safety (EHS) Guidelines, and the Good Practice Notes, each of which may be have more detailed requirements than the Plan presented here.

The Environmental and Social Management Plan (Table 30) is organized as follows:

- Section 1.0 includes measures for the procurement phase (that is, the process by which Barqi Tojik will select the contractors)

- Section 2.0 includes measures to be implemented during the project preparation stage, between the time the contractors are appointed, and the main rehabilitation activities begin. This will include employing workers and specialists, developing detailed management plans (as required by the ESMP), training workers, acquiring construction storage areas, preparation areas, and camps.
- Section 3.0 includes measures during construction, which for the hydropower plant will include mobilization of workers and equipment to the site, setting up storage areas and camps, training, and implementation of the rehabilitation works.
- Section 4.0 includes measures to be implemented during demobilization by the contractor.
- Section 5.0 includes measures to be implemented by Barqi Tojik and Nurek HPP during operation and maintenance of the hydropower station and substation, both during the rehabilitation stage and afterward.
- Section 6.0 includes measures that must be implemented during all phases of activities – from procurement through operation and maintenance, in order to avoid or reduce impacts.

9.2 Environmental and Social Monitoring Plan

Following this table of mitigation measures, Table 31 provides the Environmental and Social Monitoring Plan. Implementation of this Plan is necessary to ensure there is close scrutiny over actual environmental and socioeconomic performance so that prompt action can be taken if mitigation measures are not being implemented or if the measures are not adequately mitigating actual impacts. Most of the monitoring responsibilities of Project Management Consultant are not shown in the Table, since they will be monitoring all aspects of the contractor's implementation of the rehabilitation program on a continuous basis. The objectives of the Environmental and Social Monitoring Plan are to ensure the following goals are achieved during all phases of the project:

- Tajikistan, World Bank, Barqi Tojik, and community obligations are met
- Project impacts are identified during preconstruction, construction, demobilization, and operation
- Mitigation measures are implemented as required, and verified as being implemented
- The effectiveness of mitigation measures is evaluated and shortcoming are identified
- Mitigation measures are refined and enhanced as needed to further reduce impacts
- Mitigation measures are developed and implemented as needed to deal with unforeseen issues or changes in operations
- Barqi Tojik, Tajikistan authorities, and the World Bank are able to verify that their respective requirements are being met.

Table 30. Environmental and Social Management Plan for Nurek Rehabilitation Project, Phase 2

No.	*Activities*	*Potential Adverse Impact*	*Mitigation Measures/ Best Management Practice*	*Target outcome of mitigation*	*Responsible body*
1.0 Procurement Phase					
1.1	Preparation of bidding documents for phase 2 designs	– Failure to optimize designs to avoid impacts on people and environment – Unacceptable impacts	As required by World Bank Standard Procurement Documents, include relevant requirements for ESHS documentation (ESIA & ESMP, SEP, LMP, ESCP) in procurement documents. Include the following in work requirements: – For storage and laydown areas, and camps, use developed land away from residences as much as possible – If insulation gases are to include SF6, specify low-leakage equipment (>99% control) – Design to include specific safety measures necessary to ensure safe construction, including special requirements for asbestos, PCBs, and substandard conditions of workplaces – Design to call for any upgrades of workplaces (lighting, footing, ventilations, etc.) that are needed for safe performance of duties by all workers	– Designer understands need to minimize impacts – Minimal physical displacement and minimal economic displacement – Fish pass appropriate designed	PMC, Barqi Tojik World Bank (no-objection approval)
1.2	Preparation of bidding/ procurement documents for all construction of all project components	– Failure of bidders to recognize ESHS requirements, to plan for ESHS management, and to incorporate ESHS requirements in cost proposals and planning – Unacceptable impacts	As required by World Bank Standard Procurement Documents, include relevant requirements for ESHS documentation (from ESIA & ESMP, SEP, LMP, ESCP) in procurement documents for construction contracts and require proposals to include key elements of the following plans as part of Management Strategies and Implementation Plan (MSIP): – Occupational health and safety plan for mobilization stage – Labor management plan – Worker Code of Conduct and worker Grievance Redress Mechanism, to include provisions specified in SPDs and others noted in the ESIA & ESMP Define key personnel to include, for the project (that is, not corporate-level):	– Bidders understand ESHS requirements and prepare responsive proposals – Higher ESHS capacity by bidders – Realistic proposals	Barqi Tojik World Bank (approval)

No.	*Activities*	*Potential Adverse Impact*	*Mitigation Measures/ Best Management Practice*	*Target outcome of mitigation*	*Responsible body*
			– PMC: at least one full-time ESHS specialist (emphasis on safety, to be appointed by BT or PMC) and part-time social specialist – Contractors/subcontractors: ESHS manager, medical personnel, at least one safety officer per 50 workers Require ESHS Performance Security of at least one percent of the total contract value		
1.3	Review and evaluation of proposals	– Failure to consider bidders' ESHS qualifications and experience in scoring proposals – Unacceptable impacts	– Inclusion of ESHS specialist(s) in proposal review team, with sufficient time provided for evaluation – Awareness by entire evaluation team of key ESHS requirements – Scoring includes corporate ESHS experience and qualifications, ESHS staff experience (especially safety) and qualifications and evaluation of management plans in MSIP – Recognition and exclusion of unqualified bidders or bidders with unsatisfactory ESHS performance in past	– Bidders' ESHS qualifications and experience receive full consideration in evaluations – Bidders disqualified for poor safety and ESHS record – ESHS capacity recognized and scored	Barqi Tojik
1.4	Selection of contractors	– Selection of contractor unqualified and/or unprepared to develop and implement full Construction ESMP – Unacceptable impacts	– MSIP plans sufficient to avoid or control impacts – Key staff qualified and available – Award only to contractors with ESHS qualifications and experience that meet specific criteria	– Award to contractor able to implement this ESMP and to develop and implement specific ESHS Plans – Contractor ultimately implements ESHS requirement satisfactorily – Fewer delays in project preparation and construction	Barqi Tojik World Bank (no-objection approval)

No.	*Activities*	*Potential Adverse Impact*	*Mitigation Measures/ Best Management Practice*	*Target outcome of mitigation*	*Responsible body*
2.0 Pre-construction project preparation					
2.1	Implementation of Stakeholder Engagement Plan (SEP)	– Uninformed local people and other stakeholders – Unrealistic expectations by local people and prospective employees – Long-term distrust of contractors and Barqi Tojik – Protests or other disruptions – Vandalism	– Outreach to identified stakeholders – Realistic information on employment opportunities – Meetings with community leaders and citizens as appropriate – Implementation of Grievance Redress Mechanism – Train project personnel (Barqi Tojik, PMC, contractors, etc.) in relevant requirements of SEP, including receiving and reporting grievances	– Well-informed supportive community – Realistic expectations – Trust of contractor and Barqi Tojik to resolve issues – Timely resolution of grievances – Barqi Tojik awareness of concerns and issues – Grievances handled promptly and in accordance with Grievance Redress Mechanism	Barqi Tojik (with specific assignments for PMC and contractors)
2.2	Preparation for management of ESHS issues	– Failure to hire qualified specialists and give them sufficient time to manage issues – Noncompliance with applicable requirements – Excessive ESHS impacts due to mismanagement or failure to manage ESHS issues	– Assign key ESHS personnel defined in requirement 1.2 and provide sufficient time to perform duties – Employ and train sufficient safety officers: at least one per work crew and overall ratio of at least 1 per 50 workers – Implement MSIP and other mitigations necessary to avoid or reduce impacts to acceptable levels – Train managers and supervisors/foremen in key requirements for ESHS mitigation (i.e.., this ESMP and monitoring plan), including Code of Conduct – Develop checklists for use by ESHS staff to record findings – Develop templates for monthly ESHS reports to PMC – Develop templates for investigating and addressing root cause of serious incidents /injuries/accidents – Develop registers for recording grievances from external stakeholders and from workers and procedures for passing them to PMC and Barqi Tojik	Qualified staff in sufficient numbers to implement/oversee C-ESMP	Contractor

