Environmental and Social Impact Assessment for Rogun Hydro Power Plant

Analysis of Alternatives

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Purpose and Scope

- The ESIA was undertaken for the TEAS recommended alternative of FSL 1290 and an installed capacity of 3200 MW.
- Comparisons are made with the FSL 1255 and FSL 1220 alternatives and the “No Rogun” alternative.

Alternatives for Electricity Generation (1)

- Tajikistan suffers from a critical **need for winter electricity**, with demand exceeding supply by about 25% at present.
- Demand-side changes such as improvements in energy efficiency are needed as part of the solution.
- The shortfall can only be overcome in the mid- and long term with **additional generation capacity**.
- Fossil fuels (coal or natural gas), hydropower or alternative renewable sources such as wind or solar.

Alternatives for Electricity Generation (2)

- Tajikistan has **limited fossil fuel** resources, and importing enough for significant generation would be unaffordable even if supplies could be found. Wind and solar are also very expensive, and cannot generate electricity on a full-time basis.
- Tajikistan has **hydropower resources** that have yet to be developed. Hydropower development is considered to be essential to meet Tajikistan's long-term strategic energy needs in a sustainable manner ensuring energy self-sufficiency and security.

Alternatives for Electricity Generation (3)

- Tajik rivers have a **seasonal flow pattern** with high flow in summer and low flow in winter. Only storage HPPs can address the electricity supply problem in winter in an efficient way. Thus ROR HPPs should be implemented downstream of storage facilities.
- All Tajik potential sites for hydropower development are in the headwaters of one of the tributaries of the Aral Sea, and most of them in the Amu Darya basin, as e.g. Dashtijum HPP. Thus every storage project in Tajikistan has the **potential to influence the seasonal distribution of downstream flows**.

Alternatives for Electricity Generation (4)

- No Rogun would incur significantly higher costs to meet Tajikistan's medium and long-term energy needs.
- In the fourth year after the start of construction, the units 5 and 6 in their first step arrangement would start producing electricity.
- Shurob HPP, a ROR HPP of about 850 MW, to be built between Rogun and Nurek, cannot be built without Rogun.
- Projects located on border rivers, as the Pyanj River, **require coordination with the neighbouring countries**, which adds an element of uncertainty about timing as well as legal framework for these projects.

No Rogun Alternative (1)

- The No Rogun alternative has the following main advantages:
  - **no increase of today's potential to change downstream flow regime**, unless the alternative project is another storage HPP, with the potential negative effects on riparian countries;
  - the potential of **reducing resettlement** and submergence of agricultural land;
  - … as long as the alternative project has no such impacts.

No Rogun Alternative (2)

- Vakhsh river is **already highly regulated**, since the effects of Nurek dam on the same river will persist.
- Less potential to improve transboundary cooperation in the Amu Darya basin exists (less retention volume).
- The **cascade life span and PMF** concerns are not addressed and would ask for alternative interventions.
- Given the Tajik need for electricity supply, an alternative solution would have to be sought.
- **Job losses and the lack of creation of new jobs** in case Rogun construction would be abandoned would have negative impacts on local economy.

Evaluation of Alternative Rogun Configurations (1)

- Hydropower resources consist of storage and run-of-river (ROR) opportunities.
- ROR plants have lower generation capacity in winter due to low river flows. Storage HPPs can store summer water for use in winter, but can have major impacts on downstream water flows and users.
- Only if **new storage plants** are **upstream of and operated as a cascade** with one or more existing storage HPPs can significant benefits be achieved without such changes in downstream flows.

Evaluation of Alternative Rogun Configurations (2)

- Alternative dam sites were investigated during the feasibility study.
- The given dam site has not been reconsidered since 1981, as **topographic and seismic reasons** justify it.
- Construction has already started. Alternative dam sites are not under discussion any longer and technically not considered as an option.

