

Report on

**3rd Riparian Information-Sharing and Consultation
Process on the Assessment Studies of the Proposed Rogun Hydropower Project**

January 18 – March 4, 2013
World Bank Regional Office, Almaty, Kazakhstan



Prepared by

Europe and Central Asia Region

World Bank

In partnership with the Independent Engineering and Dam Safety and Environment/Social Panels of
Experts for the Rogun Assessment Studies

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Acronyms

EDS	Engineering and Dam Safety
EDS-PoE	Engineering and Dam Safety Panel of Experts
ES-PoE	Environmental and Social Panel of Experts
ESIA	Environmental and Social Assessment
HPP	Hydro Power Plant
ICOLD	International Commission on Large Dams
MCE	Maximum Credible Earthquake
OBE	Operating Base Earthquake
TEAS	Techno-Economic Assessment Study
ToRs	Terms of Reference
PoE	Panel of Experts
PMF	Probable Maximum Flood

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EXECUTIVE SUMMARY

On February 11 and 12, 2013, the World Bank facilitated the third information-sharing and consultation meetings as part of a six-week comment period on preliminary findings of the Techno-Economic Assessment Study (TEAS) and Environmental and Social Impact Assessment (ESIA) for the proposed Rogun Hydropower Project (HPP) at its regional offices in Almaty, Kazakhstan. These meetings are the latest in a series held at key milestones in the assessment process, the purpose of which is to share interim findings of the ESIA and TEAS with the governments and civil society of the Amu Darya Basin countries, and to get their feedback and comments.

The draft Hydrology Report and the draft Geological Investigations Report, two of the building blocks of the TEAS, were disclosed by the Government of Tajikistan and the World Bank on January 18 and presented for review and discussion. In addition to these reports, the meetings discussed updates of findings on seismicity, Vakhsh River Cascade simulations, site geology, layout of dam height alternatives, and cost comparisons of resettlement and infrastructure for various dam height options. The disclosed reports as well as the presentations made in Almaty are publicly available on the Bank's website at www.worldbank.org/eca/rogun. The comment period on the disclosed documents ran from January 18 to March 4 and included comments delivered verbally at the meetings, via email, or mailed to the World Bank Country Offices.

The February consultation meetings were organized around the three areas of riparian concern: water management, dam safety, and alternative project configurations. Riparian participants, both during the meetings and throughout the comment period, identified a number of important issues for the assessment studies. On water management, riparians highlighted the importance of confidence in the hydrologic data and inquired on: the rationale behind the revised flood management measure; the potential impact of climate change on water patterns; and the range of potential downstream impacts. On dam safety, discussions covered a variety of topics on site geology including the suitability of the proposed site and whether alternative locations were considered. Riparians also raised questions over potential risks of landslides and reservoir induced seismicity, amongst other concerns. On alternatives, discussions centered on differences in resettlement of alternative proposed project configurations.

While the meetings underscored the need for additional investigations in a number of areas (e.g., salt wedge, existing works), the dialogue and initial investigations presented during the meetings suggested the following:

- A geological and tectonic model has been developed by the consultants which is supported by detailed data and considered acceptable and reliable by the Independent Expert Panel on Dam safety and Engineering. On site suitability, the Panel affirmed the preliminary conclusion of the consultants that the site appeared to be broadly suitable and geologic concerns do not appear

to pose a risk to project feasibility, while again noting some geologic questions would require further investigation as part of detailed design. The consultants considered other locations but concluded that areas further upstream appeared to have less favorable geologic conditions and areas downstream bordered too close on the Nurek reservoir.

- The current seismic parameters for design have been based on a *deterministic* approach which is considered to be sufficient for the present assessment: assessing feasibility and comparing alternative dam heights. A *probabilistic* seismic hazard assessment would be required for the detailed design stage, and is important to determine the parameters of the Operating Base Earthquake (OBE) and to validate input parameters for the Maximum Credible Earthquake (MCE).
- Sufficient hydrological and seismic data exist with which to continue the studies at this stage.
- The Probable Maximum Flood (PMF) has been estimated and experts reaffirmed the appropriateness of adopting this design criterion for flood management as a recognized modern international standard for dam safety. Costs to meet this level of safety will be estimated and will be included in the economic analysis.
- The potential impoundment of Rogun would be expected to cause reservoir triggered seismicity (RTS), as this is a standard feature of reservoir impoundment. However any such seismicity should be below the seismic design criteria: namely, MCE. Information collected on Nurek regarding the impact of rates of reservoir filling on RTS would be taken into account when developing the project implementation schedule. Also, it was recommended to develop the RTS monitoring system so that the monitoring could start in advance of the construction works.
- Riparians emphasized the importance of assessing and monitoring potential downstream impacts from the proposed Rogun HPP. This is an important component of the assessment process and will be addressed in the ESIA. The Panels of Experts noted that impact assessment should consider environmental, social and economic implications of potential changes in flow.
- Concerns over the potential for a large-scale landslide downstream of the dam are not supported by the results of additional site investigations carried out as part of the assessment studies.
- There are significant cost differences in terms of resettlement and infrastructure across alternative project configurations (particularly dam height); estimation of these costs is being carried out for the project's economic study. Further comparison of alternatives should identify potential differences in the range of economic, environmental and social impacts.

The assessment studies are ongoing and additional consultation and dialogue with riparian stakeholders will be carried out. The ESIA and TEAS consultants are continuing analyses for their respective assessments, including outstanding issues such as the salt wedge, existing works, and resettlement action plan. As such, no conclusions on the proposed project can be drawn at this time. Subsequent disclosure and information-sharing will be held in October 2013 on dam safety issues, followed by a final set of consultations when the TEAS and the ESIA reports are fully drafted.

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I. Introduction and Background

On February 11 and 12, 2013, the World Bank facilitated the third information-sharing and consultation meetings on the Techno-Economic and Environmental and Social Assessment Studies for the proposed Rogun Hydropower Project (HPP) at its regional offices in Almaty, Kazakhstan. These meetings are the latest in a series held at key milestones in the assessment process, including meetings on the draft Terms of Reference held in 2008/2009, the first riparian information-sharing and consultations held in May 2011 on the consultants' inception reports, and the second riparian information-sharing and consultations held in November 2012 on the Environment and Social Assessment (ESIA) screening report and interim reports of the Techno-Economic Assessment Study (TEAS).¹ Subsequent meetings will be scheduled for the completion of the full draft reports (see section VI of this report).

The Bank is committed to 1) ensuring the application of international standards for safety, quality, and transparency in the assessment process and 2) facilitating good practice in information-sharing and riparian dialogue. Support for the Assessment Studies does not imply that the Bank will finance the proposed project in the future. As noted in earlier consultations, the Assessment Studies are one of many factors in the discussion on the future of the proposed Rogun HPP.

The purpose of the third meetings was to share the interim findings of the ESIA and TEAS with the governments and civil society of the Amu Darya Basin countries, and to get their feedback and comments. The draft Hydrology Report and the draft Geological Investigations Report, two of the building blocks of the TEAS, were presented for review and discussion. In addition to these reports, the meetings discussed updates of findings on seismicity, Vakhsh River Cascade simulations, site geology, layout of dam height alternatives, and cost comparisons of resettlement and infrastructure for various dam height options. The Government of Tajikistan and the World Bank disclosed the draft reports in English and Russian three weeks before the 3rd riparian meetings and these documents as well as the presentations made in Almaty and written comments from the Government of Uzbekistan are publicly available on the Bank's website at www.worldbank.org/eca/rogun. Comments were accepted until March 4, 2013, via email or mailed to the World Bank Country Offices.