No.	*Activities*	*Potential Adverse Impact*	*Mitigation Measures/ Best Management Practice*	*Target outcome of mitigation*	*Responsible body*
2.3	Complete Contractors' Construction ESMP (C-ESMP) by preparing/ updating: – Subcontractor Management Plan (if required) – Materials and Waste Management Plan – Labor Management Plan/Procedure – Traffic Management Plan – Emergency Preparedness and Response Plan – Worker Occupational Health and Safety Plan for construction phase (see 3.2) – HR Manual (finalize MSIP draft) – Worker Code of Conduct (finalize MSIP draft) Develop Plans or detailed method statements/ procedures on: – Noise and dust control, indoors and outside – Working in and near water – Worker accommodation and work camp management	– Contractor begins works without programs to avoid or minimize impacts on human and environmental resources: – Unsafe vehicles, accidents – Subcontractor ESHS performance not managed – Noise disturbances to communities – Community disruption, violence, crime, disease due to worker influx – Unsafe working conditions, workers not prepared for conditions – Unsafe and/or unsanitary accommodations	– Plans prepared by qualified ESHS specialists and project managers – PMC to review and approve all C-ESMP plans and procedures, including updated C-MSIP plans that had been submitted in contractor's proposal – All plans reviewed and ultimately approved by qualified experts – All plans to require training of all workers – Awareness-raising sessions on GBV conducted for all workers – Code of Conduct adopted, acknowledged and signed by all workers on site (Contractor, subcontractors, PMC, as applicable) – All plans include specific detailed training requirements (who is trained, when and how often is training, what is covered) – Plans to account for ongoing HPP operation and to include provisions to minimize disturbance of operations and Nurek workers – Plans to be submitted at least six weeks prior to planned mobilization – OHS Plan to include provisions for safe handling and management of asbestos, noise control/protection, working with electricity, working at heights, hotworks/welding, working near water, working in confined spaces, and other special risks – OHS Plan to include requirements for COVID-19 protection (or separate plan)	– No activities undertaken without underlying procedure or plan to protect workers, community, and environmental resources – Comprehensive contractor program for avoiding and minimizing impacts – Subcontractor compliance with plans – All activities in accordance with C-ESMP – No unacceptable or unpredictable impacts	– Contractor (prepare) – PMC (approve) – Barqi Tojik to review as needed
2.4	Appoint ESHS specialist	– Inadequate oversight of contractors by limited time available by PMC specialist – Poor ESHS performance by contractors	– Develop TOR and solicit bids from qualified ESHS specialist(s) – Appoint qualified -time specialist to spend full time on-site supervising contractor ESHS performance	– Qualified specialist appointed and on-site for supervision – Improved performance by contractors	Barqi Tojik or PMC

No.	*Activities*	*Potential Adverse Impact*	*Mitigation Measures/ Best Management Practice*	*Target outcome of mitigation*	*Responsible body*
2.5	Recruit and employ workers and subcontractors	– Unqualified workers and/or subcontractors – Misunderstandings over hiring practices – Poor labor practices (substandard pay, uninformed workers, unsafe conditions, etc.) – Excessive staff turnover	– Implement Contractors' Labor Management Plan (LMP)-see 2.3 above – Preference for local hiring, with PAPs given preference (>50% local unless Barqi Tojik approves less, with justification) – Positions to be advertised and openly competed – No employees under age 18 – Written contracts with workers, per LMP and Tajik law – Other provisions per Labor Code of Tajikistan – Subcontracts include and require compliance with contractor's LMP, C-ESMP, and Tajikistan law – Workers receive full induction training	– Maximum hiring of PAPs and other locals: establish goal of at least 50% of workforce from local population – Workers employed in compliance with law (nondiscrimination, equal opportunity, income, etc.) – Low staff turnover	– Contractor
2.6	Establishment of construction camps/laydown areas, storage areas, camps	– Contractor trespasses on land – Placement of construction zones in inappropriate locations – Impacts outside boundary of designated area	– No rehabilitation activities until C-ESMP approved – Implement C-ESMP requirements for noise, fuel and hazardous materials, noise, worker safety, and community safety, etc., including worker training on topics relevant to their jobs, including Code of Conduct – Train/warn workers to remain within boundaries and penalize for violations – Consult with roads authority concerning Traffic Management Plan and damages to public roads – Maintain photographic and written log of all off-site areas to be affected (camps, storage areas, etc.)	– Compliance with approved C-ESMP – No unexpected or unacceptable impacts – Minimal disruption to traffic –	Contractor
2.7	Establishment of accommodations, kitchens, sanitary facilities	– Worker illness or death – Worker dissatisfaction and lower productivity – Contamination of land and water	– If accommodations are to be provided, comply with ESS2/IFC/EBRD guidance "Workers' Accommodation: Processes and Standards" – Develop and use operating and maintenance checklists for operation of canteens/kitchens and accommodations – Appoint persons to be responsible for cleanliness of accommodations, workplaces, and other areas under contractor control. – Provide toilets at or near all work locations, establish and enforce rules prohibiting workers from using the bush	– Sanitary and compliant facilities and amenities – Healthy workers – Toilets in place where needed	Contractor

No.	*Activities*	*Potential Adverse Impact*	*Mitigation Measures/ Best Management Practice*	*Target outcome of mitigation*	*Responsible body*
2.8	Nurek HPP Occupational Safety and Health Plan	– Unsafe working conditions – Worker injury or death	Prior to start of work for Phase 2, develop safety plan for operations during rehabilitation works – Update existing plan or develop new plan – Plan to be developed based on assessment of working conditions and assessment of risks of every job during operations – To include at least the requirements of OHS Plans in row 3.2 below – To require "permit" system for work in confined spaces, at heights, with electricity, and with asbestos – To require training of all workers before they perform their jobs and periodically thereafter – Update plan when rehabilitation works are complete – Review and update plan as needed throughout operations, at least annually every two years	– OHS Plan in place at beginning of Phase 2 – Workers trained before beginning work during phase 2 – Safe working conditions and safe work practices – Minimal/no injuries or fatalities	Nurek HPP (to be approved by PMC)
3.0 Construction phase					
3.1	Authorization to proceed with works	– Works begin prior to C-ESMP approval and implementation	Review all Plans that are required as part of C-ESMP (see row 2.3) When plans fully meet requirements of Tajikistan law, World Bank ESSs, World Bank Group EHSGs, and GIIP, approve and issue authorization to commence work	– C-ESMP meets all standards	PMC
3.2	All activities, beginning with mobilization (see also section 5.0 below)	– Worker injury or death	Implement Occupational Health and Safety Plans (see 2.3), including: – Medical clearance for workers to perform their tasks – Assessment of risks and identification of mitigation measures for all tasks, with PPE as last resort – Design tasks for maximum safe operations – Workers provided with proper equipment and tools, and PPE, to accomplish tasks safely (boots, gloves, coveralls, eye protection, hearing protection, respiratory protection, etc.) – Only trained workers allowed to complete tasks – Safety Officers oversee all works (minimum 1 per crew and 1:50 workers overall)	– Tasks completed with no worker injuries or deaths – Tasks completed with no damage to vegetation, land or property outside construction zone	– Contractor (contractor Plans) – Nurek HPP (Nurek OHS plan)

No.	*Activities*	*Potential Adverse Impact*	*Mitigation Measures/ Best Management Practice*	*Target outcome of mitigation*	*Responsible body*
			– Sufficient First Aiders to provide first-level medical care as needed – Fully supplied first aid kits in all vehicles and equipment and quickly accessible at all workplaces – Communications established with nearest medical facilities and personnel regarding works to be completed, arrange for support as appropriate – Record safety statistics (work hours, near misses, minor & incidents and accidents, fatalities) – No solo workers near water (use "buddy system") – Provide lifesaving equipment near water – Detailed requirements for working with and near asbestos, including all aspects of asbestos management – EMF measurements at workplaces, precautions as needed to reduce levels to below guidelines – Medical specialists on-site at all times during construction – Qualified safety officers to enforce requirements, up to and including dismissal for repeated violations (at least 1 officer per 50 workers) Implement Traffic Management Plan/Procedure (see 2.3), to include: – Consultation with local traffic authorities on timing of heavy traffic, road repairs, etc. – Drivers/operators licensed for vehicles and equipment – Driver trained as needed and tested – Vehicles properly licensed/registered – Vehicles/equipment checked for safety daily by drivers/operators (horns, tires, fire extinguisher, headlights and taillights, safety belts, intact glass, etc.) – Speed limits established and enforced – Avoid sensitive areas (hospitals, schools, etc.) if possible, otherwise establish time and speed limits – Keys never left in vehicle/equipment when driver/operator not present		

No.	*Activities*	*Potential Adverse Impact*	*Mitigation Measures/ Best Management Practice*	*Target outcome of mitigation*	*Responsible body*
3.3	Implement operations-phase OHS Plan	– Outdated work practices and conditions – Worker injury or death	Implement OHS Plan beginning with contractor mobilization for rehabilitation – Train workers – Maintain statistics, report to Barqi Tojik – Update plan at end of rehabilitation and at least every two years thereafter	– OHS Plan in place throughout rehabilitation and operations – Minimal worker injury or fatality	Nurek HPP
3.4	Implement all other relevant C-ESMP plans (see 2.3) as part of all activities	- Excessive impacts on people and environmental resources	Management of activities as planned to avoid or minimize potential impacts on people and environment	– Implementation of mitigation measures – Adaptive management and modification of Plans in case of unexpected impacts – Minimal impacts, compliance with law and ESSs	Contractor
3.5	Manage contractors	- Inadequate or incomplete implementation of ESHS requirements - Contractor paid for substandard ESHS works/performance	– Include evaluation of ESHS performance in decisions on payment of invoices for work completion – Recommend withholding of payment for milestone completion invoices only when ESHS requirements for those activities have been fully implemented as required – Recommend withholding of final payment until ESHS requirements are fully met, pay only when 100% complete – Supervision of C-ESMP implementation by contractor: observations, frequent inspections, review records review, – Require contractor compliance with LMP, safety, and other requirements	– Full implementation of ESHS requirements – No unacceptable ESHS impacts	PMC
3.6	Manage subcontractors	– Subcontractors not aware of ESHS requirements – Poor labor practices and poorly trained workers – Failure to implement C-ESMP – Subcontractor paid for substandard ESHS works/performance	– Include relevant portions of C-ESMP in subcontractor procurement documents and subcontracts (see 1.1) – Require compliance with contractor's LMP, safety, and other requirements, or equivalent requirements approved by contractor – Supervision by contractor and PMC of C-ESMP implementation by subcontractors	– Subcontractor implementation of C-ESMP – No unacceptable ESHS impacts	Contractor

