Khudoni Hydro Power Project (702 MW)

Scoping Document

October 2011
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Acronyms

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<th>Acronym</th>
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<tr>
<td>APLR</td>
<td>Association for Protection of Landowners Rights</td>
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<td>ESIA</td>
<td>Environmental and Social Impact Assessment</td>
</tr>
<tr>
<td>BRL/ARS</td>
<td>BRL Ingenierie / A.R.S. Progetti S.P.A</td>
</tr>
<tr>
<td>CENN</td>
<td>Caucasus Environmental NGO Network</td>
</tr>
<tr>
<td>CH₄</td>
<td>Methane</td>
</tr>
<tr>
<td>CO₂</td>
<td>Carbon dioxide</td>
</tr>
<tr>
<td>EBRD</td>
<td>European Bank for Reconstruction and Development</td>
</tr>
<tr>
<td>IFC</td>
<td>International Finance Corporation</td>
</tr>
<tr>
<td>PR</td>
<td>Performance Requirement</td>
</tr>
<tr>
<td>SEEC</td>
<td>South East Europe Consultants Ltd.</td>
</tr>
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<td>USAID</td>
<td>United States Agency for International Development</td>
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1.0 Description of the Khudoni Hydro Power Project

1.1 Introduction

Hydrological energy is one of the most prominent natural resources of Georgia. The development of this hydroelectric power will not only provide energy security for domestic consumption but will open up huge potential for export to neighbouring countries (Turkey, Iran, Iraq, eastern European countries). The development of hydro-energy will minimize domestic requirements for external sources of natural gas and thus substitute cost of import of electricity and gas for power generation from abroad.

Before the collapse of the erstwhile Soviet Union the power needs of Georgia were met through a common grid controlled by the Soviet Union. The power to this grid was fed by Azerbaijan’s thermal generation, Armenia’s nuclear generation and Georgia’s own hydro power generation. After creation of an independent Georgia, Armenia and Azerbaijan, all these countries started operating their independent power grids. Since the major part of Georgia’s power generation was hydro based, this resulted in acute power shortage during winters because of reduced water inflows. The major water inflow in Georgia comes from snow melt in the catchment area and therefore, the winter inflow is approximately one fourth of the spring and early summer inflow. These seasonal variations are resulting varied amount of power generation.

A study on energy balance of the power sector of Georgia was conducted in 2006\(^1\) which concluded that Georgia should prefer use of hydro power to natural gas as a source for electric generation for most domestic purposes. The analysis of hydrological conditions shows that this can be a feasible solution even in low water conditions.

1.2 Project Development

The studies for possible exploitation of Georgia’s major river Enguri began in 1912 when a gauge for measuring water levels and velocity observations for river water discharge was set up near village Javari, downstream of the present location of Khudoni Dam.

Subsequently the United Power System of the Caucasus Region and the Energy Institute of the Academy of Sciences of Georgia worked on the possible use of Enguri’s energy potential. Soviet Union’s Research Design Institute, Tbilisi Branch, (Hydro Project) then carried out the final review and approval. This approved plan envisaged construction of Enguri Hydro Power Plant and Vardnili Cascade Development. Accordingly the following hydroelectric projects were constructed in the 80s.

- Enguri Hydroelectric Project – 840 MW – uprated to 1,300 MW.
- Vardnili Hydroelectric Project stage I – 220 MW
- Vardnili Hydroelectric Project Stage II – 40 MW
- Vardnili Hydroelectric Project Stage III – 40 MW
- Vardnili Hydroelectric Project Stage IV – 40 MW

Upstream of Enguri HPP, Khudoni HPP and Tobari Hydropower plants were envisaged.

Khudoni Hydro Power Project is therefore, the next step in implementing the Cascade Master plan on the Enguri River. The proposal for Khudoni HPP was approved on 31st August 1978 with Decree No. 110 NC of the United Ministry of Energy of the Soviet Union. According to Decree No. 484 issued on June 9, 1980 by Presidium of the Council of the Ministers of Georgia, 687.4 hectare land was provided for Khudoni Hydro Power Project.

The Project configuration was initially approved by the Tbilisi branch of ‘Hydro Project’ under erstwhile USSR in the year 1984 and construction of the project was done on this configuration till suspension of work in 1989. This configuration comprised an arch concrete dam, 200 m high with an underground power house and other head works and waterways.

The Project configuration has undergone 2 (two) reviews subsequently. First by CORE INTERNATIONAL INC (also referred to USAID report) during 1992 in the form of Advisory Assistance to Ministry of Energy, Georgia and second by Stucky/Colenco JV in the year 2007 on an initiative and financial grant by the World Bank.

(i) CORE INTERNATIONAL INC (USAID) – Council of Ministers of Georgia, constituted two different Commissions of Specialists. Based on those Commissions conclusions, a revision of the initial version of Khudoni HPP project was carried out by TbilHydroproject in 1990-92. All possible versions of use of Enguri river energy potential between elevation 510m (highest point of Enguri HPP reservoir’s water level) and 700m elevation (over the sea level) of the river were considered. As a result, preference was given to a two step version. This concept foresees construction of 55MW Khaishi HPP (at 522 m elevation) and 638 MW Khudoni HPP (with max pond level of 670m). Khudoni HPP was redesigned as follows:

- Calculated earthquake resistance increased from Richter 8 to Richter 9.
- Dam height was decreased from 200m to 170m
- Water pond surface area decreased from 5.2 to 4.0 km²
- Area to be flooded decreased from 528 to 406 hectares
- Generation capacity reduced from 700 to 638 mw
- Estimated annual output decreased from 1660 GWh to 1445 GWh

(ii) Stucky/Colenco JV – Swiss Joint Venture Stucky/Colenco, the winner of the tender announced by the World Bank, has carried out an elaborate feasibility study for Khudoni Project and the French Italian company BRL/ARS has provided environmental impact assessment in relation to the Project. Strategic assessment of Khudoni HPP development has been provided by the Serbian company SEEC\(^2\). Panel of Experts composed of five members has been designated by the World Bank to work within the frames of the project. Khudoni HPP rated installed capacity was recommended to be 750MW, annual power generation reaching 1455 GWh. The concept of dam was revised as arch-gravity dam, to take care of the geological fault in dam foundation. The elevation of the plant lower pool was estimated to be 515m and that of upper pool 700m. Dam foundation was planned to be 501 m and dam crest to be arranged at an elevation of 702m the length of dam ridge was to be 522 m.

Based on the technical-economic justification made by the investor company as well as other studies\(^3\) it was concluded that generally the original concept based on which construction of Khudoni dam was started by the Soviet Engineers still is the best option.


\(^3\) Colenco Power Engineering Ltd. & STUCKY, Phase II, 2008; AF- Colenco Ltd. & STUCKY, Phase III, 2010.
1.3 Need for Project

Presently, the total installed capacity available in Georgia is 4700 MW out of which 2700 MW (approx.) is hydro based. It is interesting to know that first hydroelectric power project of Georgia was built in the year 1898 in Borjomula village and had an installed capacity 103 KW. Till the year 1960, approximately 300 small mini and micro plants were functioning in Georgia on regional basis and provided electricity to independent regions. After the establishment of centralized electricity grid most of these small and mini power plants suspended operations.