The consultation process provides information on key aspects of the assessment studies. These are interim reports and findings that are shared to obtain early comments for influencing and improving the studies. These interim findings will be combined into comprehensive TEAS and ESIA reports.

¹A Report on these meetings, which also includes an overview of the Riparian process and the Bank's engagement was produced in December 2012 and can be found at: http://siteresources.worldbank.org/ECAEXT/Resources/ENG_2nd-Rogun-Riparian-Consultation-Report_final.pdf

On February 11, riparian government representatives from Afghanistan, Kazakhstan, the Kyrgyz Republic, Tajikistan, and Turkmenistan discussed various aspects of the proposed project and its potential impacts, and on February 12, more than 55 civil society organizations participated in the discussion by a video-conference between Almaty, Astana, Bishkek, Dushanbe, Kabul, and Tashkent. At both meetings, written comments from the Government of Uzbekistan were shared and discussed among participants, including the independent experts. The Bank also briefed representatives of the donor organizations and diplomatic community in Central Asia on the latest findings of the assessments and the outcomes of the riparian information-sharing meetings.

The meetings provided an opportunity for riparian governments and civil society representatives to interact with two international firms conducting the TEAS and the ESIA, with members of two independent Bank-funded Panels of Experts (PoEs)² that are providing additional oversight to the studies, and with World Bank experts. It should be noted that neither the World Bank nor the two independent PoEs have expressed an opinion on the techno-economic and socio-environmental viability of the proposed project, and such expert opinions as have been expressed relate solely to the technical aspects of the ongoing studies. The participation by stakeholders in previous rounds of discussions has benefited the assessment process and the comments and suggestions received have been considered by the PoEs who have shared recommendations with the Government of Tajikistan and the consultants, to be integrated in subsequent stages of the studies.

This report is organized around the three areas of riparian concern discussed through the February 2013 meetings: water management, dam safety, and alternative project configurations. Table 1 summarizes riparian issues and their coverage in the riparian information sharing and consultation process initiated in May 2011.

Issue	Previously discussed	January/February 2013	In progress
Dam safety (including catastrophic risk)	Design criteria Overview of geology, salt dome	Right bank stability Draft geology report Seismic risk methodology	Salt dome (Phase 0 report) Existing works (Phase I report) Flood management Seismic hazard estimates
Water management	Overview of hydrology	Draft hydrology report Vakhsh cascade model (methodology and flow constraints)	Cascade model simulations Flow impacts downstream Flood management
Resettlement	ESIA screening report		Social audit Resettlement action plan Resettlement policy framework Resettlement & Infrastructure Replacement Costs
Environment	ESIA screening report		Impact assessment Environmental management plan Resettlement & Infrastructure Replacement Costs
Alternatives	Site description	Site layout Project configurations Resettlement comparison	ESIA report Phase II report

²An Engineering and Dam Safety Panel (EDS-PoE) and an Environmental and Social Panel (ES-PoE) for the ESIA.

Water management includes considerations of climate change as well as the hydrological profile and characteristics of the proposed site and potential downstream impacts. On dam safety, a number of issues were raised; some were reviewed in this set of consultations (site seismicity and geological risks including the potential for landslides); others are undergoing further investigation and will be shared in future consultations. In the third area, a set of dam heights and capacity alternatives were presented and infrastructure and resettlement cost differences were introduced. On alternatives, riparians were mainly interested in confirming that the hydrologic modeling takes into account the different alternatives.

Sections II, III, and IV of this report provide brief descriptions of these main issues discussed and the questions raised. Section V contains the PoEs' recommendations to the Government of Tajikistan, integrating the opinions of, and discussions with, stakeholders. Section VI summarizes main results and outlines next steps. Annex A provides the agenda of the meetings, and a more detailed matrix of questions and responses is provided in Annex B. A transcript of the discussions on February 12 is available on the Bank's website (www.worldbank.org/eca/rogun).

II. Water Management

The first component of the February 11/12 riparian meetings focused on issues related to Water Management and, in particular, on (i) the draft Hydrology report (disclosed on January 18, 2013); and (ii) the methodology and assumptions for the Vakhsh Cascade Simulations. These discussions built on the overview of hydrological issues presented at the November 2012 riparian meetings. The key findings and methodologies presented and questions discussed at the meetings are summarized below.

Hydrology

The Hydrology Report is an important input for both the TEAS and ESIA. Participants emphasized the importance of obtaining a high degree of confidence in the conclusions of the Hydrology Report. The consultants reported that the available hydrologic data is sufficient (in terms of amount and quality) to continue studies of project feasibility, risk assessment and feasibility-level design. This was confirmed by the PoEs.

Hydrological safety is of utmost importance when examining the proposed project. As discussed during the November 2012 Riparian meetings, the Probable Maximum Flood (PMF) has been adopted as the appropriate design criteria for purposes of extreme flood management. At the February meetings, the consultants estimated the PMF at $7770 \text{ m}^3\text{s}^{-1}$ as the daily average³ and at $8160 \text{ m}^3\text{s}^{-1}$ as the peak flow. Significant discussion surrounded the rationale behind adoption of this measure and its implications for project design and safety.

The PoE and World Bank confirmed that the PMF is accepted as international good practice, based on the standards of the International Commission on Large Dams (ICOLD). It is considered an appropriately conservative estimate in order to assure dam and downstream safety. The economic assessment will include costs of the engineering measures needed to meet this flood⁴ which will in turn inform the conclusions of the TEAS.

Several participants raised questions regarding the potential impact of climate change on hydrological conditions for the proposed project. In response, it was noted that assessment of potential climate change impacts indicates that the most likely scenario is a gradual decrease in flood peak volumes because of earlier and longer melt seasons linked to increased temperature and glacier retreat. This confirmed that the value of PMF chosen independently to this expected trend is conservative as peaks could be expected to decrease in future. Appropriate climate change adaptation measures would need to be taken, including expansion of monitoring systems and implementation of early flood forecasting systems.

Vakhsh Cascade Simulations

Riparians emphasized the need for full analysis of the potential impacts on river flows downstream of the proposed project. Developing such an understanding is a critical component of the ESIA assessment, coordinating with the TEAS consultant's Vakhsh Cascade model to identify expected base flows. The ESIA consultants will then augment that analysis to identify potential risks and opportunities for flow

³ This value is within 5% of Hydroproject Institute Moscow's recent estimate.

⁴ The original design flood, using accepted standards of that time, was estimated at $5,400 \text{ M}^3/\text{s}$.

management, and associated environmental and social impacts in downstream communities under a variety of hydrologic and operational situations, both during filling of the reservoir and during operations. This process started during the February consultations with the presentation of methodology and boundary conditions.

The Vakhsh Cascade model used in the TEAS analysis will simulate filling and operations to assess potential energy generation under a variety of scenarios. This model will impose operational constraints so that flows are consistent with historical flows regulated and provided for under the Nukus Declaration and Protocol 566 regarding annual allocation of flows among countries. In addition, flow patterns (seasonality) would reflect the pattern of flows that have existed over the past 20 years, during both operations and filling. Two scenarios will be explored: current exercise of Protocol 566 allocations; and, as a base case, full exercise of Tajik allocations under the Protocol (stated by the Government of Tajikistan to be approximately 1^9 m^3 more than current withdrawals). The consultants indicated that the pace of potential reservoir filling is also constrained by dam safety and other engineering constraints.