No.	*Activities*	*Potential Adverse Impact*	*Mitigation Measures/ Best Management Practice*	*Target outcome of mitigation*	*Responsible body*
		– Poor ESHS performance, including safety, leading to environmental impacts, impacts on local communities, and worker injury or death	– Structure milestone payments to include C-ESMP implementation and withhold payments until ESHS requirements fully implemented – Reduce/withhold subcontractor payment until ESHS requirements are met, pay only when 100% complete		
3.7	Work in or near the river or reservoir	Excessive damage to river morphology and aquatic habitat	Implement relevant parts of Occupational Health and Safety Plan to minimize risk of working in and near water – Train workers on buddy system and lifesaving practices/equipment – Provide lifesaving equipment/measures – No refueling operations within 15m of water – Minimize work in moving or deep water – Toilets at least 10m from water, enforce use of toilets – Immediate cleanup of excess/waste concrete, tools, and debris	– Minimal impacts on river and aquatic habitats – Safe workers	Contractor
3.8	Protection of camps, storage areas, equipment, property, substation, etc. (security)	– Abuse of local population or workers, including injury or death – Loss of community support, possibly active opposition – Liability for contractor, Nurek HPP, and Barqi Tojik	Prepare and implement Security Plan: – No armed private security – Contractor/Subcontractor and guards checked for licenses, past abuses – Guards trained in appropriate use of force – Consultations with local law enforcement authorities	– No vandalism or theft – No incidents involving security	– Nurek HPP (for HPP) – Contractor (for camps, storage areas)
3.9	Protect workers employed by primary suppliers	Child labor, forced labor, and/or serious safety issues at primary suppliers	If Barqi Tojik or contractor has significant control or influence over primary suppliers (specifically, turbine and transformer manufacturers, steel provided for bridge, etc.), contractor to require information from suppliers about labor safety practices and use of child or forced labor. If results show issues, work with supplier to change practices, or change suppliers	No child labor or forced labor or serious safety issues at primary suppliers	– Contractor (supported by Barqi Tojik) – Nurek HPP

No.	*Activities*	*Potential Adverse Impact*	*Mitigation Measures/ Best Management Practice*	*Target outcome of mitigation*	*Responsible body*
3.10	Payment of invoices for completion of milestones	– Contractor disregard of safety and other ESHS requirements. – Repeated poor safety practices – Repeated risks to community	– See rows 3.3 and 3.4 above – Consider relevant ESHS management requirements to be an integral part of each construction milestone – Penalize initial failures to implement mitigations by withholding partial or final payment until mitigations are properly implemented – If contractor fails to correct, appoint third party to implement corrective measures, reduce contractor invoices by that amount and more – Penalize repeated failures to implement mitigations by considering milestones incomplete and reducing payments permanently	– Proper implementation of C-ESMP – Timely implementation of requirements of C-ESMP – Minimal impacts	PMC (for recommendations to Barqi Tojik for milestone payments of contractor invoices) Contractor (for subcontractor invoices)
4.0 Demobilization					
4.1	Completion of work	– Non-operational components – Unsafe and unstable conditions	– Satisfactory inspection by PMC and Nurek HPP – All installations working as required	– Construction complete with C-ESMP fully implemented	– Contractor – PMC (to verify)
4.2	Closure of construction areas, camps, accommodations, etc.	– Debris, wastes, contaminated soil, water remain after contactor departs – Liability for Barqi Tojik	– Removal of all tools, equipment, storage units/tanks, debris, wastes, etc. – Restoration of areas used for storage, camps, etc., as required by lease or other agreement for use – Removal of residual wastes (asbestos, scrap, etc.) – All areas to be inspected by PMC	– Areas used for construction operations restored to pre-construction uses or as agreed with land users – No residual liability or damages	– Contractor – PMC (to verify)
4.3	Payment of final invoice	Demobilization incomplete, with residual damage, leftover waste,	– Recommend that Barqi Tojik withhold payment until PMC can confirm demobilization is complete from ESHS perspective – Appoint third party to complete restoration activities if contractor fails, at contractor's expense	– No continuing or residual damages or contamination – Land restored to former use as required – Final payment made	PMC
5.0 Operation and maintenance (note that operations will continue during the construction phase)					
5.1	Preparation/updating and implementation of operating plans: – Occupational Health and Safety Plan – HR Manual	– Noncompliance with employment and safety laws – Failure to implement mitigations required for ESHS protection – Uninformed community	– Update HPP Operating Manual to include updated ESHS plans – ESHS plans updated to meet GIIP, Tajikistan law, World Bank ESH Guidelines, and ESMP – OHS Plan to require at least one safety specialist for every 50 workers	– Legal compliance – Informed and supportive community – Safe working conditions and workers	Nurek HPP

No.	*Activities*	*Potential Adverse Impact*	*Mitigation Measures/ Best Management Practice*	*Target outcome of mitigation*	*Responsible body*
	– Emergency Preparedness and Response Plan To be included in overall operating manual, not kept as separate plans	– Unacceptable risks to workers, biodiversity, community	– Develop a single Emergency Preparedness and Response Plan for the entire Vakhsh Cascade	– Continuous flow sufficient to support biodiversity – Improve cascade response to floods	
5.2	Develop/update operating rules and Operating Plan for the HPP as specified in the Techno-Economic Study, including continuing operation during extreme floods	– Turbine shutdown during floods – Overtopping of dam – Increase in downstream flooding – Partial or complete dam failure	Updated Operating Plan to meet recommendations in dam safety study and allow dam to pass waters from newly calculated 10,000-year event and 90% of PMF until Rogun comes online	– No overtopping during extreme event (100,000-year event)	Nurek HPP
5.3	Develop/update operating rules for Nurek reservoir to maintain Full S	– Reservoir reaches level that requires overtopping of the dam – Increase in downstream flooding	Updated Operating Plan to meet recommendations in dam safety study	– Reservoir kept at a level that prevents overtopping	Nurek HPP
5.4	Geological-geotechnical investigation to assess stability of the "triangular" block" landslide and implementation of required stabilization measures	– Landslide partly blocks tunnel and reduces ability to discharge water, including during flood events – Dam overtopping and downstream flooding	– Investigations undertaken – Recommended stabilization measures implemented	– Bank remains stable – Tunnel remains intact	Nurek HPP
5.5	Routine maintenance, security patrols	– Worker injury or death – Damage to ground surface and cover vegetation, soil erosion – Traffic accident – Damage to private property (trees, crops, etc.)	Workers trained in requirements of Nurek HPP Operating Manual and safety requirements for their jobs Security personnel trained in UN Principles	– Works completed safely – Workers and security personnel trained in requirements of their jobs	Nurek HPP
5.6	Implementation of monitoring plans (see ESHS Monitoring Plan)	– Unexpected conditions not recognized – Unexpected or unacceptable impacts	– All aspects of ESHS performance monitored as required – Plans reviewed at least bi-annually and updated as needed	– Changes in conditions recognized and addressed – Compliance	Nurek HPP

No.	*Activities*	*Potential Adverse Impact*	*Mitigation Measures/ Best Management Practice*	*Target outcome of mitigation*	*Responsible body*
6.0 All phases					
6.1	Oversight of ESHS performance of design and construction	– Lack of timely knowledge about contractors' ESHS performance – Unnecessary ESHS impacts – Minor issues become major problems	– Appoint qualified professionals to oversee ESHS performance on the project – Provide for at least half-time attendance at site – PMC to communicate with Barqi Tojik on weekly basis on ESHS issues, submit written reports on ESHS performance on monthly basis – PMC to communicate with Barqi Tojik on weekly basis on ESHS issues, submit written reports on ESHS performance on monthly basis – Monthly progress meetings involving contractor, PM, Barqi Tojik – Barqi Tojik corporate staff to visit site unannounced at least monthly – Barqi Tojik HSE Department (corporate) to: - Schedule and participate in consultation meetings and informal interviews - Periodically consult with municipal and village authorities - Review grievance logs periodically – Maintain communications with important NGOs – Maintain communications with Committee for Environmental Protection	– PMC supervision of ESHS matters – ESHS compliance – Barqi Tojik project HSE staff and corporate HSE Department knowledgeable and up to date on ESHS performance – Barqi Tojik management well-informed of issues before they become problems	PMC Barqi Tojik (as noted)
6.2	Operating passenger and heavy vehicles	– Traffic accidents – Injury or death to drivers or passengers – Damage to pedestrians, other drivers and passengers, property – Liability to contractor and project	Implement Traffic Management Plan throughout construction – Trained and licensed drivers – Speed limits – Daily safety checklist (see row 3.2) – Passengers only in seats designed for persons (safety belts, etc.), no standing or riding in back of trucks or on equipment – No giving rides to public – Travel on planned routes through Nurek City	– Vehicles and equipment operated by authorized personnel – Safe vehicles and equipment – No traffic accidents – No injuries to drivers or passengers, no damage to property	Owner/ Operator of each vehicle: Contractor, PMC, Barqi Tojik
6.3	Completion of all construction works	Nuisance or injury to community	– Control noise by maintaining equipment and vehicles, training workers – Implement Code of Conduct to avoid worker interference with community affairs (GBV, disruption, etc.)	– Code of Conduct implemented – Minimal grievances due to nuisance and worker behavior	Contractor