Of all the hydro energy resources in Georgian rivers, the river Enguri is estimated to have an approximate potential of 3,530 MW with power production potential as 10.3 billion KW. Out of this potential 5.5 billion KW has already been developed through the construction and operation of Enguri and Vardnili hydro power plants. In order to utilize the remaining part of economically feasible hydroelectric potential, it was proposed by the erstwhile Soviet Union engineers to construct Khudoni hydro power plant and Tobari hydro power plant in the upper reach of river Enguri at the elevations of 510 m and 1060 m. The proposed Khudoni dam is to be located in upper Svaneti on the southern slope of the main Greater Caucasus range.

During winter months there is a power ration in Georgia because of low river inflows and the power consumption is much larger as compared to summer months. During this period Georgia aims to satisfy all energy demands through domestic production and achieve independence from power generated by gas power stations. During summer months the reliable export market to Turkey exists. Therefore Government of Georgia has placed Khudoni Hydro Power Plant on high priority list.

The Russia - Georgia conflict has brought to the fore the vulnerability of the all-important Enguri hydropower plant as it straddles the administrative boundary with Abkhazia with the Enguri dam on the Georgia proper side and its turbines and power generators on the Abkhazian side of the administrative boundary. However, in the very worst crisis scenario where production from Enguri would be halted, Khudoni would still be able to produce its power.

1.4 Project proponent

The project owner is Trans Electra Ltd., which works mainly in Georgia and Eastern European countries in the field of hydro energy projects’ planning, research, implementation, exploitation and management. The company is willing to establish itself in the region’s hydro energy sector (by means of owning and implementing hydro energy projects). The founders and the highly qualified employees of the company as well as company’s Georgian and foreign contractors have many years of wide experience in hydro power plants construction.

In December 2009, a memorandum of understanding was signed between TransElectrica Ltd. and the Government of Georgia, represented by the Ministry of Energy for the construction of Khudoni HPP on BOO basis. The company then carried out investigations and framed proposals and submitted to the Government of Georgia. After this an implementation agreement was signed on the April 28, 2011 for further action leading to the construction of the project on BOO basis. The agreement provides reserving the electricity produced during the winter months for use in Georgia and for balance months the same can be exported.
1.5 Main technical characteristics of the Khudoni Hydro Power Project

Scope of the Project
After detailed techno-economic studies\(^4\) it has been concluded that the present partially done works at the existing Khudoni location still remain the best alternative.

The Khudoni Power Project envisages the following:
- Concrete Arch dam 200.5 m high
- Length of arch dam at crest 522 m
- Flooded area 528 ha
- Underground Power Plant Building 111m X 23.6m X 49m housing
- 3 no. Francis or Alstom Turbines generating 234 MW each
- Intakes, Head Race Tunnels
- Pressure Shafts & Tail races 3 no. each
- Net Power Generation per year 1500 Mkwh

Topography and Engineering Geology
The proposed Khudoni dam is to be located in Upper Svaneti valley on the southern slopes of the Main Greater Caucasus range where three distinct landscapes can be distinguished: the zone below 1,800 m above sea level is covered mainly by mixed forest and characterized by dominated erosive forms of terrain and rather dissected surfaces of river gorges. The zone located between 1,800-3,000 m above sea level the relief forms of old glacial genesis - trough gorges, moraines, circuses, kars, etc. dominate along with the erosive forms of the relief. The surface of this zone is heavily dissected. The zone above 3,000 m above sea level is mainly covered by eternal snows and glaciers.

The geology of the location of the Khudoni Power Project is as follows:
- Jurassic volcanic rocks, including clastic volcanic rocks and soft red brown sandstones of Middle Jurassic age;
- The dam section consists of fresh greenish grey igneous rocks and soft sandstones, fine grained shale overlaid by permeable and weathered rocks and loose unconsolidated sediments deposited by rivers. A fault consisting of crushed material which is the largest tectonic feature which affects the dam foundation, has also been noticed, however with proper grouting and dental concreting any adverse effect of this fault can be taken care of. On the left bank above elevation of 670 m alluvial overburden exists.

Seismotectonics
An assessment has been made of the regional geology in terms of seismotectonic behaviour of the project area\(^5\). It has been concluded that the works should take account of the following design criteria.

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\(^4\) Colenco Power Engineering Ltd. & STUCKY, Phase II, 2008; AF- Colenco Ltd. & STUCKY, Phase III, 2010.
\(^5\) Colenco Power Engineering Ltd. & STUCKY, Phase II, 2008; AF- Colenco Ltd. & STUCKY, Phase III, 2010.
• Maximum credible earthquake: Magnitude 9 earthquake.

• A smaller value can be adopted for batch plants and other temporary site installations.

Hydrology

Relevant records of discharges in the Enguri River are available from 1933. These provide a high quality basis for assessment of the energy available for hydropower generation. High flows are experienced during the April to September period. Flood frequency analysis has concluded that a flood discharge of 2,500 m$^3$/sec should be adopted for the design of the permanent works and that the diversion works should be designed for a non-monsoon flood of 1,000 m$^3$/sec. Annual inflows into reservoir have been estimated as 4,110 million m$^3$/sec.

Sedimentation

The Khudoni reservoir, according to its morphological properties and relief, is attributed to the mixed type of mountain reservoirs. For instance, the dam upstream to Khaishi village and on the Nenskra river tributary is of canyon type. Peculiar configuration of Khudoni HPP is favourable in terms of reservoir sedimentation. Only the main part of the reservoir (in Enguri River gorge) becomes silted with Enguri River’s suspended sediments and the parts of the reservoir located in the gorges of Nenskra and Tkeishi tributaries get silted up with their sediment loads. The sediment load of these rivers is quite small as compared to that of Enguri River. Accordingly, the data available for river Enguri upstream of Khudoni dam has been used for estimating sedimentation yield.

Power Evacuation

• A G I S sub-station of 500 KV has been proposed for evacuation of power

• 0.5 km of transmission line to connect switch yard to National Grid.

Infrastructure

Enguri HPP has already been developed just downstream of Khudoni HPP and therefore majority of the regional infrastructure is already in place. The most significant local infrastructure works had been put in place when the construction of the project was originally taken up. Of course the existing access roads and buildings earlier put up before suspension of project will need restoration and rehabilitation. Temporary construction facilities will be required including quarries and batching plants, etc.