The PoEs supported the design of the model but added that more analyses are required, including the impact of sedimentation. It was also advised that the model: (i) be expanded to assess operating rules in a multi-objective approach and under different flows conditions in order to better consider non-power issues such as flood and drought management benefits and irrigation downstream; and (ii) explore dry years and worst case scenarios for the downstream countries. Riparians emphasized the importance of assessing/monitoring downstream impacts in a comprehensive manner, covering environmental, social, and economic concerns and fully exploring potential scenarios. The Bank concurred that this aspect is required. On the Nukus Declaration and Protocol 566, the ES-PoE recommended that a more detailed examination of international legal obligations be undertaken to seek clarity on the application of broad commitments.⁵

Riparians also raised concern over the proposed reservoir's impact on hydrologic patterns and of the project's impact on the quality of water downstream. The proposed Rogun Reservoir would accumulate water from the main stem and tributaries as they flow into the Vakhsh only (i.e., the proposed project would not divert from outside the watershed). The ESIA is exploring the additional evaporation caused by the proposed Rogun reservoir. Subject to final analysis, it is expected that this additional evaporation would be small relative to annual flow. Possible effects on salinization and quality of potable water as well as other economic, social and environmental implications will be considered. Riparian countries were invited to contribute to the information base for this analysis.

Real Time Monitoring

In addition to hydrology and Vakhsh Cascade modeling, hydrologic real time monitoring was discussed. The Consultant recommended that, should the proposed project be considered feasible and should it proceed, a mechanism be put in place to monitor (and possibly forecast) inflows, reservoir levels and outflows in real time and that these data be publicly accessible. This mechanism would enhance potential operation and improve transparency for all stakeholders. For example, inflow forecast,

⁵ Interpretation and application of the Nukus Declaration and Protocol 566 are defined through a process of review and discussion that regularly engages senior government officials through the regular meetings of the Interstate Coordination Water Commission.

together with monitoring, aims at improving reservoir management and allows reducing the risk of failures, such as the reservoir being too full when an incoming flood is imminent or the possibility of failing to meet low flow requirements during drought periods. The PoE strongly supported this concept and urged cooperation and data sharing on the part of downstream countries, also noting real time monitoring is consistent with international good practice. In addition, the PoE indicated that the monitoring system could be complemented by a hydrological/hydraulic prediction and simulation system to support operational management. Riparian participants supported this suggestion. Several stakeholders called for broader monitoring (beyond the influence of the proposed project), including upstream and full-basin monitoring. The ES-PoE made the recommendation that monitoring include separate information from the Pyanj and Vakhsh catchments.

III. Dam Safety

Dam safety investigations, which have numerous components, are critical inputs for the assessment of feasibility. At the meetings, discussion was held on three aspects of dam safety (in addition to those already covered under water management): geology at the site, stability of the right bank downstream of the proposed dam, and seismic hazard assessment. The preliminary findings presented and questions discussed at the meetings are summarized below.

Geology

The consultants established a geological and tectonic model which was supported by detailed data and considered acceptable and reliable by the EDS-PoE. This is an important first step in the Assessment Studies given the complex geological environment. Based on the modeling and data from the expanded site investigation, preliminary findings from the TEAS consultants were that:

- A central core earth/rockfill dam appears to be the only type of structure, for the proposed size, which can accommodate the expected deformations, particularly on the existing faults.
- Dam zoning and geometry could be designed to cope with fault deformations (creep phenomena and seismic events); however, it was recommended that measurements of deformations should be resumed.
- Overall permeability of the rock mass appears to be suitable at the dam site.
- There seems to be no major slope stability issues on a large scale at the dam site.
- Local potential unstable areas could be treated with standard remediation/reinforcement measures within the area such as above the portals of the tunnels of particular relevance.
- The assessment of the safety implications of the salt wedge in the foundation area of the proposed dam is an important element of the techno-economic assessment. Current understanding is that the proposed mitigation measures (grouting cap and hydraulic barrier) would be sufficient to ensure the safety of the dam. Should the proposed project be deemed feasible, the effectiveness of these measures would need to be monitored during the construction and operation phases so that, if needed, effectiveness could be restored by appropriate and feasible interventions.

The EDS-PoE noted a variety of issues which would need to be explored in more detail should the proposed project proceed to detailed design stage, including salt inclusion in the foundation, creep of faults crossing the dam site, and stability behavior of the powerhouse cavern and other underground structures. The PoE concurred with the above conclusions as adequate for the assessment of feasibility and comparison of alternative project configurations.

Participants at the meetings and in written submissions raised a number of questions related to the geological conditions including: whether the proposed site was geologically suitable and if alternative locations were considered; if the proposed Rogun HPP would be subject to settlements like at the Nurek HPP; and what could be the impact of underground waters located at the base of the dam. On site suitability, the PoE affirmed the preliminary conclusion of the consultants that the site appeared to be broadly suitable and geologic concerns do not appear to pose a risk to project feasibility, while again noting some geologic questions would require further investigation as part of detailed design. The

consultants considered other locations but concluded that areas further upstream appeared to have less favorable geologic conditions and areas downstream bordered too close on the Nurek reservoir. On the settlements of the dam, the consultants and PoE both affirmed that dam settlement noted in Nurek was common after construction and that an observed settlement of 1-1.5% of the height is considered normal. To accommodate the post-construction settlement of the dam, a higher crest would need to be built during construction.

Riparians also voiced concern over the protection of the salt layer in the dam foundation (the “salt wedge”). A separate report on this issue is being prepared and its findings will be shared with stakeholders. Mitigation, monitoring and possible remedial measures have been identified by the consultants to deal with the conditions posed by the salt wedge. The suitability of these measures will be further reviewed by the PoE and the World Bank experts, and the relevant costs of these measures will be included in the economic assessment.

The consultants stated that the safety of already completed works is a critical issue. A separate report on existing works, currently under finalization, is dedicated to assessing the suitability of existing works and identifying any required strengthening measures. The findings of this report will be shared with stakeholders.

One area of specific investigation is the siltstone part of the powerhouse cavern. Instrumentation (multi-position borehole extensometers) has been installed to monitor any progress of rock mass deformation in order to apply timely appropriate measures. Assessment of underground works requires detailed analysis and this analysis is in progress. Results, and the engineering measures to manage such conditions, will be part of the report on existing works which will be carefully reviewed by the PoE and Bank experts, and the findings shared with the stakeholders.

Downstream Right Bank Area

The preliminary views on the stability of the right bank conveyed by consultants in November 2012 were confirmed by additional investigations and documented in the report disclosed in January 2013 and discussed with riparians and the PoEs in February 2013. The study found that the downstream right bank area does not seem to be the site of an old large landslide and is not a vulnerable site for large potential instability (while not precluding much smaller landslides). Although it is an area of tectonic disturbance, this does not appear to be cause for major concern vis-à-vis a large landslide potential. Indeed there is no evidence of preexisting unfavorably oriented weak and persisting discontinuities (such as bedding plane) or fault that could generate a massive structural failure. The cases where strength conditions could appear low would be limited in size and could be mitigated with appropriate measures.

Stakeholders expressed interest in exploring this subject further given the area’s high seismicity and dam safety implications. Discussions broadened to include slope stability, the potential for mudslides, and measuring seepage and permeability in the rock. The consultants described, and the EDS-PoE supported, that after extensive site investigations (detailed in the Geological Report), evidence suggests that there is little to no potential for large scale landslides in the future (on the downstream right bank

or elsewhere in the dam site surroundings) which could affect the proposed project's feasibility. At the same time, the TEAS will include costs of measures to control small scale slope instability in the area of the proposed works. Although mudslides have occurred, it is foreseen by the experts that adequate mudflow controls could be built into the proposed project design, if the project proceeds. On seepage and permeability, the consultants presented evidence of investigations that do not suggest critical concerns related to project feasibility. The EDS PoE supported these findings and noted that construction of a grout curtain was foreseen to reduce seepage through the foundation, as is usual in dam projects.