No.	*Activities*	*Potential Adverse Impact*	*Mitigation Measures/ Best Management Practice*	*Target outcome of mitigation*	*Responsible body*
			–	– Work completed safety	
6.4	Stakeholder engagement and grievance management	– Uninformed stakeholders – Distrust of Barqi Tojik – Increased vandalism	– Barqi Tojik and Nurek HPP to implement Stakeholder Engagement Plan – PMC and/or contractor to notify local authorities of ongoing activities – Barqi Tojik implement stakeholder GRM, with support from PMC & Contractor: record, address, and communicate resolutions – Barqi Tojik, PMC, and Contractor implement own worker GRMs: record, address, and communicate resolutions – Barqi Tojik monitors PMC's worker GRM – PMC monitors Contractor's GRM	– Informed stakeholders – Public support – Grievances addressed and resolved	– Barqi Tojik & Nurek HPP – PMC – Contractor
6.5	Hazardous and nonhazardous waste and materials management	– Spills and contamination of soil and surface water – Extra cost due to wastage – Risks to workers	Implement Materials and Wastes Management Plan, including – Minimize use of hazardous materials, using nonhazardous substitutes wherever possible, reuse or recycle wastes/materials where possible – Store hazardous materials (including fuels) in secure area over impermeable surface – Material Data Safety Sheets to be kept at all locations where hazardous materials (including fuels, paints, lubricants) are stored or used – Allow only authorized and trained personnel to work with hazardous materials – Segregate used materials/wastes in categories to maximize ability to restore, reuse, recycle and minimize disposal – Dispose wastes in licensed disposal area or hire licensed hauler to take wastes to a licensed area (verified by contractor) – For hazardous wastes taken away by hauler, verify hauler's license and verify that final disposal/recycling location is properly permitted – Implement Asbestos Removal Plan – Use licensed haulers for waste removal	– Minimal spills and contamination, rapid and proper cleanup as needed – Proper and safe waste management, including third-party management	Contractor

No.	*Activities*	*Potential Adverse Impact*	*Mitigation Measures/ Best Management Practice*	*Target outcome of mitigation*	*Responsible body*
6.6	Vehicle and equipment fueling and maintenance	– Spills and contaminated soil or water – Fire	– Vehicle and equipment fueling and maintenance only over impermeable surfaces. Use drip trays when not over paved surface. – Fire extinguishers with proper chemicals in all vehicles/equipment and at all fueling locations – Spill cleanup kits at all locations where fuel and hazardous chemicals are stored and in all vehicles and mobile equipment – Vehicles maintained per manufacturers' recommendations: mufflers, safety equipment, engine and fuel burning (no black smoke), etc. – No fueling within 15m of open or moving water	– No contamination from incidents involving fueling – Vehicles maintained as required	Contractor
6.7a	Responses to emergencies	– Unsafe working conditions – Worker injury or death – Community member injury or death – Excess damage to property or people	Implement Emergency Preparedness and Response Plan for ongoing operations during construction phase. EPRP is to include: – Appointment of emergency response team(s) – Train workers in their responsibilities in case of emergencies and in responding – Identify possible emergencies and possible consequences (fire, accidents, injuries or deaths, earthquake or weather event, civil unrest, spills) – Consult with local fire brigades, police, civil authorities concerning emergency response capability – Develop and use checklists to verify readiness for emergencies – Place and maintain emergency response equipment (fire extinguishers, first aid kits, radios/communication devices, etc.) – Account for ongoing rehabilitation activities in close proximity to operational workplaces and for cooperation with contractor(s) – Conduct investigations/reviews to identify causes and avoidance measures following emergencies, including accidents – Update EPRP at conclusion of rehabilitation	– Emergencies avoided – Emergency equipment in place and ready if needed – Quick and effective responses to emergencies – Cooperation between contractor and Nurek HPP staff	Nurek HPP

No.	*Activities*	*Potential Adverse Impact*	*Mitigation Measures/ Best Management Practice*	*Target outcome of mitigation*	*Responsible body*
			– Plan/procedure for prevent accidental shutdown of more than one turbine, and for dealing with such accidental shutdown		
6.7b	Responses to emergencies	– Unsafe working conditions – Worker injury or death – Community member injury or death – Excess damage to property or people	Implement Emergency Preparedness and Response Plan for rehabilitation works. EPRP is to include: – Appointment of emergency response team(s) – Train workers in their responsibilities in case of emergencies and in responding – Identify possible emergencies and possible consequences (fire, accidents, injuries or deaths, earthquake or weather event, civil unrest, spills) – Develop and use checklists to verify readiness for emergencies – Place and maintain emergency response equipment (fire extinguishers, first aid kits, radios/communication devices, etc.) – Account for ongoing operations in close proximity to rehabilitation workplaces and for cooperation with Nurek HPP – Conduct investigations/reviews to identify causes and avoidance measures following emergencies, including accidents	– Emergencies avoided – Emergency equipment in place and ready if needed – Quick and effective responses to emergencies – Cooperation between contractor and Nurek HPP staff	Contractor

Table 31. Environmental and Social Monitoring Plan for Nurek Rehabilitation Project, Phase 2

Activity	*What*	*Where*	*How*	*When*	*Why*	*Who*
	(Is the parameter to be monitored?)	*(Is the parameter to be monitored?)*	*(Is the parameter to be monitored?)*	*(Define the frequency / or continuous?)*	*(Is the parameter being monitored?)*	*(Is responsible for monitoring?)*
All works and continuing in operation	Implement recommendations from Techno-Economic Study (see Appendix 1)					
All construction works	Technical progress and implementation of mitigation	Selected past and all current work areas	– Observations during normal activities – Inspections	Continuous or as necessary	Verify implementation of mitigation measures	PMC

Activity	*What*	*Where*	*How*	*When*	*Why*	*Who*
	(Is the parameter to be monitored?)	*(Is the parameter to be monitored?)*	*(Is the parameter to be monitored?)*	*(Define the frequency / or continuous?)*	*(Is the parameter being monitored?)*	*(Is responsible for monitoring?)*
	measures, compliance with Tajikistan ESHS law, World Bank ESF, and C-ESMP		– Monthly reports and incident reports			
			ESHS monitoring audit	First year of construction, once during construction, one further time during last year	– Verify implementation of C-ESMP – Identify needed modifications to C-ESMP	Third-party international consultant appointed by Barqi Tojik
			Inspections	At least weekly		
	Working conditions (equipment, tools, etc.) and workers (PPE)	All active work areas	Observations	During daily rounds (continuous)	– Verify implementation of OHS Plan – Verify safety of working conditions and workers – Provide guidance to supervisors and workers	Contractor supervisors & Safety Officers, PMC supervisors & ESHS specialists
			Inspections	At least weekly		Contractor safety/ESHS manager
	Worker and supervisor safety training	All active work areas	Records checks & interviews	Daily or as needed before beginning new work	Ensure workers are trained to work safely	Supervisor (foreman)
				Spot checks (at least once every site monthly)		Contractor safety/ESHS manager
Progress reports/ meetings	Technical progress and status of C-ESMP implementation: – Safety – Grievance management (workers and external stakeholders)	Project-wide	– Interviews with contractor ESHS & technical staff – Review monthly contractor and PMC ESHS reports – Review worker & stakeholder grievance registers – Workplace visits	Monthly	Verify technical progress and ESHS protection	Mandatory attendees: project management and ESHS managers/specialists of Barqi Tojik, Nurek HPP, PMC, contractor
Drivers and vehicle safety	Driver qualifications	Office	– Verify valid driver's license and operator's permit as required	– Before allowed to vehicles/equipment (at hiring)	Ensure drivers are licensed and trained	Contractor PM & safety manager