Salient Features of the KHPP

Table 1. Location of the project

<table>
<thead>
<tr>
<th>a)</th>
<th>Location</th>
<th>Western Georgia, Upper Svaneti, Mestia Municipality, Khaishi village</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>405 km from Tbilisi and 70 km from nearest rail head Zugdidi</td>
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### Table 2. Hydrology

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<tr>
<td>a)</td>
<td>Design Discharge</td>
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<td>b)</td>
<td>Flood Discharge</td>
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### Table 3. Reservoir

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<td>a)</td>
<td>Entire Catchment Area</td>
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<td>b)</td>
<td>Capacity</td>
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<td>c)</td>
<td>Live Storage</td>
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<tr>
<td>d)</td>
<td>F R L</td>
</tr>
<tr>
<td>e)</td>
<td>M D L</td>
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### Table 4. Arch dam

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<tbody>
<tr>
<td>a)</td>
<td>Height</td>
</tr>
<tr>
<td>b)</td>
<td>Length at crest level</td>
</tr>
<tr>
<td>c)</td>
<td>Top width</td>
</tr>
<tr>
<td>d)</td>
<td>Base width</td>
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### Table 5. Underground Power Station

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<tr>
<td>a)</td>
<td>Machine Hall</td>
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<td>b)</td>
<td>Transformer Hall</td>
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<tr>
<td>c)</td>
<td>Control Room</td>
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Table 6. Gate chambers

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<tr>
<td>a)</td>
<td>Length</td>
<td>10 m</td>
</tr>
<tr>
<td>b)</td>
<td>Width</td>
<td>58 m</td>
</tr>
<tr>
<td>c)</td>
<td>Height</td>
<td>25 m</td>
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Table 7. Tunnels

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<td>a)</td>
<td>Main Access tunnel (MAT) to Machine Hall Cavern</td>
<td>10 m x 10 m, horseshoe, length-130m</td>
</tr>
<tr>
<td>b)</td>
<td>Diversion tunnel</td>
<td>10 m x 9 m horseshoe, length – 437.84 m.</td>
</tr>
<tr>
<td>c)</td>
<td>Lekhera diversion tunnel</td>
<td>3.30 m x 3.30 m diameter, horseshoe shaped, length - 240 m</td>
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<tr>
<td>d)</td>
<td>Intake Tunnels</td>
<td>3 no, each 6.0 m diameter, circular and of length - 57.46 m</td>
</tr>
<tr>
<td>e)</td>
<td>Head Race Tunnels</td>
<td>3 no, each 6.0 m diameter, circular and of lengths - 240m, 260m and 280m.</td>
</tr>
<tr>
<td>f)</td>
<td>Tail Race Tunnels</td>
<td>3 no, each 8 m diameter, circular and length – 145 m.</td>
</tr>
<tr>
<td>g)</td>
<td>Outfall Structure</td>
<td>3 no, gated area having opening size - 8m x 8m</td>
</tr>
<tr>
<td>h)</td>
<td>Pressure Shaft tunnels</td>
<td>3 no, each of 6.0 m diameter, circular and length 156 m.</td>
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Table 8. Gates

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<tbody>
<tr>
<td>a)</td>
<td>Spillway</td>
<td>3 no, each of size 9m x 12m</td>
</tr>
<tr>
<td>b)</td>
<td>Intake</td>
<td>3 no, each of size 10m x 13m</td>
</tr>
<tr>
<td>c)</td>
<td>Stop log gates</td>
<td>3 no, each of size 8 m X 8 m</td>
</tr>
<tr>
<td>d)</td>
<td>Gantry crane</td>
<td>3 no, each of 50 t capacity</td>
</tr>
</tbody>
</table>
Table 9. Turbines

| a) | Number | 3 no |
| b) | Type   | Francis or Alstom Vertical Axis Turbines |
| c) | Speed  | 187.5 RPM |

Table 10. Generators

| a) | Number | 3 no |
| b) | Capacity | 234 MW each |

Table 11. Power Output

| a) | Annual Saleable Energy (at Bus Bar) | 1500.00 GWH |

1.6 Construction Schedule and costs

The time required for construction schedule has been estimated considering the extent of already executed works which result in shortened construction period.

The time requirement for completing balance works has been estimated as six years. Implementation period of the Khudoni Hydro Power Project is April 2012 – May 2018. Duration of works – 73 months.

The estimated cost of the project is 778 million USD.
2.0 Alternatives for the Khudoni Hydro Power Project

Studies were done by Tbilisi Branch of Hydro Project Institute in 1955, to formulate a master plan for proper technical, economic, financial and environmental development of natural river fall in river Enguri. These studies and all other previous preliminary data available were again reviewed in 1960 and the cascade development of river Enguri for generating power was framed. The recommended cascade development is shown in the figure 2.0-1 below.

The construction of Enguri Dam was taken up according to this 1960 cascade plan. After completion of Enguri dam, the construction of Khudoni Dam was also taken up according to the same cascade scheme. The height of Khudoni Dam was kept at 200 m and the full reservoir level was 700 m. The construction started with these parameters and was quite advanced when it was suspended in 1989 due to a combination of various reasons including political, financial and seismic apprehensions.

Since, the Enguri dam and downstream cascade of Vardinili HP Plants (I, II, III and IV) already stand constructed, therefore any alternative evaluation is dictated by Enguri Dam reservoir and is possible only upstream of existing Khudoni Dam site. The World Bank mission and the Panel of Experts constituted by the Government of Georgia engaged a JV Stucky and Colenco (renowned international consultants in construction of dams and based in Switzerland) in 2007.
to carry out the detailed evaluations. The findings confirm the original Khudoni site as the most suitable location and also matching the long term strategy of energy development by the Government of Georgia.

The aim of evaluating various alternatives was to:

- Develop conceptual designs at each site varying the dam height and installed capacity to optimize the energy production. Studies made to sufficient detail to allow a proper technical, economic, financial and environmental assessment,
- Apply appropriate contingencies consistent with the level of information available for environmental, technical, economic and financial evaluations;
- Formulate rating criteria for technical, environmental-social-cultural, and economic and financial evaluations;
- Selecting and recommending the single best option.

The detailed topography and geology of the area leads to evaluation of the following four different sites. See Fig. 2.0-2.

I. Existing Khudoni Site: This is the original site selected by HydroProject and where substantial work stands done before suspension. The dam location is 113.7 km from the origin of Enguri River and has a river bed elevation of 530 m.

II. Khaishi 1 site: This can be at the upstream end of Khudoni Reservoir at river bed elevation of 700 m to match with Khudoni reservoir. This site had also been studied by HydroProject with 2 subalternatives having river bed elevation at 701 m (104 km from origin of river Enguri) and the 2\textsuperscript{nd} with the river bed elevation of 670 m (105 km from the origin of River Enguri).

![Fig. 2.0-2. Possible alternative locations of the Khudoni Dam](image)
Khudoni Hydro Power Project
Scoping document

III. Khaishi 2 site: This site is located 107 km from the origin of Enguri River at bed elevation of 635 m. This option combines the dam at this location with the underground power house cavern already excavated for Khudoni project.

IV. Khaishi 3 site: This site is located at 109 km from the origin of Enguri River at a bed elevation of 570 m. This also combines an upstream dam with the already excavated power house location of original Khudoni Project.

The merits and demerits of the above mentioned 4 alternatives are given below:

I. Existing Khudoni Site:

2 possible scenarios emerge:

(a) 170 m high arch dam with full reservoir level at 670 m. This alternative had emerged after the studies undertaken by United States Agency International development (USAID) mission and CORE International Inc. (consultants for resource evaluation) in the year 2005. This alternative decreases the installed capacity to 630 MW from the original envisaged 700 MW. This involves part spilling of water without producing electricity during high river inflow season. This is due to reduced capacity of the reservoir. This reduction in summer energy produced, makes this option uneconomical because most of the revenues are earned by export of this summer energy to neighbouring countries. It is also pointed out emphatically that even the so reduced height of the dam still involves flooding of Khaishi village. Another concern of USAID mission was the seismic activity risk and non availability of competent rock above 670 m elevation on the left bank. Both these concerns have been adequately addressed in the proposals now finalized by suitable engineering designs.