Seismic Hazard Assessment

The seismic activity of the site is well known by consultants, experts, and stakeholders and is a major factor in dam safety, site design and operation, and consequently overall technical and economic feasibility. A Seismic Hazard Assessment Report is forthcoming from the TEAS consultants. In the meantime, the consultants presented the seismic parameters for this stage and reaffirmed that the project is being assessed using seismic design parameters associated with the Maximum Credible Earthquake (MCE). This criterion was discussed during the November 2012 information sessions. An internationally recognized safety standard, the MCE is defined as the highest level of earthquake that could be credibly conceived in this area. Consultants indicated that the proposed project's design could appropriately take into account the seismic conditions to meet the MCE. The PoE concurred that project design could meet the requirements of MCE and no issues appear to have been identified thus far from a seismic perspective which would jeopardize feasibility. The current seismic parameters for design have been based on a *deterministic* criteria which the PoE noted appears to be sufficient for the present assessment. A *probabilistic* seismic hazard would be required for the detailed design stage, and is important to determine the parameters of the Operating Base Earthquake (OBE) and to validate input parameters for the MCE.

Several stakeholders raised particular concern about impoundment of the proposed project's reservoir. The EDS-PoE noted that reservoir triggered seismicity is a well-known phenomenon whereby construction and filling of a reservoir may trigger a release of tectonic movement. However, any reservoir triggered seismicity would be less than MCE design criterion and so would be addressed in the design safety standard. It was noted, based on the experience of Nurek dam and other high dams in the seismically active areas of the world, that after about 10 years of construction and impoundment of reservoirs, geological settings usually adjust to these reservoirs, and the reservoir triggered seismicity ceases. However, because the reservoir seismicity could be triggered with construction of such a high dam, the rate of construction and filling is critical. The consultants and PoE noted that significant relevant information on this phenomenon, which will inform the TEAS, is available from the experience at Nurek.

IV. Introduction to Alternative Dam Heights

The comparison of project feasibility across different project configurations depends on output from interim studies, including those discussed in both the November and February information sharing sessions. However, the basic structure of comparisons was introduced. The consultants described that the TEAS would analyze three different elevations for the dam:

- low dam alternative of 265 m height with full supply reservoir level of 1220 masl;
- intermediate dam of 300 m height with full supply reservoir level of 1255 masl; and
- high dam of 335 m height with full supply reservoir level of 1290 masl.

The consultants presented three installed generation capacities for each dam height. Therefore, nine combinations of reservoir elevation and installed capacity are to be compared with respect to economic viability and environmental and social impacts. It was also noted that these alternatives would also be compared to a “no project” situation, which would entail a need to find other measures or sources of supply to meet demand.

The February riparian meeting focused on the ESIA aspects, particularly the comparison of alternatives with respect to resettlement and infrastructure replacement costs.

Preliminary analysis indicates a considerable difference in number of affected people for the different dam height options (see Table 2 below), which has implications for costs, social disruption, and project complexity. Costs include both ongoing preliminary resettlement and full reservoir resettlement. Estimating the costs is complicated by the lack of an overall resettlement budget, no market for land (as it is allocated by the state), and the fact that significant infrastructure has already been built.⁶ These analyses, after further work, will be incorporated into the final assessment of the recommended alternatives, in combination with the economic and technical assessments.

The ESIA consultants provided a brief overview of potential differences in ecological impacts across the alternatives. It was noted that, at this time, the ESIA consultants had not considered impacts on sediments or hydrology (including flow impacts downstream of Nurek) pending the technical analysis of these aspects by the TEAS consultants.

The ES-PoE emphasized that potential differences in environmental impacts need to be fully considered and included in the ESIA comparison of alternatives. They reiterated that an in-depth analysis of alternatives needs to be prepared in a timely manner consistent with World Bank policies. This includes a review of the No Project alternative (which in this case is complicated by a partial existing structure) and an assessment of downstream impacts. At the same time the ES-PoE made positive note that work has started on the alternatives associated with three different dam heights (265m, 300m, and 335m) and power generation options. They also noted the need for the TEAS and ESIA consultants to work together in a more interactive manner to achieve a satisfactory comparison of alternatives.

⁶Consistent with standard economic methodology, only future costs (of infrastructure and resettlement) are included in the comparison.

Table2: Comparison of Resettlement Across Alternative Dam Heights

Key Parameters	Option 1	Option 2	Option 3
Dam height (m)	265m	300m	335m
FSL (masl)	1220	1255	1290
Reservoir Area (sq. km.)	68	114	170
Total # of Villages affected	25	36	78
Total # of households affected	1586	2301	6,035
Total #of people affected	12,520	18,186	42,402

Source: ESIA Consultants' presentation on "Resettlement and Infrastructure Replacement Cost Estimates for Dam Alternatives"
(<http://siteresources.worldbank.org/INTECCU8/Resources/563344-1360501336092/Resettlement-and-Infrastructure-Replacement-Cost-Estimates-for-Dam-Alternatives-ENG.pdf>)

Stakeholders inquired on the possibility of constructing two (or more) smaller hydropower plants instead of a single large structure such as proposed currently. The consultants responded that multiple projects appear to be less economic as energy output would be similar while costs would be significantly higher. Additionally, as discussed during the geological investigations, the consultants affirmed that site conditions appear to be less favorable elsewhere in the cascade.

Participants sought confirmation that resettlement thus far has progressed in accordance with World Bank standards. The resettlement process is being currently held at "Stage 1" – resettlement of seven identified villages that are impacted by agreed site activities (for maintenance and safety purposes) and which began prior to the Assessment Studies. It was decided that this process should not be interrupted after the halt in rehabilitation of works because it would ultimately make the resettlement process more difficult for the affected communities. Preparation of the new resettlement sites is progressing well. The consultants and the ES-PoE indicated that, in their view, resettlement is generally proceeding in conformance with the applicable World Bank policy (OP 4.12). A specific directorate has been created to handle resettlement and it has been well resourced by the Government.

Should the Resettlement Action Plan and Resettlement Policy Framework be found to be acceptable, there is a solid basis to have confidence in a well-managed process. The Resettlement Directorate has responded to earlier recommendations and set up an effective grievance mechanism with representatives at all sites.

V. Panel of Experts' Recommendations to Government of Tajikistan

Representatives of the Environmental and Social Impact Assessment and the Engineering and Dam Safety Panels of Experts participated in the two days of consultation and information sharing (February 11 and 12, 2013). The following recommendations from each panel were presented to the Government of Tajikistan on March 22, 2013, based on the opinion of the experts, site observations, and comments from the meetings.⁷

A. Engineering and Dam Safety Panel of Experts (EDS-POE)⁸

Hydrology:

- Database is sufficient for Phase II which determines feasibility and preferred dam option.
- In order to manage the PMF sufficient discharge capacities must be included in design of hydraulic works both during operation and construction.
- It is important to undertake monitoring in order to assess downstream impacts.