Activity	*What*	*Where*	*How*	*When*	*Why*	*Who*
	(Is the parameter to be monitored?)	*(Is the parameter to be monitored?)*	*(Is the parameter to be monitored?)*	*(Define the frequency / or continuous?)*	*(Is the parameter being monitored?)*	*(Is responsible for monitoring?)*
			– Check with traffic police if needed – Skills test as needed	– Annually thereafter		
	Mobile plant/ vehicle safety (horns, backup alarms, lights, tires, safety belts, fire extinguisher, cleanup kit, first aid kit, etc.)	All mobile plant in use	Inspect and complete checklist	Daily before first use	Minimize traffic accidents, protect workers and other drivers/pedestrians	Driver/operator
			Review checklists and vehicles	Spot checks: at least monthly for each vehicle		Contractor safety manager
Noise generation	Noise levels	Workplaces	Noise meters	Monthly at each type of workplace	Verify noise is within applicable standard or identify and implemented mitigation as needed	Contractor ESHS personnel
		Site boundary (bridge area and camps/storage areas)		Within 24 hours of request or noise complaint by worker or external party		
		At nearest residence if works are within 250m		Weekly, if work is ongoing within 250m of houses		
		All monitoring locations (as above)	Records review, spot checks with meter	Quarterly or as needed	Verify contractor is monitoring and controlling noise	– PMC during rehabilitation – Nurek HPP during operations
Ensuring adequate hygiene	Sanitation, water, etc.	Kitchens, break areas, toilets, accommodations, as appropriate	Inspections	Weekly	Verify amenities meet GIIP standards	Contractor PM and ESHS manager
	Toilets & potable water	Work locations	Observations	Daily during rounds	– Verify workers have potable water – Verify toilet facilities are available	Safety Officers and/or ESHS specialists, supervisors, managers
			Inspections	At least weekly		Contractor ESHS specialist and/ or safety officer

Activity	*What*	*Where*	*How*	*When*	*Why*	*Who*
	(Is the parameter to be monitored?)	*(Is the parameter to be monitored?)*	*(Is the parameter to be monitored?)*	*(Define the frequency / or continuous?)*	*(Is the parameter being monitored?)*	*(Is responsible for monitoring?)*
		Selected work locations	Inspections and records review	Monthly		PMC ESHS specialist
Worker grievance resolution	Contractor worker grievance register	Work sites and records offices	Review of register	Weekly	– Verify grievances are being recorded and resolved – Take action if they are not	Contractor HR manager and PM
	PMC worker grievance register					PMC ESHS manager
	Nurek worker grievance register					Nurek HPP ESHS/HR manager
	Barqi Tojik grievance register					PMC ESHS/HR manager
	Grievance handling and resolution		Review of selected grievances: Interviews of managers responsible for resolution and of complaining workers	Before monthly progress meeting during rehabilitation, at least monthly during operations	Verify grievances are being addressed properly	Contractor, PMC, Barqi Tojik: HR & ESHS manager
External stakeholder grievance resolution	Stakeholder grievance register	Contractor records office	Review of register	Weekly	– Verify grievances are being recorded and resolved – Take/Require action if they are not	Contractor and PMC HR & ESHS manager HR manager and PM
	Grievance handling and resolution	Community	Interviews of selected stakeholders who submitted grievances and with persons responsible for addressing	Before monthly progress meetings	Verify grievances are being addressed properly	Contractor & PMCESHS manager, social specialist/CLO
			Detailed review of registers and persons responsible for addressing grievances	Monthly	Verify grievances are being recorded and addressed	Barqi Tojik ESHS/HR manager
Stakeholder engagement	Worker behavior in communities	Community	– Reviews of grievance log – Interviews with community leaders	Quarterly	Determine need for training/dismissals/ etc.	Contractor HR manager, PM, social specialist/CLO
	Community satisfaction with project	Community	– Reviews of grievance log – Interviews with community leaders and local residents	Quarterly	Identify community issues	Social specialist, CLO

Activity	What	Where	How	When	Why	Who
	(Is the parameter to be monitored?)	*(Is the parameter to be monitored?)*	*(Is the parameter to be monitored?)*	*(Define the frequency / or continuous?)*	*(Is the parameter being monitored?)*	*(Is responsible for monitoring?)*
			– Stakeholder engagement meetings to provide information, receive feedback	Annually	Info community, identify issues	Barqi Tojik ESHS team

9.3 Incidents, Non-Conformances, and Corrective Actions

The Contractor will develop and implement a procedure to register, track, identify corrective measures document, and close violations of applicable ESHS requirements, including this ESMP and the Construction-ESMP. If monitoring observations, inspections, or reviews of records required by Table 31 reveal the Contractor or others are not complying with applicable requirements, including the Construction-ESMP, this will be documented and followed up until there are satisfactory responses and compliance. Instances of noncompliance with ESHS requirements will be addressed immediately or as soon as practicable, with response actions commensurate to the risk of the nonconformance (which could range from simple non-use of proper PPE to life-threatening misuse of equipment). All but the most minor will be documented, and repeat violations will always be documented. There should be a graduated system of penalties for workers who repeatedly violate ESHS requirements, including proper use of PPE, beginning with verbal warning, proceeding to written reprimand, and continuing through dismissal for repeated violations. Similarly, there should be a graduated system of penalties for supervisors and managers if there are repeated instances of safety or other violations or issues associated with work or workers under their supervision.

ESHS personnel must have the authority to order work to stop if serious breaches of safety or other ESHS requirements are observed that could lead to injury or property damage. In such a case, only the project manager and the ESHS personnel would have the authority to allow work to resume, and only then if the issue had been resolved.

In addition, workers may refuse to undertake a task if they are in fear of serious injury of death. In such a case, the supervisor and project manager must investigate and order appropriate action to reduce the risk or change the job.

9.4 Reporting

Reports by the PMC to Barqi Tojik and by the contractor to the PMC will be as required in the respective contracts. Monthly reports will include details of environmental, social, and health and safety performance, including at least the following, some of which may be in addition to what may be required by the contracts:

- Status of violations and corrective actions reported as outstanding in the previous month's report
- Summary of activities undertaken and completed in the previous month, including training
- Workforce: number of workers (PMC, contractor, and subcontractors), number local vs other Tajikistan vs foreign, number women and men, number of new hires, and number of terminations and reasons
- Summary of ESHS supervision actions: person-days by ESHS specialists, number of inspections, areas visited, etc.)
- Results of ESHS supervision actions: issues identified and actions taken (warnings or dismissals, stop work orders, requirements for safety equipment or new PPE, other actions)

- Description of environmental issues observed (spills, improper materials storage, improper waste management, etc.) and actions taken to bring into compliance
- Description of consultations with local authorities and local community members, including who participated, reasons, and outcomes
- Visits by authorities, Barqi Tojik PRG, World Bank, and others with oversight responsibility: reasons for visits and outcomes
- Summary of stakeholder grievances received during period and to date, number resolved during period and to date, and number outstanding. For grievances not resolved as of the end of the period, the report should provide a description of grievance, reason for lack of resolution, and actions to be taken.
- Summary of worker grievances (PMC, contractor, and subcontractor workers) received during period and to date, number resolved during period and to date, and number outstanding. For grievances outstanding over 30 days, the report should provide a description of grievance, reason for lack of resolution, and actions to be taken.

In addition to regular monthly reports, significant issues and events would be reported by the contractor to the PMC, by the PMC to Barqi Tojik, as soon as possible. Such issues and events would include severe injuries or fatalities to workers, any damage to private property or injuries to community members, significant spills or releases of hazardous substances, protests or incidents of unrest associated with the project, and other incidents specified in the respective contracts. Barqi Tojik will submit a quarterly report to the World Bank that summarizes EHSH performance on the Project. In addition, Barqi Tojik will report serious incidents, including severe injuries or fatalities, to the World Bank as soon as possible and follow up with detailed reports within two weeks.

9.5 Implementation and Cost

Barqi Tojik will oversee the Project Management Consultant, which will in turn review and approve the contractors' own management plans and then oversee the contractors to ensure that these companies, their subcontractors, and all workers are fully implementing the required mitigation measures during the preconstruction, construction, and demobilization phases. These measures include training for workers so they are familiar with their own personal responsibilities as well as their employers'. The first level of monitoring during construction will be conducted by the contractors in routine management of ongoing activities. This will be supplemented by nearly continuous monitoring by the Project Management Consultant.

In addition, there will be at least three (and more if determined by Barqi Tojik and/or the World Bank to be needed) third-party audits, including one immediately after Phase 2 begins, another during construction, and another before the contractors demobilize. During operations, there will be many fewer activities that could result in significant impacts, so monitoring will be less intense, with continual oversight by Nurek HPP and general performance monitoring conducted by Barqi Tojik and various government agencies, and periodic reviews by the World Bank, and more specialized monitoring conducted by safety specialists as needed. Nurek's organization is shown in Figure 27 – as can be seen, the Health, Safety, and Environment (HSE) Department reports to the Chief Engineer, who in return reports to the HPP Director.