- Increasing seismic coefficient from 8 to 9 on Richter scale (it may be noted that Enguri dam has been designed with much less seismic coefficient)
- Removing the incompetent soil strata from above 670 m and replacing the same with high strength concrete, making it suitable for the left bank abutment.

(b) This original option of 200 m high arch dam as envisaged by the then Soviet engineers with full reservoir level at 700 m and installed capacity of 700 MW as has been established by all the studies done so far by various agencies is still the best and has therefore been retained.

This site has a big advantage in the use of already degraded areas because of substantial surface and underground excavations already done.

II. Khaishi 1 site:

At this location, 8 different alternatives involving run of the river schemes with low diversion weirs, medium height concrete dams and high height dams were studied. At this location, the catchment area of the river is substantially reduced to 1930 km² in comparison with 2780 km² for the exiting Khudoni site. The annual river inflows also decrease to 2700 million m³ per year compared to approx. 4000 million m³ per year at the existing Khudoni site. Therefore less water
Khudoni Hydro Power Project

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is available for generation at this site. The river bed level at this site for all the proposals is 633 m and a head race tunnel between 7.5 to 9.0 km will have to be constructed to connect with the existing underground power house cavern of Khudoni Dam. The construction of this tunnel, as also huge underground de-silting chambers in case of run of river alternatives, through comparatively weaker geology poses many geological and environmental risks and can cause damages to the existing surface constructions. An additional access road of approx 10 km length is also required to be constructed besides a bridge over river Nenskra for future access. The existing Khudoni site access roads are already constructed.

The site is geologically suspect and therefore technically almost infeasible. The low profile concrete diversion weirs would require associated underground descending facilities and create a very small pond for adequate submergence for intake operation. On the other hand, the construction of high dams will have geological foundation issues and at the same time, create comparatively smaller reservoirs. Any development at this site will preclude development of Enguri River between this site and the tailrace of existing Khudoni Power house. This option also involves the construction of steel aqueduct for crossing River Nenskra.

III. Khaishi 2 site

This site is located upstream of the confluence of Enguri and Nenskra Rivers the dam site for this alternative is located at river bed elevation 633 m. This option can also have run of the river scheme, low dam, medium dam and high dam alternatives. In this case also, the catchment area decreases to 1940 km² and annual inflow to 2700 million m³ per year which is much less than the corresponding figures for Khudoni dam site. This option also involves construction of approx. 6 km of head race tunnel to link with the existing underground waterways at Khudoni. An underground de-silting chamber will have to be constructed in poor geology which has many geological and environmental risks besides potential damages to existing surface constructions. An additional access road of approx 8 km length is also required to be constructed besides a bridge over river Nenskra for future access. The existing Khudoni site access roads are already constructed. The run of the river schemes have very limited storage capacity for daily regulation and winter generation. The river profile is steep for 3 km from this location to upstream and then flattens, therefore restricting the reservoir volume. Dam with the same height at existing Khudoni site has a much larger reservoir. All the options at this site will preclude any downstream development on Enguri River to the tailrace works of existing Khudoni Power house. Since this site is located upstream of the confluence of Enguri and Nenskra Rivers, the water availability is further reduced. Because of poor geological conditions high dams may not be feasible and low dams though feasible, will be expensive to construct, operate and maintain.

IV. Khaishi 3 site

This dam site is located between the confluence of Enguri and Nenskra River and village Khaishi at river bed elevation 566 m and has 5 different alternatives. With the run of the river comprising low diversion weir, medium dam and 2 variants of high dam. The exploitation of this alternative also involves the construction of head race tunnel 4.3 km long and an underground de-silting tank to link with the existing underground works at existing Khudoni site in poor geology. Considerable geological and environmental risks are therefore involved besides potential damage threat to existing surface constructions. The catchment area and annual inflows in this option also get reduced to 2550 m² and 3700 million m³ per year. An additional access road of
approx 6 km length is also required to be constructed. The existing Khudoni site access roads are already constructed.

The natural river slope is also very steep between km 104 to km 109 and this steep topography doesn't allow optimum reservoir capacity. All the options at this site will preclude development on the Enguri River downstream of Khaishi village to the tailrace of existing power house site.

**Technical Analysis**

- **Geology** - The difference between the data available and validated for geology and geotechnical parameters between the Khudoni site and any other site is enormous. Clearly the geological risk for the construction of head race tunnels to the existing power house exists as well as the risk for the actual foundation for any dam constructed. In principle the geological conditions deteriorate the further upstream from the existing site at Khudoni. However one site at the Khaishi 1 downstream location does seem to provide a suitable location for a high dam with competent rock out crops evident – the river bed elevation at this location being 670 m (this would mean however that the Khudoni Dam could only be built to 670 m)

- **Construction Schedule** – The construction time will be shortened on account of amount of geological information available to allow final design to be prepared, the existence of site installation platforms and the fact that the river diversion and cofferdams are in place and need only repair. In addition the relocation of the road network around the reservoir is largely in place. For all other alternatives these mentioned preparation works shall add to between 3 and 6 years to the construction program. For the above reason the Khudoni site has clear advantages for development.

**Operation Analysis**

- **Hydrology** - Should any other site apart from the Khudoni site be developed then the power potential of the river reach between that site and the location of and other dam or intake cannot be used reducing the hydro power development capacity for the river reach. Should a run of river or low dam be constructed as per one of the Khaishi alternatives then it will be impossible to construct a dam in the future at the Khudoni location. Annual inflow for Khudoni is in the range of 3'700 Mm³ decreasing to 2'600 Mm³ for the Khaishi 1 alternatives.

- **Installed Capacity** – Due to the size of the existing power house cavern, the advanced state of the excavations and the fact that certain geological problems were encountered during the excavation it is preferred not to alter the existing works and to complete the cavern in the current configuration. As such the size of the installed units is limited to 702 MW total. In addition the cavern and upstream waterways will be over sized and the existing investment lost should a small installed capacity be used. For all high dam alternatives considered an installed capacity of 702 MW is possible with this capacity reducing for the lower run of river plants. For the Khudoni site an installed capacity of less than 702 MW would mean spilling water thus losing generation power. To have a higher than minimum installed capacity allows further development, back up and fluctuations in the inflow over the years. For this reason the Khudoni site and an installed capacity of 702 MW is optimum. Of important note is that the smaller installed capacity of the alternatives less than the 702 MW reduces the possibility for export sales during high demand times.

**Economy**
The economic main indicators are the investment costs, internal rate of return on the investment and the net present value of the investment. On this account also, the existing Khudoni site project configuration is better than other alternatives.

- Sunken Costs - Of note is that the investment made to date (the sunken costs) in the project for the existing works is estimated at around US$ 178 Million inclusive of tax. The investment made in the dam concrete and excavation, river diversion, site installation platform construction and reservoir access road construction will be lost should any other site be developed.

- Cost to completion - Inclusive of taxes per kW installed varies from just over US$ 1000 per kW to US$ 3'500, the Khudoni site being the cheapest.

- Economic indicators - The Khudoni site is significantly the best performing in this respect

Environmental, Social and Cultural Issues

The aspects related to this part of the study have been dealt with by the BRL joint venture but are summarized here for ease of reference.