Dam Safety:

- Geological and seismic conditions are well understood. The EDS-POE agrees with the current interpretation of the anomalous geomorphological feature on the right bank; that it is not a landslide, and that it poses no threat to the proposed dam. This downstream right valley side was further investigated and the conclusion is that this setting is the result of tectonic deformations and not of an old landslide and so the conditions are favorable for global stability. There are issues which will need to be addressed in the design (fault movements, salt dome, anti-seepage measures, weak ground and deformation in underground works, etc) but no issues that would affect the feasibility of the project as a whole are anticipated from the geologic and seismic perspective. Reservoir triggered seismicity (RTS): impoundment of Rogun is expected to trigger seismicity, but these RTS earthquakes are typically with lower magnitudes. Since the Phase II design will be for a Maximum Credible Earthquake (MCE), the level of the RTS will be well below the accelerations that are adopted in the design that is based on the MCE. However, information collected on Nurek regarding the impact of rates of the reservoir and embankment filling on the RTS should be taken into account when discussing the project implementation program. Also, it is recommended to develop the RTS monitoring system so that the monitoring could start well in advance of the construction works.
- Historical performance of Nurek: the records of seepage and settlements collected in the past 30 years show that the seepage and settlements observed are well within the values expected for such a dam and well within international dam safety standards.

⁷ The following recommendations have been slightly modified from the March 22 set and so account for additional comments received after the riparian meetings. These updated recommendations will be shared with the Government of Tajikistan upon publication of this report.

⁸ The following PoE members attended the February 11 and 12 riparian meetings; the recommendation reflect the opinion of the panel as a whole: Ljiljana Spasic-Gril, Dam safety and seismicity; Paul Marinos, Geology; Ezio Todini, Hydrologist.

B. Environmental and Social Impact Assessment Panel of Experts (ES-PoE)⁹

Downstream Flow Variations and Possible Impacts: The ES-PoE draws attention to the requirement of World Bank Safeguard Policy OP4.01 (Environmental Assessment) that potential impacts throughout the entire project affected area must be undertaken. It is consequently important for the project affected area to be objectively decided by first analyzing potential changes in flow patterns below the confluence of the Vakhsh and Pyanj rivers that might occur if the Rogun dam is constructed. The POE advises that analysis of potential downstream impacts requires the urgent attention of the Consultants.

Floods and Maximum Possible Floods: The ES-PoE regards the method for determination of PMF as appropriate and is satisfied that the estimates of 7770 m³/s as average daily and 8160 m³/s as peak, are appropriate and conservative. Consequently the need for additional spillway capacity is supported.

Sedimentation: The ES-PoE notes the attention now being given to reservoir sedimentation and the fact that a reservoir sedimentation expert has been contracted to serve on the project POEs. It further notes that the long-term sustainability of the Rogun HPP will be directly related to the rate at which sediment accumulates in the reservoir.

Climate Change: The ES-PoE notes with approval the increased attention that has been given to climate change. It deems the methodology developed and the data used for estimation of floods, in a snow and glacier fed catchment subject to climate change, to be appropriate and notes the conservative values derived for Probable Maximum Floods (PMF). The ES-PoE also notes that the potential effects of climate change in Turkmenistan and Uzbekistan have not been assessed despite their potential to change water demand/availability in those countries.

Hydrology: The ES-PoE concurs with the explanations given concerning hydrological modeling and is satisfied that an appropriate hydrological data base is being used in the relevant studies.

Land- and Mud-slides: The Panel has advised, and reiterates, that the potential for land and mud-slides into the Rogun reservoir should be systematically compared for each of the alternative dam heights that are being assessed. Although not anticipated to impact the feasibility of any of the proposed dam heights, the design selection may be affected by different land and mud-slide risks. Different heights may cause different impacts in terms of reservoir mass movements; this will form part of the selection criteria for recommending the preferred project configuration/dam height.

Monitoring: The ES-PoE supports the suggestions that (i) water use monitoring throughout the Aral basin be implemented as good water management practice, although it likely goes beyond the scope of the proposed Rogun project and (ii) real-time web-based monitoring of the Vakhsh cascade be introduced as part of the Environmental Management Plan. In addition, the Panel of Experts indicated that the monitoring system could be complemented by a hydrological/hydraulic prediction and simulation system to support Rogun/Nurek operational management.

Operational Options: The ES-PoE agrees that the existing Nurek and planned Rogun reservoirs should be operated as a multi-purpose coupled system as this will provide greatest benefit for people and the

⁹ The following PoE members attended the February 11 and 12 riparian meetings; the recommendations reflect the opinion of the panel as a whole: Richard Fuggle, ESIA; Ezio Todini, Hydrology; Frederico Giovannetti, Resettlement (by Video Conference).

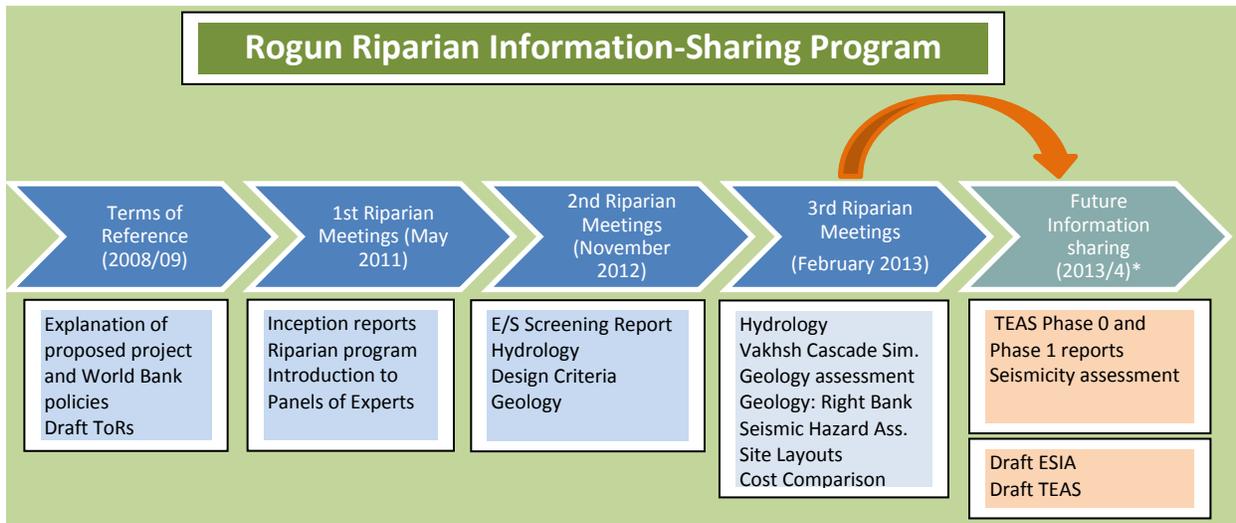
ecological health of the Vakhsh and Amu Darya rivers and flood plains. Choosing an “optimum dam and operational configuration” should adopt a multi-objective approach, taking into consideration irrigation, river and floodplain health and domestic needs as well as energy output.¹⁰

Objectivity of Studies: It is stressed that neither of the two independent Panels of Experts have expressed an opinion on the appropriateness of the proposed project. No judgment has been made for or against the proposed Rogun project. Such opinions as have been expressed relate solely to the ongoing studies, assessments, and investigations which will inform the detailed design proposal and the ultimate decision on whether or not the initiative proceeds; and if it does, under what conditions.

¹⁰ Addressing Nurek and Rogun as a coupled system recognizes that changes at one can affect operations at the other. Managing them in this way will capture the effects on the flows downstream of Nurek both within and outside Tajikistan. A multi-objective approach ensures that the identification of the preferred project configuration considers the range of environmental, social and economic priorities of downstream communities such as irrigation, river and floodplain health and domestic needs, as well as energy output.