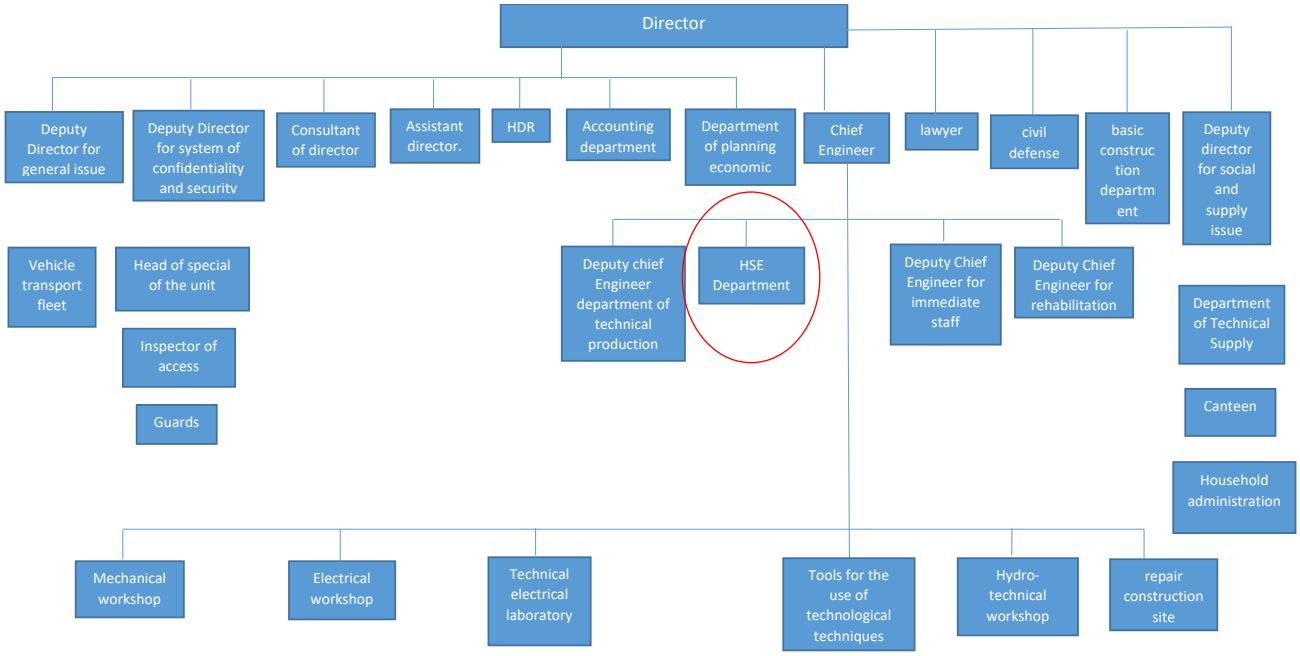


Figure 27. Organization of Nurek HPP

Staff and managers who will be responsible for overseeing implementation of the ESMP include the following:

- Barqi Tojik: one environmental manager (currently employed) plus consultants as needed
- Project Management Consultant: one subcontract consultant who is limited to less than one day per week. This will be supplemented by at least one full-time additional safety specialist, to be hired by Barqi Tojik or the Consultant, who will support the Consultant.
- Contractor: an expatriate Health, Safety, and Environment (HSE) manager and one local technicians/advisor[20]
- Subcontractor: two HSE inspectors, one local HSE support staff, and two local nurses
- Nurek HPP: four safety specialists[21] plus consultants as needed
- International consultants to conduct third-party audits: team of at least two ESHS specialists

The overall budget for implementing the requirements of the Phase 2 Environmental and Social Management Plan and Monitoring Plan is estimated to be approximately $1,500,000, or slightly less than one percent of the total Phase 2 project cost. This will include the following approximate costs:

- Barqi Tojik, Project Management Consultant, and contractor ESHS staff costs: $1,000,000

[20] Additional contractor/subcontractor safety staff will be needed during the height of construction, when there will need to be at least one safety officer for every 50 workers.

[21] It is considered likely that the initial audit by international consultants will recommend additional specialists for Nurek HPP so these are not included here.

- Third-party audits (assumes three audits by international consultancy): $120,000
- Annual consultations, including support by local consultants/NGOs (@$5,000 annually): $50,000
- Safety equipment, medical supplies, etc.: $250,000
- Materials and waste management: $75,000

Appendix 1

Recommended Actions for Dam Safety

Dam safety recommended actions

(Proposed by Tractebel Engineering to Barqi Tojik in the report "Techno-economic assessment study for rehabilitation of Nurek hydro power plant and dam safety provisions", Volume II Chapter 8 – "Recommended Actions and Cost Estimate")

Abbreviations: BT: Barqi Tojik TA: Technical Assistance by Engineering Consultant

Recommendation		*Reference*	*PFM Number*	*Priority*
Technical documentation				
TD1	Gather technical information on the dam and its monitoring system and updated condition of the monitoring system in a dedicated report.	CHAPTER 2		2
TD2	Secure the access to the main documents related to dam safety (gather all documents relevant for the Dam Safety in a specific file in paper and soft copy).	CHAPTER 2		2
TD3	Draw a set of modern synthetic drawings (AutoCAD or similar) of the dam and its appurtenant structures. The drawings should include the layout of the whole monitoring system. Autocad or similar with suitable computer equipment should be used by the Hydrotechnical Department for this purpose. Show on a drawing the actual water routing and check if there are redundancies (flows measured at several places).	CHAPTER 2		2
TD4	Create a digital database including all geological and geotechnical data. Efforts are necessary in a first step to recover the results of the investigations carried out at the design stage.	CHAPTER 5		2
Organization of the surveillance				
OS1	Name a competent and specialised entity providing continuous technical assistance for the surveillance of the dam and its appurtenant structures at Level 2 (Detailed yearly analysis of the monitoring data and after special events such as floods or earthquakes or unusual condition detected by visual observation or monitoring by specialists) and at Level 3 (5-year detailed analysis of the monitoring data, inspections and associated reports by Experts).	CHAPTER 2		1
OS2	Organize for the Team in charge of the dam surveillance a visit of a large dam with up-to-date surveillance organisation and monitoring system such as Birecik (Turkey)	CHAPTER 2		2

Recommendation		*Reference*	*PFM Number*	*Priority*
Electrical Supply of Dam, Water Intake and Spillways				
EL1	Establish a specific procedure mentioning the frequency and the conditions of periodic tests of the mobile generator located at the Water Intake. Barqi Tojik confirms that such procedure exists and is in application.	CHAPTER 2		Completed
EL2	Replace the Medium Voltage (MV) cables (6kV) of the 3 electrical loops which supply the spillways, the intake and dam equipment also with allowance for significant displacements due to strong ground motions.	CHAPTER 2 CHAPTER 7	N3, F1, E3	1
EL3	Install a new diesel generator on top of Spillway Intake (or in the Bottom Spillway Gate Chamber?)	CHAPTER 7	E3	2
EL4	Replace transformers and electrical cubicles which allow to supply and control water intake equipment, spillways equipment, and dam equipment.	CHAPTER 2		2
Hydro-electromechanical Equipment of dam tunnels				
HE1	– Make available the procedure of Surface Spillway radial gates operation, tests and maintenance	CHAPTER 7	N7	1
HE2	– Go on with maintenance and tests and associated records of Bottom and Surface Spillway radial gates.	CHAPTER 7 CHAPTER 2	N9, N7, N2	1
HE3	– Install emergency drainage pumps for the concrete plug of the dam	CHAPTER 7	N3	1
HE4	– Install a new alarm with transmission to the HPP control room signaling drainage pumps of the dam are not functioning	CHAPTER 7	N3	1
HE5	Install sensor detecting high water level in the manholes gallery (with lower penstocks access covers) with an alarm transmitted to HPP control room	CHAPTER 7	N8	1
HE6	Install equipment to give the possibility to manually open the radial gates of Surface Spillway in case of emergency with no electrical supply.	CHAPTER 2		1
HE7	Install equipment to give the possibility to manually open the radial gates and emergency gates of Bottom Spillway in case of emergency with no electrical supply.	CHAPTER 2		1
HE8	Establish detailed maintenance program for hydro-electromechanical equipment and keep record of maintenance works performed. Barqi Tojik confirms that such procedure exists and is in application.	CHAPTER 2		Completed
HE9	Continue keeping record of all tests carried out with the hydro-electromechanical equipment.	CHAPTER 2		2
HE10	Replace the electrical hoists and replace the lifting cables of radial gates of Surface Spillway	CHAPTER 2		2
HE11	Rehabilitate the gantry crane of Surface Spillway	CHAPTER 2		2