- All alternatives looked at, inclusive of the existing Khudoni site, have associate environmental problems to be addressed. These amount to over US$ 5 Million for waiting compensation to non resettled people and repair of environmental damage (erosion, etc.)
- All alternatives have associated costs for resettlement however the Khudoni alternative has the highest costs at around US$ 60 million.
- Social and cultural – these issues, although important in terms of the information flow and welfare of the population have a much less financial implication being of the order of US$ 4 million for the Khudoni site and US$ 2 million for all other alternatives studied.
- Impacts – impacts on the local community will be felt whatever dam site is selected due to the close proximity of the major construction works. Should one of the Khaishi alternatives be selected, then major reconstruction of the roads through the village will be required. Strict dust and noise limitation measures have to be put in place and the negative influence of migrant workers has to be correctly managed which is not an easy task.

The analysis and comparison of alternatives showed that the existing Khudoni dam site with a 200 m high arch dam is the best available option. Therefore, the following shall be taken into account:

1. The river inflow varies extensively between summer and winter months. Therefore, most of the generation shall take place during summer months and generate revenues by way of exports. Therefore, it is imperative that storage reservoir capacity should be as large as possible to avoid spilling of water without generating electricity (which will be ensured by the designed 200 m high dam).

2. The topography of the area above the existing Khudoni dam doesn’t now allow a reservoir of substantial live storage to be formed even after constructing 200 to 250 m high dam.

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8 Colenco Power Engineering Ltd. & STUCKY, Phase II, 2008.
9 Ibid
10 Ibid
3. For any run of the river, project configurations above the existing Khudoni site long head race tunnels and huge underground de-sanders need to be constructed in poor geology. These constructions not only render these options uneconomical but also entail huge geological and environmental risks and damages.

4. Any developments at the alternative sites preclude the possibility of utilizing the river fall between that location to the tail race outlets location of existing Khudoni Dam site.

The results of all these studies\(^{11}\) show that based on an overall appreciation of the task, with regards to environmental and geological considerations, and the goals of the Georgian Government to develop to maximum extent the hydro power resources of River Enguri, the existing Khudoni dam site with a 200 m high arch dam is the best available option. These conclusions have been drawn in full appreciation for the social, environmental and cultural issues involved by burdening the project financially including mitigation measures expenses. These conclusions are in line with and have been corroborated earlier by the World Bank mission, Panel of Experts appointed by the Georgian Government and the studies carried out by JV Stucky and Colenco.

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\(^{11}\) Colenco Power Engineering Ltd. & STUCKY, Phase II, 2008; AF- Colenco Ltd. & STUCKY, Phase III, 2010.
3.0 ESIA for the Khudoni Hydro Power Project

3.1 ESIA Process

An environmental and social impact assessment (ESIA) is a process of assessing the possible negative and positive impacts that a proposed project may have on the environment, considering natural, social and economic aspects. The purpose of the assessment is to ensure that decision makers consider the environmental and social impacts of the proposed development prior to final decision-making.

The ESIA process has the following main stages:

- Scoping;
- Environmental baseline study;
- Potential impacts assessment; and
- Development of environmental and social management plans considering environmental monitoring at the next stages of the project development.

3.2 Scoping

The objectives of the scoping of the Khudoni Hydro Power Project are as follows:

- identify applicable legislation, guidelines, standards and criteria to be considered in project planning;
- determine the scope of the environmental and social baseline;
- define key environmental and social issues and concerns to be addressed by ESIA;
- identify opportunities to avoid, minimize and mitigate impacts through the identification of feasible alternatives in the location, technology and design of the proposed project;
- identify potential important barriers that would prevent project implementation;
- identify sensitive areas;
- inform all stakeholders of the proposed project and ESIA process; and
- finalize the Terms of Reference for experts undertaking the impact assessment.

3.3 Next Stages

At the next stages of the ESIA process the baseline information on the project area and potential impacts of the project on natural and social environment will be obtained.

Objectives of the Impact Assessment stage:

- description of potential environmental and social risks and impacts;
- evaluation of the significance of risks and impacts during construction and operation;
• identify beneficiaries and affected parties; and
• identify measures to avoid, minimize, mitigate or compensate any adverse and residual impacts.

Objectives of the Environmental and Social Management Planning stage are to:

• define the main goals of management;
• outline and prioritize management activities;
• define objectives or acceptance criteria;
• identify performance indicators;
• outline resources required for implementation;
• specify timeframes for implementation;
• define responsibilities for implementation; and
• outline monitoring programs.

3.4 **Key Guidance Documents for ESIA**

ESIA of the Khudoni Hydro Power project is based on and guided by:

• The Georgian legislation: *Law of Georgia on Protection of Environment* and *Law of Georgia on Environmental Impact Permit*;

• The World Bank and EBRD environmental and social performance requirements;

• International conventions ratified by Georgia; and

• The World Bank and EBRD stakeholder engagement requirements.

3.5 **Participants of ESIA**

CENN (Caucasus Environmental NGO Network) has been retained by TransElectrica Ltd. to carry out ESIA of the Khudoni Hydro Power project.

APLR (Association for Protection of Landowners Rights) is working on resettlement plan. The project risk and safety issues are studied by Trans Electrica Ltd.
4.0 Key issues identified at the scoping stage!

4.1 Area of influence of the Khudoni Hydro Power project construction and operation

The construction (construction of the dam, arrangement of a water reservoir, selection of sites quarries of inert materials, road construction, resettlement, etc.) and operation of the Khudoni HPP complex will have an influence on the areas adjacent to the Khudoni HPP site in terms of development of geological-geomorphological, hydroclimatic and biological processes and socio-economic impact.

The analysis of the problems associated with likely impacts of the mentioned facility – activation of landslides, mudflows, rockfalls; degradation of vegetation and biota; change of access roads; relocation of social and cultural facilities and resettlement of the population shows that the area of influence of the Khudoni HPP will cover the both slopes of the Enguri river at the elevation of up to 500-1,200 m above sea level and at a distance of about 10-12 km upstream the dam site. Khudoni HPP construction site is locates in the lowest part of upper Svanet depression. The length of the depression long the river Enguri is approximately 114 km, while the maximum width – 42-46 km is reach new the location of dam. The uppers Svaneti depression represents the catchment of the river Enguri upstream from the location of Khudoni dam.

The mentioned area will include: 1) the southern, south-western and south-eastern slopes of the Likhni (2,361 m), Skormeti (1,835 m) and Uturi (3,270 m) mountains on the right side of the Enguri river gorge where the residential houses, farmlands, agricultural lands, forest and meadows of the villages Leburtskhila, Idliani, Skormeti, Tobari, Lakhani and Kveda Kedani are located. 2) the northern and north-western slopes of the Samegrelo (Egrisi) range and the slopes of the north-westernmost section of the Svaneti range with the farmlands, agricultural lands, forests and meadows of the villages Nalkhorvali, Khaishi, Kveda Tsvirminda and Kveda Vedi.

The construction of the Khudoni HPP will have a partial influence on the areas located along the bed of the Enguri gorge downstream the high dam where the various construction infrastructure facilities will be located.