VI. Next Steps

Significant work in the assessment process is still underway and will require additional consultation and dialogue with riparian stakeholders. The ESIA and TEAS consultants are continuing their analyses for their respective assessments. Subsequent disclosure and information-sharing will be held in October 2013 on safety issues (related to seismicity assessment, status of existing works and the salt wedge formation), followed by a final set of consultations when the TEAS and the ESIA reports are fully drafted.¹¹



*Updated from February 2013 consultation: An interim set of consultations is planned for October 2013 on specific dam safety issues, to be followed by a final set of consultations to review the draft TEAS and ESIA reports.

¹¹ Updated from February 2013 presentation.

ANNEXES

Annex A: Agenda of February 11 Meeting

Assessment Studies for Proposed Rogun Hydropower Project

THIRD RIPARIAN INFORMATION SHARING AND CONSULTATION MEETING

World Bank Central Asia Regional Office

41-a Kazybek bi St., Almaty, Kazakhstan Tel. +7 (727) 2980-580

AGENDA

Almaty time, for other participating cities please note time difference with Almaty

Purpose: To share new information from the assessment studies on the proposed Rogun Hydropower project with riparian governments		
Time	Topic	Moderator/Speakers/Presenters
08:30 – 09:00	<i>Registration</i>	
1. 09:00 – 10:00	Welcome <ul style="list-style-type: none"> • Opening comments (15 min) • Introduction of delegations (5 min each) • Update on Assessment Studies (10 min) 	Chair: Saroj Kumar Jha, Regional Director, Central Asia, World Bank Speakers: <ul style="list-style-type: none"> • Heads of riparian delegations • JorgFrieden, Executive Director for Azerbaijan, Kazakhstan, Kyrgyz Republic, Poland, Serbia, Switzerland, Tajikistan, Turkmenistan, and Uzbekistan, World Bank • Stephen Lintner, Senior Advisor, Operational Risk Management, World Bank • ImtiazHizkil, Senior Power Engineer, World Bank
2. 10:00 – 12:30	Water Management – Techno-Economic Assessment Study with ESIA <ul style="list-style-type: none"> • Introduction • Presentation followed by Q&A: Hydrology Report (15 min) • Presentation followed by Q&A: Vakhsh Cascade Simulations – Methodology and Assumptions (15 min) 	Moderator: Daryl Fields, Senior Energy-Water Specialist, World Bank Presenters: <ul style="list-style-type: none"> • Ascencio Lara, Hydropower Expert, Coyne & Bellier / ErkanTekirdaglioglu, Director Hydro-Power Projects Division, Coyne & Bellier Speaker: <ul style="list-style-type: none"> • Pierre Beidermann, Director – International Department, Poyry
	<i>Coffee and tea</i>	
	Water Management (continued) <ul style="list-style-type: none"> • Commentary by Engineering and Dam Safety and Environmental and Social Panels of Experts and World Bank (30 min) • Moderated discussion (60 min) 	Moderator: Daryl Fields, Senior Energy-Water Specialist, World Bank Speakers: <ul style="list-style-type: none"> • EzioTodini, Hydrologist, Panel of Experts • Richard Fuggle, Environmental Expert, Panel of Experts • RikardLiden, Senior Hydrologist, World Bank Participant Roundtable
12:30 – 13:30	<i>Lunch</i>	
3. 13:30 – 16:00	Dam Safety – Techno-Economic Assessment Study <ul style="list-style-type: none"> • Introduction • Presentations: (30 min) 	Moderator: Alessandro Palmieri, Lead Dams Specialist, World Bank

	<ul style="list-style-type: none"> ○ Geology assessment ○ Geological investigations in the Downstream Right Bank ○ Questions and Answers ● Presentation: (15 min) <ul style="list-style-type: none"> ○ Seismic Hazard Assessment ○ Questions and answers 	<p>Presenters:</p> <ul style="list-style-type: none"> ● Ascencio Lara, Hydropower Expert, Coyne & Bellier / ErkanTekirdaglioglu, Director Hydro-Power Projects Division, Coyne & Bellier ● Ascencio Lara, Hydropower Expert, Coyne & Bellier / ErkanTekirdaglioglu, Director Hydro-Power Projects Division, Coyne & Bellier
<i>Coffee and tea</i>		
	<p>Dam Safety (continued)</p> <ul style="list-style-type: none"> ● Commentary by Engineering and Dam Safety Panel of Experts (20 min) ● Moderated discussion (60 min) 	<p>Moderator: Alessandro Palmieri, Lead Dams Specialist, World Bank</p> <p>Speakers:</p> <ul style="list-style-type: none"> ● Ljiljana Spasic-Gril, Dam Safety Expert, Panel of Experts ● Paul Marinos, Geologist, Panel of Experts <p>Participant Roundtable</p>
4. 16:00-17:00	<p>Introduction to Alternative Dam Heights</p> <ul style="list-style-type: none"> ● Introduction ● Presentation: Site Layouts for Different Dam Heights (10 min) ● Presentation: Cost Comparison on Resettlement and Infrastructure options (10 min) ● Commentary by Environmental and Social Panels of Experts (10 min) ● Moderated discussion (30 min) 	<p>Moderator: Stephen Lintner, Senior Advisor, Operational Risk Management, World Bank</p> <p>Presenters:</p> <ul style="list-style-type: none"> ● Ascencio Lara, Hydropower Expert, Coyne & Bellier / ErkanTekirdaglioglu, Director Hydro-Power Projects Division, Coyne & Bellier ● Robert Zwahlen, Environment and Social Development Specialist, Poyry <p>Speakers:</p> <ul style="list-style-type: none"> ● Frederico Giovanetti, Resettlement Expert, Panel of Experts ● Richard Fuggle, Environmental Expert, Panel of Experts <p>Participant Roundtable</p>
5. 17:00 – 18:00	<p>Summary</p> <ul style="list-style-type: none"> ● Recap of findings and comments (10 min) ● Next steps and Q&A (5 min) ● Closing comments (15 min) 	<p>Chair: Saroj Kumar Jha, Regional Director, Central Asia, World Bank</p> <p>Speakers:</p> <ul style="list-style-type: none"> ● Daryl Fields, Senior Energy-Water Specialist, World Bank ● Elena Karaban, Senior Communications Officer, World Bank ● Stephen Lintner, Senior Advisor, Operational Risk Management, World Bank <p>Participant Roundtable</p>
<i>Refreshments</i>		

Annex B: Matrix of Comments received and responses

3rd Information-Sharing and Consultation Meetings on the Assessment Studies of the proposed Rogun HPP

Comments received during comment period (by March 4, 2013) at rogunconsult@worldbank.org

Note: The reader is referred to the main text of the consultation report for additional information.

Topic	Comments/Questions	Response
Water Management		
Hydrology	It is important to have high level of confidence on the hydro report conclusions. <i>Expressed by stakeholders from Tajikistan</i>	The hydro report was evaluated as sufficient by the Panel of Experts for the current focus of the assessments studies, namely feasibility and comparison of project configurations. The consultants have expanded the assessment of climate change, recognizing a long term impact on flow volume and pattern in part due to glacier melting. Common to climate change science, numerous uncertainties exist; however, the Panels of Experts supported the approach to integrating into the project assessment. Should the proposed project advance, there will be a need for additional information on climate change and extreme values curve for detailed design.
	Taking into account the global warming and the registered fact of reduction of glacier areas in the region, the amount of snow cover (precipitation accumulation) will have a significant impact on the river's water content. <i>Expressed by stakeholders from Kazakhstan</i>	
	As it is known, snow melting in the Vakhsh river basin does not cover the entire basin or its larger part immediately. High variation of elevations causes non-uniform water inflow from different parts of the basin to the river channel. Has this specific feature of the Vakhsh river's flow formation been considered? <i>Expressed by stakeholders from Tajikistan</i>	
	In the Report, the estimated hydrological characteristics have been also defined using data of analogous rivers. Selection of analogous rivers must conform to all of many conditions; however, the Report does not indicate their soil types, hydrogeological conditions, ratios of lake surface, forestry area, ploughed area and bogged area to drainage area, as well as factors distorting the natural river flow of the analogous rivers. <i>Expressed by</i>	
		The analogous river data have been preliminarily used, but in the final Hydrological Report have not been taken into account for estimating the 1/10,000 years flood because they did not add substantial information with the risk of including non-homogeneous types of rivers.