Recommendation		*Reference*	*PFM Number*	*Priority*
HE12	Rehabilitate hydraulic servomotors of emergency gates and radial gates of Bottom Spillway and replace their hydraulic power units	CHAPTER 2		2
HE13	Replace electrical hoist of maintenance gate of Bottom Spillway	CHAPTER 2		2
HE14	Replace the pumps of the two drainage stations with their electrical equipment (level sensors, electrical cabinets…)	CHAPTER 2 CHAPTER 7	N3	2
HE15	Implement the possibility to operate the intake gates from the HPP control room	CHAPTER 2		2
HE16	Rehabilitate the electrical hoist of intake gates and replace the lifting cables	CHAPTER 2		2
HE17	Install a level sensor with a permanent transmission of the water level to the HPP control room	CHAPTER 2		2
HE18	Perform detailed inspection of lower penstocks covers and covers rehabilitation.	CHAPTER 7	N8	2
HE19	Replacement of the HPP drainage pumps (with spare pumps)	CHAPTER 7	N8	2
HE20	Possibility to close intake gates from the HPP control room in case of emergency	CHAPTER 7	N8	2
Monitoring instruments				
MI1	Get two new reading devices to secure the reading of the vibrating wire sensors in case the one used today gets broken. This recommendation is valid even if the automation of the monitoring system is considered (in order to keep a possibility of reading the sensors manually).	CHAPTER 2		1
MI2	Global diagnosis of the VW sensors and piezometers to be carried out by a specialized company, followed by repair works whenever possible (clean plugged piezometers, maintain twin tubes, calibrate doubtful manometers).	CHAPTER 2 CHAPTER 4		2
MI3	– Complete monitoring of water table in foundation – Replace some piezometers in the foundation under the core D/S grout curtain and add new ones from the galleries inside the plug or the grouting galleries. – Add some piezometers in the foundation under the downstream shoulder from tunnels 6-TC and 8-TC. – Reinforce the grid of piezometers in the banks for a closer monitoring D/S the grout curtain/axis of dam and further D/S.	CHAPTER 7 CHAPTER 4 CHAPTER 4 CHAPTER 4	A4, A5	2
MI4	Periodically calibrate the manometers.	CHAPTER 2		2
MI5	Replace the 3 inverted pendulums out of order in the Power Intake Tower. Resume monitoring and enter the data in the database.	CHAPTER 7 CHAPTER 4	N1	1

Recommendation		*Reference*	*PFM Number*	*Priority*
MI6	Monitor the largest reservoir rim landslides. In particular, resume monitoring of reservoir rim landslide areas no. 6, 9, 13 and 14 (monitoring stopped in 1989, characteristics of clayey siltstones of no. 9 not studied). Study and monitor new instabilities triggered after the survey carried out in 1977-1978.	CHAPTER 7 CHAPTER 5	N4	2
MI7	Improvement of monitoring of the downstream slopes and spillway tunnels: Inclinometers across the sliding plane and piezometers, automated 3D crack sensors in spillway and transport tunnels. Monitor the landslides with alarms and protocols for different alert levels such as an alarm when the displacements of 3D crack sensors reach a given speed.	CHAPTER 7 CHAPTER 4 CHAPTER 2, CHAPTER 5	N5	2
MI8	Add benchmarks in the potentially unstable zones on Left and Right Banks DS the dam Resume monitoring of possible unstable zones DS the dam, Store the data in the database.	CHAPTER 4		1
MI9	Upgrade seismic monitoring with new digital 3D-accelerometers.	CHAPTER 3		2
Monitoring measurements				
MM1	Continue monitoring of core with special attention to profiles P0, P4, P5, P11, P25, P27, P14 to P18.	CHAPTER 7	A1	2
MM2	Regularly weight and analyse deposits of upstream weirs in dam and plug to detect core erosion. Store the information in the database. OS?	CHAPTER 7 CHAPTER 2	A1	2
MM3	Reassess the capacity of weirs and measuring conditions. If necessary, replacement of weirs and measuring tools.	CHAPTER 2		2
MM4	Measure the discharge at each significant leak or drainhole.	CHAPTER 4		2
MM5	Keep gathering more geodetic data for Water Intake and Surface Spillway and collect those more often (at least once a year) so as to get longer time series of reliable data to confirm the drifts.	CHAPTER 4		2
MM6	Resume the monitoring with the jointmeters of the Water Intake.	CHAPTER 4		2
MM7	Carry out periodic checks of the differential displacement which could lead to the jamming of the gates of Water Intake and Surface Spillway.	CHAPTER 4		2
MM8	Continue surface monitoring of geodetic targets over the downstream slope area.	CHAPTER 7 CHAPTER 5	N5	2

Recommendation		*Reference*	*PFM Number*	*Priority*
MM9	– Develop complementary functionalities to the monitoring database: Collecting the data on a pre-defined frequency, Reading the remote sensors on demand, Validating the collected data, Comparing with limit values, Adding new sensors, Defining pre-programmed graphs, Adding drawings (plan views, horizontal cross sections, vertical profiles) showing location of sensors and the corresponding monitoring data, Tools for monitoring analysis: assessment of effective stress, hydraulic gradient, drawing of isolines, statistical tools, etc. – Panda database being no more developed by EDF, change for another monitoring database with the above functionalities.	CHAPTER 4		2
MM10	Store all monitoring data in the database	CHAPTER 4		2
MM11	Following sensors could be automated: a choice of wire sensors, main weirs for seepage flows, upstream and downstream water levels, new Vibrating Wire piezometers, and the monitoring - with alarm - of triangular block landslide shearing the Bottom Spillway tunnel.	CHAPTER 4		2
Visual Observation				
VO1	Regular inspections of Surface Spillway chute to detect large rocks falls possibly blocking the chute	CHAPTER 7	N6	1
VO2	– Regular inspections of reservoir rim landslides and analysis of recent aerial images. – Inspections of reservoir rim landslides after heavy rains, snow melting and earthquakes.	CHAPTER 7	N4	2
VO3	Go on with visual observation of the worn out joint No. 7 of gallery II.	CHAPTER 2		2
VO4	Regularly inspect the aeration ducts of Surface and Bottom Spillways and keep them in working order.	CHAPTER 7	O5	1
VO5	Regularly inspect the inside of Spillways hydraulic tunnels and chutes to detect sign of cavitation and damage to lining of concrete. Repair if needed.	CHAPTER 7	O5	2
Investigations and surveys				
IS0	Perform detailed inspection of Surface and Bottom Spillway tunnels to assess condition of lining. *This inspection (which could not be carried out so far by the Consultant) is of utmost importance considering the high speed of the flow and the risk of cavitation and in the fracture area crossed by the sliding plane.*	CHAPTER 7	N5	1
IS1	Find documentation of construction of the dam to assess the risk of internal erosion of core due to inadequate filter	CHAPTER 7	A1	1
IS2	Check the top elevation of the core near the banks	CHAPTER 7	F2	1

Recommendation		*Reference*	*PFM Number*	*Priority*
IS3	Search for detail drawings of the core galleries I and II and its construction joints (and mechanical characteristics).	CHAPTER 7 CHAPTER 2	A6	1
IS4	Assess the discharge capacity from drainage tunnels to Bottom Spillway hydraulic tunnel	CHAPTER 7	A7	1
IS5	Core drilling and laboratory testing to check concrete swelling of Intake Tower, Surface Spillway Intake and Power House around discharge gates.	CHAPTER 7	N1, N2, A8	1
IS6	Search for the initial calculation note of Surface Spillway radial gates and hoisting systems.	CHAPTER 7	N7 N9	1
IS7	Continue regular inspections of the manholes gallery (with lower penstock access covers) to detect possible water ways between gallery and HPP	CHAPTER 7	N8	1
IS8	Perform a bathymetry of reservoir and assess impact of sedimentation on ability to pass the floods	CHAPTER 7	O1	1 – in progress
IS9	Perform detailed inspection of Surface and Bottom Spillway radial gates, hoisting mechanism and covers of bottom gate chamber.	CHAPTER 7	N9	1
IS10	Assess the compaction of core behind galleries I and II through geophysical survey (sonic)	CHAPTER 7	A2	2
IS11	Investigate (on drawings) the possibility for the water of going inside the core through the penetration sleeves seen in the Gallery II (855) and in other core galleries if any.	CHAPTER 2		2
Engineering Studies				
ES0	Investigate and assess Glacial Lake Outburst Floods (GLOFs) based on glacial lakes 'inventory and analysis of GLOF's hydrographs	CHAPTER 7	F5	1
ES1	Simulation of flood routing without any turbined flow to assess for which return period the core is overtopped	CHAPTER 7 CHAPTER 7	N1 E2	1 1
ES2	Simulate the scenario to check the ability to pass floods without Bottom Spillway.	CHAPTER 7	E8	1
ES3	– Define a rule curve based on simulations to reduce the risk of overtopping the dam for a flood exceeding 1/10000 flood. – Before flood period, lower the reservoir water level to anticipate compensation for loss of discharge capacity in case Surface Spillway gates are jammed. – May need to reduce the reservoir level to reduce risk of overtopping in post-earthquake condition. – Assess the risk of a flood occurring mid-July.	CHAPTER 7	F2 N2 E4, E5, E7, E8	1