Socio-Economic Conditions: The area of socio-economic influence of the project will be determined using the following criteria:

Groups under the direct influence:

- The population the residential houses of which will be flooded due to the project implementation (population within the flooded zone);
- The population having residential houses on the areas adjacent to the flooded zone;
- The population the residential houses of which will be isolated due to the project implementation;
- The population on the territory of which the people for the flooded zone will be resettled.
- Private companies having infrastructure on the areas adjacent to the gas pipeline and surface facilities.
Groups under the indirect influence:

- The population having residential houses on the areas adjacent to the project zone.

The area of socio-economic influence of the project will be determined on the basis of the socio-economic data and stakeholder/focus group consultations.

ESIA studies the settlement structures, land use types and socioeconomic conditions of the above target groups (communities).

The Resettlement Action Plan will study the status of the affected lands and structures.
### 4.2 Key issues and possible mitigation measures

<table>
<thead>
<tr>
<th>Key issues</th>
<th>Possible mitigation measures</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Seismicity</strong></td>
<td></td>
</tr>
<tr>
<td>The part of the Enguri river gorge where the Khudoni HPP will be constructed is located within the Gagra-Java tectonic zone. Nearby some deep faults are recorded. Therefore the area is characterized by high seismic potential (M=7). The earthquakes of a medium magnitude (M=4-5) are associated with the above tectonic faults. The most notable are the Chkhalta earthquake (1963, M=6.4), the epicenter of which was 50 km far from the dam site and the Racha earthquake (1991, M=7) with the epicenter located at a distance of 120 from the Khudoni HPP.</td>
<td>The seismicity of the area shall be considered in the project technical-engineering parameters. The seismicity coefficient shall be increased from 8 (as was initially designed) to 9 on Richter scale. A local seismic network should be arranged around the Khudoni HPP construction site to determine the parameters of nearby tectonic faults and specify the seismic hazards.</td>
</tr>
<tr>
<td>According to the seismic division map of Georgia the Project area is included in 9 magnitude earthquake intensity zone of Richter scale magnitude. When constructing high dams a so-called induced seismicity, which may be demonstrated once the reservoir is filled shall be considered along with the natural (tectonic) seismicity. Generally, the earthquakes caused by induces seismicity are of medium magnitude (M=5), however may have rather significant local effect.</td>
<td></td>
</tr>
<tr>
<td><strong>Activation of the Engineering-geomorphological processes due to implementation of engineering works</strong></td>
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</tr>
<tr>
<td>The initial assessment of the Khudoni HPP site revealed the trends of the development of existing geodynamic processes and their activation in the future. Among these processes the most notable are macrofragmental rockfalls and existence of clastic slopes in the gorges of the Enguri river and its tributaries. A number of landslide areas are also recorded on the slopes of the mentioned gorges.</td>
<td>Once the reservoir is put into operation the movement of large amounts of ground and clastic materials into the reservoir is expected. This issue shall be further studied.</td>
</tr>
<tr>
<td><strong>Geology</strong></td>
<td></td>
</tr>
<tr>
<td>Jurassic clay-shales, sandstones and volcanic rocks overlaid by Quaternary river alluvium (cobble, sand gravel) on the bottoms of the river gorges and somewhere on the adjacent slopes and delluvial-proluvial gravel clays are found on the surface of the study area.</td>
<td>Engineering-geologic characteristics of the rocks developed on the slopes of the gorges and riverside areas as well as thickness of the Quaternary sediments found on the bottoms of the river gorges shall be taken into account.</td>
</tr>
<tr>
<td><strong>Climate</strong></td>
<td></td>
</tr>
<tr>
<td>The area of influence of the Khudoni HPP construction and operation located at a height of 500-1,500 m above sea level is characterized by humid climate with moderate cold winters and long cool summers. The mean annual temperature of air is 12-13(^{\circ})C. Air temperature in winter varies between -3 - -0.5(^{\circ})C, absolute minimum reaches -27 – 23(^{\circ})C, annual precipitation – 1,200-1,500 m, mean decade snow cover height – 20-80 cm, duration of snow cover – 1-2.5 months.</td>
<td>During frosty days there may be interruptions in concreting operations. Some more activities may be delayed due to the steady and relatively deep snow cover. To avoid the mentioned interruptions in operations all requires measures shall be implemented.</td>
</tr>
</tbody>
</table>
## GREENHOUSE GASES

Emission of greenhouse gases (Methane CH₄, Carbon dioxide CO₂, etc.) may occur at the Khudoni HPP construction stage and as a result of decomposition of organic matter in the reservoir. The area of the future reservoir shall be cleaned from the vegetation (tree trunks, branches, leaves, grasses). The emissions of greenhouse gases at the construction and reservoir operation stage shall be studied.

## HYDROGRAPHICAL NETWORK

The surface (surface area at normal pool elevation – 5.28 km², volume of water – 364 million m³) of the reservoir created as a result of blocking the Enguri river gorge with a high dam will cause spatial and temporal redistribution of liquid and solid flows of the Enguri river. This will lead to the change of hydrological, hydrothermal, hydrochemical and hydrobiological regimes of the river which contribute to the development of the morphodynamic processes along the rivers upstream the dam. The vegetation along the river banks will degrade leading to reduction of fish spawning areas. The basic legal rights related to rivers and surface water objects specified in the Law of Georgia on Water shall be observed, a brief hydrological analysis of the Enguri river basin shall be carried out, the characteristics of the water regime, as well as the values of mean annual, maximum and minimum flows and solid flows at the dam cross section shall be specified. Determination of the likely impact of the volumes of liquid and solid inflows of the river on Khudoni HPP construction and operation.

## UNDERGROUND WATERS

The Enguri river is fed by its tributaries and underground streams flowing from the slopes, therefore the planned reservoir will hamper underflow discharge of surface and underground waters leading to the rise of the levels of underground waters on the slopes. This will result in increase of water content on the slopes and sharp reduction of the stability of their subsoil. The adjacent slopes will become unstable. Increased levels of underground waters on the slopes will increase the water content in subsoil and may lead to activation of landslide and rockfall processes. The engineering-geological characteristics of the rocks of the slopes adjacent to the Khudoni water reservoir and neighboring areas shall be considered and adequate landslide prevention measures shall be implemented.

## SOILS

Mainly forest podzolized soils of medium and small thickness and fragmented podzolized grey soils are found within the study area. The fragments of meadow alluvial soils are also found on the bottoms of the river gorges. Soil removal-stocking and reinstatement-reclamation activities shall be implemented on the construction site and flooded area with observation of the requirements of the Law of Georgia on Soil Protection and the Law of Georgia on Conservation of Soils and Restoration-Improvement of their Fertility.

## VEGETATION

The broadleaved forests are widespread within the project influence area located at a height of 500-1,200 m above sea level. Oak (Quercus iberica) and hornbeam (Carpinus orientalis) forest are found in the relatively dry areas, while chestnut (Castanea sativa), beech (Fagus orientalis), etc. grow on humid slopes. The majority of forests are degraded to a different extent due to the human activity. Implementation of the requirements of the Forest Code of Georgia and restoration of the protected species in accordance with the rule established in the Law of Georgia on Biodiversity during implementation of forest cutting activities on the territory of the future water reservoir. Instituting strict control over forest cutting activities within the construction influence area.

## FOREST

On the basis of obtained information the quantitative and qualitative characteristics of the forest fund (identification of forested agricultural lands, unused areas, forested areas) shall be carried out. Identification of the measures to mitigate the negative impacts of the construction.