	<i>stakeholders from Tajikistan</i>	
Flood management	There should be absolute confidence in that the PMF value is not overestimated or underestimated. The PoEs opinion and other conclusions, responses and opinions on this issue should be published. <i>Expressed by stakeholders from Tajikistan</i>	Hydrological safety is of the utmost importance when studying the proposed project. The Assessment studies have revised the design criteria for flood management. This significant increase in maximum flood estimate is due to the difference between the statistical approach, which was the standard method at the time of original design, and the newly adopted design criteria that was presented in November 2012. Specifically, design criteria pertaining to maximum floods will require the use of the Probable Maximum Flood (PMF) which is internationally recognized as the most severe event for the design of a dam with such a large population and economic assets present in the downstream area. This compares with a 1 in 10,000 year flood criterion used by the Soviet Union The economic assessment will include cost implications of the engineering measures needed design for this higher flood. This economic analysis will inform the conclusions of the Techno-Economic assessment. The consultant has not taken into account the variation in elevation in the estimation of PMF. This is why a more detailed study must be performed in a successive phase to reduce the uncertainty in the PMF estimate as well as on the shape of the inflow flood wave; although the PMF estimation is sufficient for this stage of the assessment process.
	What is the cost implication on the spillway of adopting the new PMF standard? <i>Expressed by stakeholders from Kazakhstan and Uzbekistan</i>	
	Have short-term mud floods not been considered? <i>Expressed by stakeholders from Tajikistan</i>	
	If the carrying capacity of the spillway is insufficient, reconsideration of the dam's concept will be inevitable. In such case, it will be necessary to design and construct an additional spillway. <i>Expressed by stakeholders from Tajikistan</i>	
	It is necessary to be absolutely certain that data and measurement results from flash floods from previous years are reliable. <i>Expressed by stakeholders from Tajikistan</i>	
	The hydrological estimates do not consider the mudflow danger of the Vakhsh and its tributaries. Do the methods of flood estimation and PMF calculation selected by the Consultant apply to the mudflow-hazardous Vakhsh at all? <i>Expressed by stakeholders from Tajikistan</i>	
Downstream Impacts	Will the Assessment Studies fully consider the potential positive and negative downstream impacts (social, economic, and environmental), and will this be done through the context of the Nukus Declaration? <i>Expressed by stakeholders from Afghanistan, Kazakhstan, Tajikistan, and Uzbekistan</i>	A comprehensive understanding of the potential impacts downstream from the proposed Rogun HPP is a required component of the ESIA. In order to undertake this analysis, the consultants will develop a model of the Vakhsh Cascade to estimate potential changes in flow. This analysis will be used as input to the analysis of the potential environmental, social, and economic downstream impacts. The cascade model currently under development as the studies are finalizing estimations of the Rogun inflow. Reservoir and flood operations will modify inflows, resulting in a set of discharges to the Nurek Reservoir and subsequently downstream. The Government of Tajikistan reiterated its commitment to the
	How do the commitments under the Nukus Declaration shape the Assessment Studies, and how is Afghanistan accounted for under water allocation as it is not explicitly included in Nukus? <i>Expressed by stakeholders from Afghanistan and</i>	

	<i>Uzbekistan</i>	<p>Nukus Declaration and obligations and rights under Protocol 566 that allocates flow across countries. These flows (volume and pattern) will be incorporated into the Cascade model as constraints or boundary conditions that must be met. The consultants will also examine the potential impact on flows in unusual circumstances, such as very wet or very dry years.</p> <p>Afghanistan is not a signatory to Nukus Declaration or Protocol 566. Protocol 566 does assume Afghan water usage of 2.2 cubic km per year, roughly equivalent to discharge of Kunduz river. Afghanistan is implicitly taken into account but does not preclude future agreement which fully includes Afghanistan. The PoEs and World Bank would support this idea but it would be outside scope of this project.</p> <p>As a downstream riparian, the potential impact of the proposed project on Afghanistan will be addressed in the Assessment Studies through the modeling of potential changes in flows (Vakhsh Cascade model) and the subsequent ESIA analysis of possible effects on water users.</p>
Water Monitoring	<p>Will the WB be able to strengthen the hydrological posts in the upstream areas? The report only mentions the downstream; but this does not provide upstream. <i>Expressed by stakeholders from the Kyrgyz Republic.</i></p>	<p>To improve operational effectiveness, should the proposed project proceed, additional hydrological data from the upper watershed is valuable and the World Bank currently supports a project for improving Hydromet in Kyrgyz Republic and Tajikistan. However, as noted above, the hydrologic data is considered adequate for the current studies so additional posts are not needed for the purposes of assessing project feasibility.</p>
	<p>The suggested water use monitoring activities, they need to cover the entire Amu Darya basin all the way to the Aral sea – will give data on water usage. <i>Expressed by stakeholders from Tajikistan</i></p>	<p>The Assessment Studies will determine the scope of potential impact of the proposed project. Data collection and analysis will be undertaken in this sphere of impact.</p>
	<p>Does the World Bank have any authority to influence the downstream countries and Tajikistan, particularly in the issue of efficient use of water for irrigation purposes? Under the current water use system, up to 35% of agricultural water is lost during the irrigation season. Are any measures being taken in relation to this issue? <i>Expressed by stakeholders from Tajikistan</i></p>	<p>Central Asian countries have identified inefficient water use as a major concern. The World Bank is one of several partners supporting efforts to improve water use efficiency, including in irrigation as one, albeit significant, component of strengthened sustainable water management systems. However, water use management in downstream countries is outside the scope of analysis for the Assessment Studies.</p>
Dam Safety		
Geology	What is the opinion of geologists in whether dam	With the data from additional site investigations, which are nearly complete,