Recommendation		*Reference*	*PFM Number*	*Priority*
ES4	Enhance the flood forecasting	CHAPTER 7	F2	1
ES5	Investigate spillway options for an additional spillway	CHAPTER 7	F2	1
ES6	Update assessment and inventory of landslides on the reservoir rim in order to determine the maximum height of waves.	CHAPTER 7	N4	1
ES7	Perform stability calculations of slopes possibly shearing or blocking Bottom Spillway tunnel and chute in normal and seismic condition	CHAPTER 7	E8, N5	1
ES8	Check Surface Spillway radial gates design taking into account the current thickness and hoisting mechanism. Check Bottom Spillway radial gates design.	CHAPTER 7	N7, N9	1
ES9	Check the compatibility of filter material with core material and with shoulder material.	CHAPTER 7	A1, A3	1
ES10	Assess the limit gradient possibly leading to erosion of dam foundation	CHAPTER 7	A4, A5	1
ES11	Check the maximum admissible deformation (opening and shear) of seals of core galleries 1 and 2	CHAPTER 7	A6	1
ES13	Assess rise of RWL due to Rogun cofferdam break	CHAPTER 7	F3	1
ES14	– Update seismic hazard assessment	CHAPTER 7	E4, E5, E7, E8	1
ES15	– Check seismic design of dam, seismic belts and internal concrete elements (core galleries, plug) including settlement of dam.	CHAPTER 7	E4, E5, E7	1
ES16	Communication procedure to set up between Rogun and Nurek during Rogun construction	CHAPTER 7	F3	2
ES17	Communication procedure between Rogun and Nurek during Rogun operation	CHAPTER 7	F4	2
ES18	Adapt Nurek Emergency Action Plan during Rogun construction	CHAPTER 7	F3	2
ES19	Adapt Nurek Emergency Action Plan once Rogun in operation	CHAPTER 7	F4	2
ES20	Update the assessment of the stability of the foundation in the switchyard area.	CHAPTER 5		2
ES21	Study Nurek dam break wave propagation through 1D and 2D modelling. Draw flood inundation maps based on the results. This constitutes a necessary input of the Emergency Preparedness Plan	EPP		2

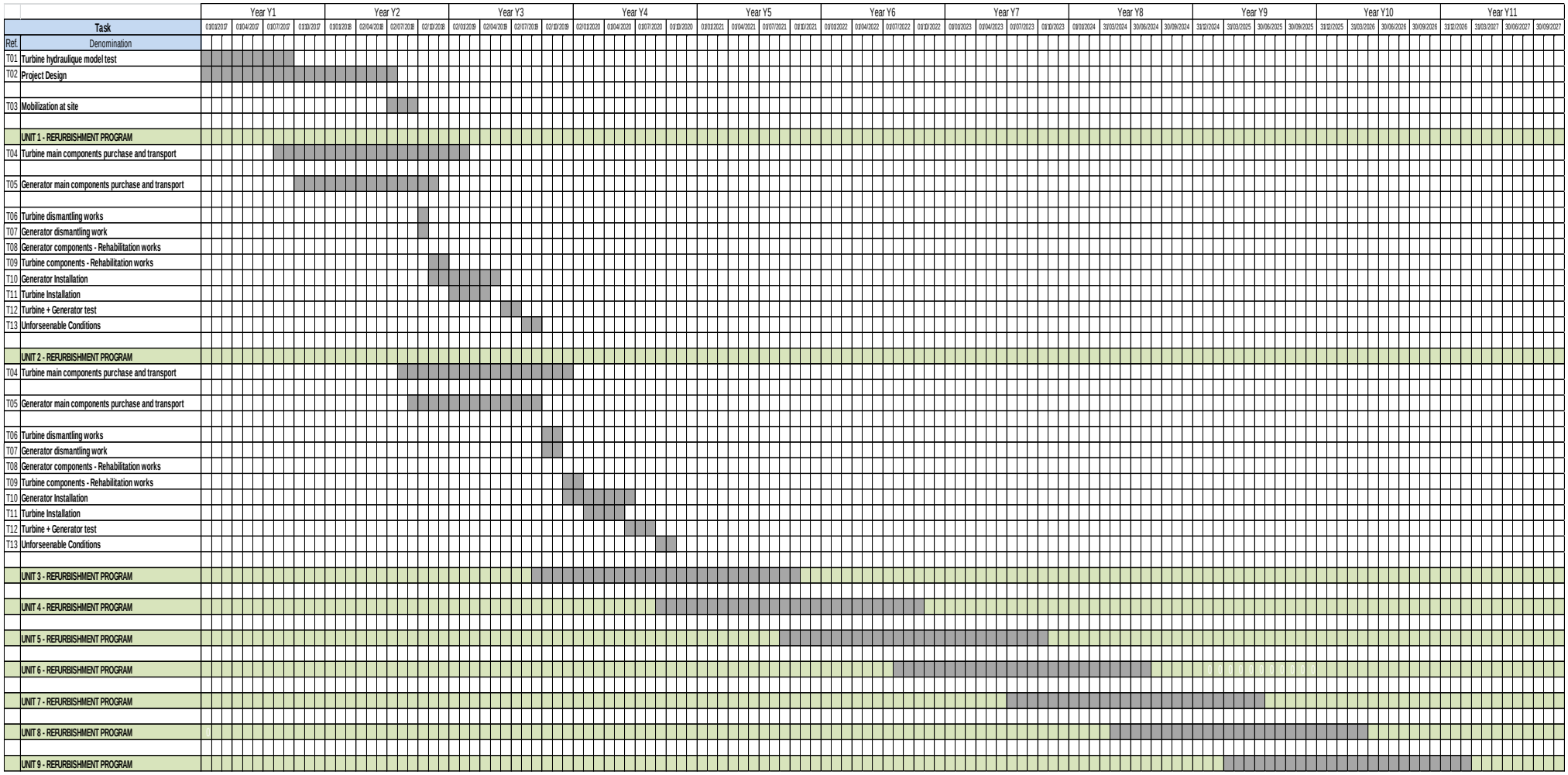
Recommendation		*Reference*	*PFM Number*	*Priority*
ES22	If deemed necessary by Barqi Tojik after analysis, name a competent Technical Assistant for the implementation of the Emergency Preparedness Plan following the indications of the present report.	EPP		2
Reservoir Operation				
RO1	Operate the reservoir at FSL 910 (no higher level)	CHAPTER 7	N7	1
RO2	Clarify procedure for operation in flood condition	CHAPTER 7	F1	1
RO3	Use when possible the Surface Spillway as the priority spillage option to control the risk of triggering "Triangular block" landslide shearing the Bottom Spillway tunnel and filling the tailrace under normal conditions	CHAPTER 7	N5	1
RO4	Keep the rate of drawdown between 0.5 and 1 m a day depending on the reservoir water level to control the risk of reservoir rim landslides	CHAPTER 7	N4	2
Works				
WO1	Flexible/durable sealing of damaged area of the Bottom Spillway tunnel lining	CHAPTER 7	N5	1
WO2	Install rocks falls protections above the Surface Spillway outlet	CHAPTER 7	N6	1
WO3	Remove the fallen rocks near the side walls of the Surface Spillway outlet	CHAPTER 7	N6	1
WO4	Remove the added upper part of Surface Spillway radial gates	CHAPTER 7	N7	1
WO5	Clean all the tunnels and galleries from the mud of May 2014, and in particular: tunnel 1-T, transport tunnel to 4-TC, Tunnel 4-TC, gallery I (765), tunnel 5-TC.	CHAPTER 2		1
WO6	Drainage galleries across the fracture of the Bottom Spillway	CHAPTER 7	N5	2
WO7	– Extend the concrete roof and side walls of the Surface Spillway outlet. – In the meantime, take away the rocks fallen in the Surface Spillway chute and replace the damaged ventilation shafts in case of rockfall.	CHAPTER 7	N6	2
WO8	Have scrapers ready to remove the materials slid from the tailrace channel in post-earthquake condition to limit time during which HPP is stopped.	CHAPTER 7	E1	2
WO9	Remove the bad quality concrete and the water at the Right Bank side of the gallery II and redo the work.	CHAPTER 2		2
WO10	Increase the discharge capacity of the channel in tunnel 2-TC.	CHAPTER 2		2
WO11	Improve water tightness of the passages for cables and tubes (twin tube piezometers) into the galleries.	CHAPTER 2		2

Recommendation		*Reference*	*PFM Number*	*Priority*
Access and security of staff				
AS1	Secure the access to the spillways outlets by cleaning the road from the slit materials as often as needed	CHAPTER 2		2
AS2	Replace the rock fall protections on both banks over the downstream shoulder	CHAPTER 2		2
AS3	Install proper lighting in all tunnels and galleries.	CHAPTER 2		2
AS4	Install proper aeration where required. In particular: – In the tunnels and small tunnels of the plug: 7a-C, 6-C, 6a-C, 6b-C, 8-C, 8a-C, 8b-C, U/S, central and D/S small tunnels, junction tunnel in the plug and D/S small tunnel with exit of seepage (weirs B-3 PAN, B-4 PAN and B-5 PAN). – In tunnel 5-TC – In tunnel 9-TC in the Right Bank (not visited). – In Galleries II and I	CHAPTER 2		2
AS5	Install stairs with proper railing in the tunnels descending to the concrete plug.	CHAPTER 2		2

Appendix 2

Rehabilitation Project Work Schedule

Project refurbishment work schedule*



*In this table, refurbishment tasks for unit 3 to 9 are the same as for turbine 1 and 2