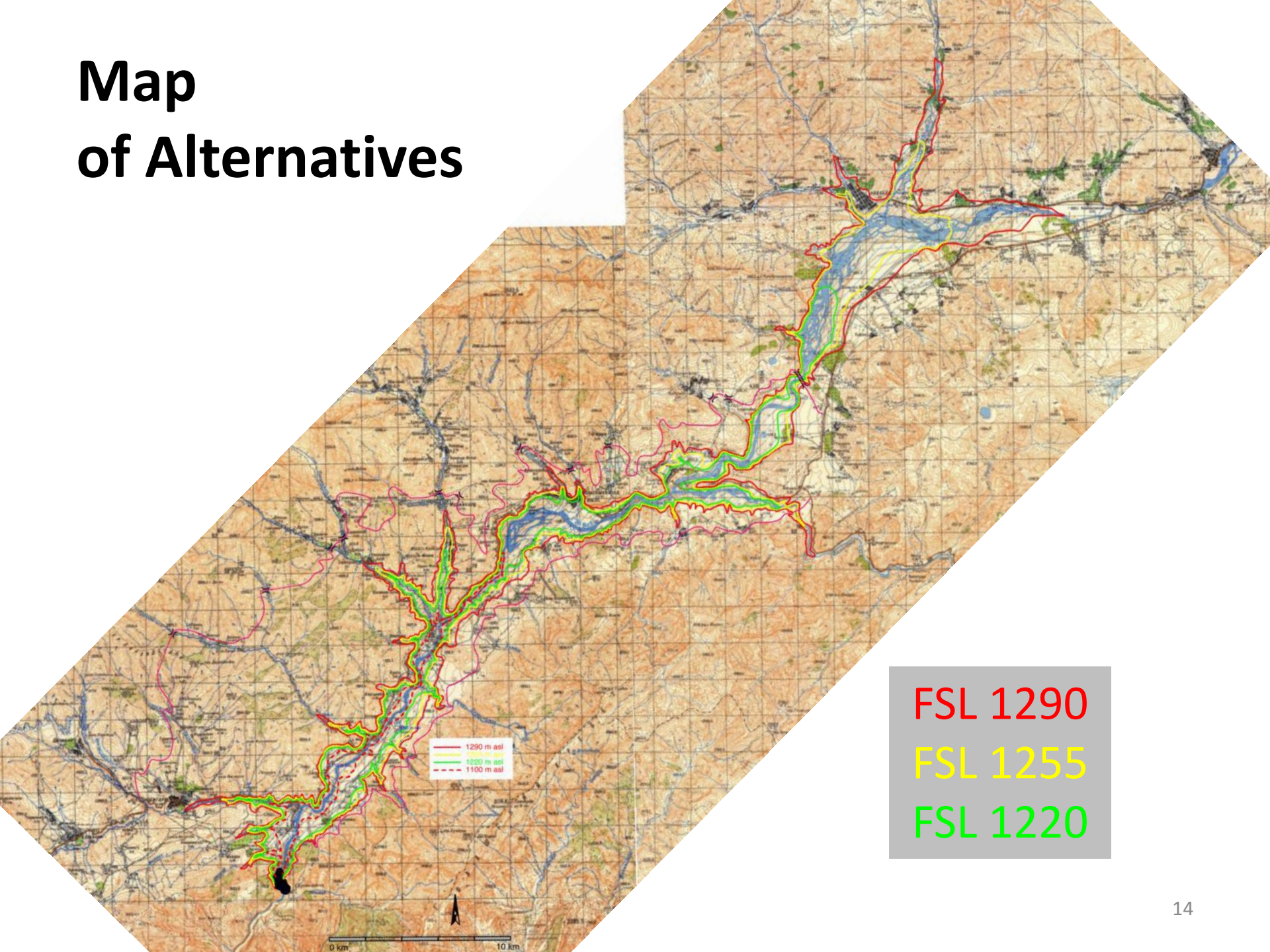
Summary of TEAS key data

Key Parameters	FSL 1290	FSL 1255	FSL 1220
Dam height [m]	335	300	265
Reservoir active storage [hm^3]	10’300	6’450	3’930
Area at FSL [km^2]	170	114	68
Filling period [yr]	16	13	9
Minimal operating lifetime [yr]	115	75	45
Annual energy cascade [TWh]	34.4, 34.3, 34.1	32.5, 32.4, 32.2	30.2, 30.1, 29.8