Assessment	<p>should be located in that place or not? <i>Expressed by stakeholders from Kazakhstan</i></p>	<p>information is considered sufficient to assess feasibility. There will be a need for additional studies/investigation should the proposed project proceed to detailed design and construction.</p>
	<p>At the Nurek HPP the dam has sunk 3m, can this happen to Rogun? <i>Expressed by stakeholders from Uzbekistan</i></p>	<p>Normally, 1-1.5% of the height (or 3-4.5m) is accepted as normal for settlement. A higher crest is built during construction to accommodate for this.</p>
	<p>There are underground water at base of the dam, what is the impact of this on the design? <i>Expressed by stakeholders from Kazakhstan</i></p>	<p>Bore holes were drilled during investigation to assess the hydrogeological conditions inside the rock mass. Foundation treatment works that reduce seepage through the foundation will be implemented. These works will comprise construction of a grout curtain. . The consultants recommend acquiring more information should the project proceed to detailed design by drilling more bore holes and the left abutment to understand the extension of the grout curtain in this abutment. These additional investigations are not necessary at the level of comparing alternatives – only at the detailed design stage</p>
Slope stability, mudslides, and seepage	<p>The Report says nothing on the necessity of calculation of general and local slope stability under the own weight of soil and load (seismic, filtration, vibration) due to a possible soil slide; <i>Expressed by stakeholders from Tajikistan</i></p>	<p>The extent of the mass movements that can take place in this area has been the subject of site investigations and geological assessments. Preliminary results were presented in November 2012. The current assessment, fully supported by the Panel of Experts, is that the possibility of a large scale landslide which could affect the future works in that area has been excluded. For the full explanation, please refer to the Geological Report which has been disclosed online.</p> <p>At the same time, the techno-economic assessment will include costs associated with measures aimed at controlling small scale slope instability in the area of the works, especially near inlets and outlets of water discharge facilities.</p> <p>The downstream bank is very steep and mudslides have occurred. However, it is foreseen that adequate controls can be built into the ultimate design should the proposed project proceed.</p> <p>The boreholes drilled at the right bank of the dam aimed to confirm the geological structure. The rock strength parameters were tested during previous investigations.</p> <p>The levels of seepage at Nurek have been quite low and impressive by international standards. Nonetheless there are reasons for caution, and so it is very important to monitor potential seepage.</p>
	<p>Annexes No. 1, 2, 3 and 4 to the report on geological investigations in the right bank has not been published (the geological map, information on drilled boreholes, and the report). <i>Expressed by stakeholders from Tajikistan</i></p>	
	<p>Boreholes were drilled in 2012: IF1 (the upper part of the right bank at the location of the dam) and WRB1 (the upper part of the right bank near the dam axis). Only one geotechnical parameter of these boreholes has been determined – permeability. The rocks of these two boreholes should be tested also for: strength, shear strength, compressibility (compression strength) and suffusion (mechanical and chemical). Rock samples should be tested in both dry and wet states. These tests should be performed to ensure higher confidence in the rock's strength and low permeability. <i>Expressed by stakeholders from Tajikistan</i></p>	

	The Report (“Risk of Landslide”) states that “mitigation measures must be implemented in order to control the risk linked to the pore pressure increase during the life of the project.” It is not clear who is to develop the mitigation measures. <i>Expressed by stakeholders from Tajikistan</i>	
Monitoring of geodesic system	Follow up monitoring of the geodetic system implemented (“Recommendations” of the report). Who is to perform follow-up monitoring? <i>Expressed by stakeholders from Tajikistan</i>	Operational responsibilities for monitoring would be determined only after feasibility and a decision to proceed to the next stage is made.
Sedimentation	What measures will be taken to prevent fast silting of the dam, if the Rogun HPP is fully approved and constructed? <i>Expressed by stakeholders from Tajikistan</i>	Sedimentation is integrated into the Assessment Studies, including flood management and economics. The PoE has been expanded to include an independent expert on sedimentation.
	In the Vakhsh river valley, in the vicinity of the proposed engineering structures, there are significant amounts of loose clastic sediments of different types that are an ideal source of mudstream and avalanche hydrological phenomena. Moreover, the Vakhsh is a mountain river, and this means that its “transport competency” (<i>i.e.</i> , capacity to carry suspended and transported sediments with the stream) will be high, which will inevitably cause the sediments to accumulate within the proposed reservoir area, in the head race of the Rogun hydropower plant. Therefore, an additional study is required when designing this hydro-engineering structure. <i>Expressed by stakeholders from Kazakhstan</i>	The Studies benefit from the existence of many years of good evidence in terms of bedload and suspended load (e.g. from the Nurek HPP). Topographic surveys developed for Nurek, together with the bathymetric data, provide a strong basis for estimating the impact of sedimentation on reservoir capacity. With the available information the consultants have been able to estimate the average/mean annual volume of the sediment transport – it is roughly 60 Million cubic m per year. With up to 13,000 Million cubic m of storage capacity in the proposed reservoir, functionality could be maintained for 200 years without major sediment-related incident. To prolong useful life of tunnel spillways, a sediment flushing system will be installed. A surface spillway will also be provided.
Seismicity / Impact of reservoir filling on seismicity	The proposed construction site of the engineering structure is a seismic-hazard zone, how is this being accounted for in the design and construction? <i>Expressed by stakeholders from Kazakhstan</i>	The seismic condition of the area is one of several important topics currently undergoing detailed investigations, recognizing that this is a serious safety concern, further underscored by the fact that the area is seismically active. Preliminary information from the Deterministic Seismic Hazard Assessment presented at the 3rd Riparian meetings, indicated that the proposed project's design could appropriately account for the seismic conditions and potential challenges and meet the internationally recognized Maximum Credible Earthquake (MCE) standard which has been adopted as the design criterion for Rogun. The investigations underway are deemed appropriate by the Panel of Experts for the purposes of assessing feasibility and discussing alternative
	The expert on engineering and geological issues stated that filling of the reservoir does not affect the seismicity of the area. <i>Expressed by stakeholders from Uzbekistan</i>	

		<p>project configuration.</p> <p>Reservoir triggered seismicity is a well-known phenomenon. Earthquakes are caused by tectonic movement –i.e. energy released along tectonic plates. It has been observed on several large reservoirs in the world, constructed in seismic areas, that the impoundment of a reservoir may trigger a release of this energy but do not <i>induce</i> seismic activity itself. Also, these reservoir triggered earthquakes generate lower seismic activity. Since this proposed HPP would be designed to accommodate the Maximum Credible Earthquake (MCE), which is highest level of seismic activity that could be conceived in this area, any reservoir triggered seismicity would be less than MCE.</p> <p>After about 10 years of construction and impoundment of reservoirs, the geological setting usually adjusts to these reservoirs and the reservoir triggered seismic activity ceases. However, reservoir triggered earthquakes may be affected by the pace of construction and filling and so must be taken into account in the Assessment Studies.</p> <p>Data is fully adequate to assess reservoir triggered seismicity given the availability of information collected from Nurek reservoir. The Assessment Studies related to seismicity have also been informed by existing research into this area conducted by Hydroproject Institute – Moscow. It is also recommended in the Assessment Studies that a monitoring system is developed and installed at Rogun to monitor the reservoir triggered earthquakes prior to the dam construction, during construction and impoundment and after construction completion.</p>
	<p>Have you done any studies to look at the creeping of those formations? <i>Expressed by stakeholders from Uzbekistan</i></p>	<p>When excavating caverns and tunnels, some time dependent deformation was observed and measured, providing good information for the studies. The PoEs recommends that the designs of underground structures takes into account the creep deformations of the faults in the foundation and increased monitoring rates, while numerical analysis is considering this issue for judging on the appropriate measures to be applied for stability. This issue will be addressed in both the Phase 1 report on existing structures and as part of the TEAS report.</p>
Introduction to Alternative Dam Heights		
Alternatives	<p>Have you looked into the option of building two smaller dams instead of one larger one, with the same capacity? What would be the economic benefits of</p>	<p>The Assessment Studies will prepare a system-wide expansion plan that will consider a variety of projects on a least cost basis. That component of the studies is underway.</p>

	<p>those two options? <i>Expressed by stakeholders from the Kyrgyz Republic</i></p>	
<p>Infrastructure and Resettlement Costs</p>	<p>How will infrastructure be taken care of once flooding begins and how has resettlement been progressing so far? <i>Expressed by stakeholders from Uzbekistan</i></p>	<p>Current resettlement is limited to areas of activity (with safety implications) and resettlement that began before the Assessment Studies began. It was decided that this process should not be interrupted as it would cause further social disruption. With a few small exceptions, resettlement is consistent with World Bank standards. A specific unit has been created to handle resettlement issues and it has been well resourced.</p> <p>Replacement of infrastructure is included in the resettlement analysis, and costs of future infrastructure investments will be included in the economic analysis.</p>