### Inventory of the areas of the forest funds adjacent to the reservoir.

<table>
<thead>
<tr>
<th>Scoping document</th>
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</thead>
<tbody>
<tr>
<td>Implementation of the requirements of the Forest Code of Georgia and restoration of the protected species in accordance with the rule established in the Law of Georgia on Biodiversity during implementation of forest cutting activities on the territory of the future water reservoir. Instituting strict control over forest cutting activities within the construction influence area.</td>
</tr>
</tbody>
</table>
Khudoni Hydro Power Project  Scoping document

areas by important timber tree species). It will be necessary to identify the exact area of the forest that will be subject to clear cutting and to determine relict, endemic and red listed timber tree species.

the future water reservoir shall be required to avoid negative impacts occurring during and after the construction process, as well as to ensure and increase the sustainability of the above forested areas.

The inventory materials shall serve as a baseline data for the monitoring to be implemented during the construction and operation of the reservoir.

<table>
<thead>
<tr>
<th>FAUNA</th>
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<tbody>
<tr>
<td>According to the studies carried out to date, 2 species of amphibians, 7 species of reptiles, 249 species of birds and 55 species of mammals are widespread within the study areas. Their existence is associated mainly with the forest coenosis. Caucasus viper (<em>Vipera kaznakovi</em>) red listed endemic reptile is found in the forests of the Enguri river gorge.</td>
</tr>
<tr>
<td>To mitigate the impacts of the project the following activities shall be carried out within the study area:</td>
</tr>
<tr>
<td>• Identification of significant ecosystems in terms of animal biodiversity;</td>
</tr>
<tr>
<td>• Identification the animal species with indication of protected and endemic ones;</td>
</tr>
<tr>
<td>• Identification of sensitive areas; and</td>
</tr>
<tr>
<td>• Assessment of likely impacts of the Khudoni HPP construction.</td>
</tr>
<tr>
<td>The Khudoni water reservoir like other dam lakes is less important for water birds as a nesting, wintering, feeding and resting area.</td>
</tr>
<tr>
<td>To mitigate the adverse impact on ichthyofauna:</td>
</tr>
<tr>
<td>• the construction norms shall be strictly observed;</td>
</tr>
<tr>
<td>• the river pollution shall be prevented; and</td>
</tr>
<tr>
<td>• a fishway shall be arranged to facilitate the anadromous migration (Black Sea salmon, hop, starry sturgeon, Colchic sturgeon)</td>
</tr>
<tr>
<td>The project implementation will have a considerable impact on the ichthyofauna, including trout (Georgian red listed species), Caucasian chub, Colchic barbel, Colchic nase, of the Enguri river and its tributaries within the project area of influence.</td>
</tr>
<tr>
<td>LANDSCAPES / VISUAL</td>
</tr>
<tr>
<td>The project implementation will have considerable visual impact on landscapes both at the construction and operation stages.</td>
</tr>
<tr>
<td>At the construction stage the impact due to construction of roads, movement of goods/traffic, arrangement of constriction sites, appearance of the buildings under construction, construction materials and machinery will occur.</td>
</tr>
<tr>
<td>At the operation stage the major changes of the landscape is expected due to the dam, surface infrastructure of the hydro power plant and flooded area.</td>
</tr>
<tr>
<td>WASTES</td>
</tr>
<tr>
<td>At the construction and operation of the Khudoni HPP the generation of the different volumes of the following wastes is expected: hazardous wastes, non-hazardous wastes, inert construction and household wastes.</td>
</tr>
<tr>
<td>The waste management plan for the project implementation process shall be developed in accordance with the following principles: waste hierarchy (implying ranking of activities in terms of their optimality in waste management); duty of care (a person generating or holding the wastes is obliged to ensure proper waste management), BATNEEC principle (application of the best available techniques not entailing excessive costs) and “Polluter pays” principle (obliging the party responsible for producing pollution to pay for the</td>
</tr>
</tbody>
</table>
**EMISSIONS**

During the construction process the deterioration of the air quality is expected within the construction site due to high concentration of road-construction machinery, vehicles, dump trucks, concrete carriers within the limited area, as well as operation of concrete plants and fractionation of inert materials. Emissions of hazardous substances generated by infrastructure of fuels and lubricants (warehouses) and during welding operations shall be taken into account.

To mitigate the impacts the construction companies shall be advised to use modern machinery which meets international environmental standards. The concrete plants shall be equipped with standard filters, the fractionation of inert materials shall be implemented using the wet method, warehouses of fuels and lubricants shall be arranged at safe location with observation of all standards, the engines of the vehicles shall undergo periodical inspection on emissions and maintenance, watering of temporary roads shall be considered to avoid dust pollution, etc.

**NOISE**

Earth works, arrangement of construction works, construction of new road sections, drilling operations, explosive operations, quarries, batch plants and other activities will generate high levels of noise and vibration. Noise generated by traffic movement will be also significant.

The noise level will be increased within 1-2 km from the construction site; however it will have a temporary character.

Noise generated during the implementation of underground activities will have a negative impact on the health of the people working underground (tunnels).

The power plant will be located under the ground. Noise generated due to the movement of water and air during operation of its turbines, generators, transformers will have negative impact on the personnel.

Noise sources also are: aeration pipes, compressor house and pumps, air-feed system under turbine wings, supporting facilities, etc.

The main task of the assessment of environmental impact of noise is the calculation of the cumulative impact of noise sources and determination of the expected noise level at controlling-measuring points. To assess the impact of noise and vibration on the environment the relevant characteristics of the various construction machinery and technological processes shall be determined, the sources of concurrent noise sources shall be identified and the potential impact at the controlling-measuring points shall be calculated. The baseline noise level shall be determined at controlling-measuring points in advance.

Noise protecting measures shall be implemented to protect the personnel from the adverse impacts of noise.

**OCCUPATIONAL HEALTH AND SAFETY ISSUES**

**Khudoni Hydro Power project construction stage**

At this stage the following health and safety issue should be considered:

- Inadequate workplace conditions for workers - inadequate working conditions and related workplace safety issues are of primary importance at the construction stage. Inadequate workplace conditions could cause serious problems to the workers;
- Dust, noise and vibration generated at the construction stage will have negative impact on the personnel;
- Workers’ accidents.