Summary of ESIA key data

Key Parameters	FSL 1290	FSL 1255	FSL 1220
Summer flow Amu Darya Intended Operation [km^3]	37.4	37.4	37.4
Summer flow Amu Darya Maximising winter energy [km^3]	30.0	30.9	33.5
Resettlement # Villages	77	36	25
Resettlement # Households	6035	2433	1825
Resettlement # Persons	42’000	18’000	13’000

Map of Alternatives



FSL 1290
FSL 1255
FSL 1220

Reservoir sedimentation

- Considering a 100 hm^3/yr sediment inflow, the life expectancy would be **45, 75 and 115 years** respectively for the three dam heights.
- Considering a 62 hm^3/yr sediment inflow, the life expectancy would be **80, 120 and 200 years** respectively for the three dam heights.
- FSL 1290 alternative, providing the longest life span, is the **best option for low cost energy production** to comply with Tajik power demand as well as potential regional energy exportation for the longest period.

Flood Safety Issues

- Large reservoir with corresponding operation and spillway capacities provides **flood mitigation opportunities**, but increases **risks of artificial floods** and would have the potential to cause larger damage in the worst case scenario of a dam failure.
- **FSL 1220** alternative would **not be able to protect the cascade in case of a PMF**, significant investment on the cascade would have to be made for this purpose.
- **FSL 1290 and FSL 1255** alternatives allow **safe PMF evacuation for entire cascade** and improve flood routing capacity by appropriate flood management.

Resettlement

- The number of PAPs raises with increasing FSL. For Rogun reservoir this increase is not linear. While the difference between FSL 1220 and FSL 1255 is of about 5’000 persons, a resettlement of an **additional 24’000 persons** is caused by the FSL increase from 1255 to 1290 m asl.
- FSL 1255 alternative would result in reduced resettlement.
- FSL 1290 alternative will require a **significant institutional commitment** over a longer period of time.

Effects on Riparian Countries (1)

- Under the intended filling and operation mode of Rogun, there will be **no significant difference** between the FSL 1290 and FSL 1255 alternatives.
- Nevertheless, a larger storage volume would allow **higher flow transfer** from the high flow season (summer, vegetation period) to the low flow season (winter, non-vegetation period) for maximising winter energy output.

Effects on Riparian Countries (2)

- Regarding future average Vakhsh summer flow without Rogun of 9.3 km^3, FSL 1290 and FSL 1255, with a potential to reduce Vakhsh summer flow to 2.0 and 2.7 km^3 respectively, would have a **high potential to generate adverse impacts** on Vakhsh flow pattern and on water availability for irrigation along Amu Darya.
- While FSL 1290 alternative constitutes a higher risk for retaining more water in wet summers, it also offers a **higher potential for improving** the situation by making its regulative capacity available for providing additional water for irrigation in dry years.

Conclusions (1)

- The resettlement process is intended to **minimize potential negative impacts** of relocation and effects on people's livelihoods.
- Resettlement planning is designed to ensure there is **fair and adequate compensation** of all losses caused to the affected population by the project, with the result that the status of affected people is restored or improved, and that they are consulted throughout the process.
- Potential adverse impacts due to resettlement could be reduced by FSL 1255 alternative.

Conclusions (2)

- Tajikistan intends to **maintain the current seasonal pattern** of flows in the Vakhsh river.
- TEAS studies show this is technically and economically feasible, within **existing agreements and practices**, including Tajikistan utilizing its allocated share.
- Rogun would also contribute to **flood control** benefits by adding the ability to manage PMF and flood risks.
- Rogun could also be operated to partly **overcome downstream water shortages** during dry years.
- Rogun HPP would provide significant **extension of the lifespan** of Nurek and the Vakhsh hydropower cascade.

Conclusions (3)

- The recommended **mitigation, management and monitoring measures** should be sufficient to manage the principal project risks while allowing the project to achieve its primary aim of generating power to help overcome critical shortages in winter.
- It is recommended that an **ESMP** is finalized which incorporates all Consultant's recommendations so that robust programs of adaptive management are in place to allow continuous adjustments as needed to minimize environmental and social impacts.

Recommendation

- Based on the analyses presented in this ESIA, the Consultant confirms the recommendation of the TEAS that **Rogun HPP FSL 1290 alternative** be taken forward for detailed consideration.