The Georgian legislation (The Labor Code of Georgia (25 May, 2006), The Sanitary Code of Georgia (May 8, 2003), The Law of Georgia on Public Health (June 27, 2007), The Law of Georgia on Healthcare (December 10, 1997), The Law of Georgia on Safety of Hazardous Enterprises (October 12, 1997)) and the international requirements (PR 2: Labor and Working Conditions of EBRD Environmental and Social Policy) and International Labor Organization (ILO) core labor standards will be observed to mitigate the abovementioned potential negative impacts.
<table>
<thead>
<tr>
<th>Khudoni Hydro Power project operation stage</th>
<th>Scoping document</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Inadequate working conditions and related workplace safety issues;</td>
<td></td>
</tr>
<tr>
<td><strong>SOCIAL HEALTH AND SAFETY ISSUES</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Khudoni Hydro Power project construction stage</strong></td>
<td></td>
</tr>
<tr>
<td>• Dust, noise and vibration generated at the construction stage will have negative impact on the local population;</td>
<td></td>
</tr>
<tr>
<td>• Workers misbehavior / socio-cultural differences /potential conflicts of migrant workers enter area and diseases associated with the arrival of temporary labor in the area;</td>
<td></td>
</tr>
<tr>
<td>• Vibration due to movement of heavy machinery on the existing roads;</td>
<td></td>
</tr>
<tr>
<td>• Possible accidents of local community members at the construction stage.</td>
<td></td>
</tr>
<tr>
<td><strong>Khudoni Hydro Power project operation stage</strong></td>
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<tr>
<td>• Noise generated at the operation stage will have negative impact on the local population;</td>
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<td>• Air emissions - exhaust gas emissions produced by the combustion of natural gas or liquid hydrocarbons in turbines, compressors, pumps and other engines for power and heat generation, are be the most significant source of air emissions;</td>
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<tr>
<td>• Security issues - unauthorized access to the territory of hydro power plant;</td>
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<tr>
<td>• Public health risk associated with the change of water quality.</td>
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<tr>
<td><strong>SOCIOECONOMIC INFLUENCES</strong></td>
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<td>A significant physical and/or economic resettlement (the physical resettlement involves the change of place of residence, and economic - the loss of income sources) will occur on the project area.</td>
<td>TransElectrica Ltd will be required to hold Intensive consultations and relationship building with the affected population and the representatives of local small businesses to develop a relevant resettlement action plan, property acquisition/compensation strategy and methods and actions for livelihood rehabilitation.</td>
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<tr>
<td>Khudoni Hydro Power Project will have potential impact on local small businesses (sow-mills, shops, drugstores, etc.)</td>
<td>A mechanism for the timely consideration and response to lawful complaints and claims of the population affected by the project and implementation of mitigation measures should be developed before commencement of the process of land acquisition.</td>
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<td></td>
<td>Implementation of activities directed to the rehabilitation of social networks through provision of alternative livelihoods or other relevant mitigation</td>
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<tr>
<td><strong>Khudoni Hydro Power Project</strong></td>
<td><strong>Scoping document</strong></td>
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<tr>
<td>Measures will be required. Issues and procedures for the compensation of damage caused to informal land users as a result of loss of immovable property and source of income shall be considered.</td>
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</table>

**Cultural Heritage and Archaeology**

The archaeological sites studied in the eighties of the 20th century and requiring further research as well as the modern cemetery and the Saint George Church to be flooded fall within the direct influence of the Khudoni HPP.

At the present stage of the assessment of impacts of the project on cultural heritage the further research of the areas to be flooded, as well as the assessment of the likely impacts on cultural heritage objects at the construction stage, development of relevant recommendations and the map of the cultural heritage objects is advisable.

For the purpose of prevention of destruction and damage of archaeological monuments the implementation of the archeological monitoring will be required at the construction stage.

The issue of relocation of the Church and the cemetery shall be agreed with the population, Patriarchate and the Ministry of Culture.

**Emergency Situations and Safety**

Impact of a surge developed as a result of dam brake

Mathematical forecast of the downstream impact of a surge developed as a result of dam brake, which implies determination of temporal variation of main parameters of a dam-brake surge for each section, i.e. creation of a temporal computer model of inflow, depth, velocity and maximum depth of flooding (where the duration of a reservoir emptying is considered and the cross sections of the riverbed are numbered).

Examination of the existing engineering documentation and measurement-inspection appliances/planned monitoring measures;

Identification of accident contributing factors and scenarios.

Development of a plan on provision of the dam with safety and measurement-inspection appliances/monitoring considering the specific requirements:
- characteristics of the existing safety system and its shortcomings;
- the personnel responsible for safety, management and competency development needs;
- required preventive and mitigation measures and procedures;
- monitoring procedures;
- specifications of measurement-inspection appliances;
- operation schedule, monitoring schedule
5.0 Approach for land acquisition and resettlement

According to the preliminary data the construction of the Khudoni Hydro Power plant on the river Enguri in the Mestia Municipality of the Samegrelo-Zemo Svaneti region may involve physical as well as economic displacement. Although at the present stage the scope and scales of resettlement are not determined and a number of activities still have to be implemented (inventory of immovable property within the project area, socio-economic baseline survey, etc.), some general assessment can be made about the impacts. The potential construction site of the Khudoni Hydro Power plant is located on the territory of the two municipalities: Mestia and Tsalenjikha. The project area covers the settlements with residential houses, private land plots, monuments of cultural heritage, etc.

Assets potentially affected by the Project may include legally registered (under Public Registry) as well as non-registered assets of various types (including private farmlands and agricultural land plots), municipal and state land with titled as well as non-titled occupancy. Project implementation may also cause negative social and economic consequences, including loss of land plots, residential houses and supporting buildings, businesses and work places, disruption of the social network, loss or restriction of access to natural areas and infrastructure, etc.

Land/asset acquisition and resettlement of the affected people involves the preparation of a relevant Resettlement Action Plan, taking into account the Georgian legislation and regulations as well as IFI’s requirements as per Environmental and Social Policy.

A resettlement plan includes the inventory and socio-economic study of the area of project influence, the results of the consultations with the population being under direct and indirect influence of the project and other stakeholders and therefore enables the organizations involved in the project implementation to have a realistic picture of project impacts and the scales of unavoidable resettlement.

In particular, a resettlement plan includes the following:

- Description of Project impacts on land, immovable assets and people in accordance with the environmental and social policy of IFIs and the Georgian legislation;
- Legal analysis (what is the legal framework for compensation of affected properties in Georgia and what are the gaps, if any, with the requirements of IFIs, including the World Bank (OP 4.12 and OP 4.12) and EBRD);
- Categorization of affected assets (for example land with title, municipal or State land with non titled occupancy, apartments in municipal housing, individual houses, etc.);
- Description of the population within the Project influence area (household composition, age structure, occupation, jobs, livelihoods, etc.); inventory of assets/land and harvests;
- Description of the land tenure regime in the Project area and related issues;
- Identification of all potential negative impacts (loss of residential houses, businesses and work places, services and cultural heritage, disruption of the social network, loss or restriction of access to natural areas and infrastructure);
- Entitlement framework (proposed compensation measures for each category of affected assets/people);
Assessment of potential livelihood restoration measures;

Consultation with stakeholders on resettlement, potential compensation and livelihood restoration measures; and

Action plan, including preliminary costing, implementation arrangements and timeframe.

The main principle during land acquisition and resettlement will be offering affected communities compensation for loss of assets at replacement cost, which is usually calculated as the market value of the assets plus the transactions costs related to restoring such assets.

Compensations have to be provided to people who have formal legal rights to the land, persons who do not have formal legal rights to land at the time of the census, but who have a claim to land that is recognized or recognizable under national laws as well as people who have no recognizable legal right or claim to occupy the land. In addition, people who have no legal right/claim to occupy the affected land have to be offered resettlement assistance to restore their standard of living at a suitable alternative site, however they will not receive compensation for land, unlike persons with existing legal rights or people with recognizable claim to the land. Moreover, livelihood restoration measures have to be provided in cases, where people experience loss of income.

The Resettlement Action Plan will be made public and available for all stakeholders once the finalization of ESIA is completed.
6.0 Next Steps

During the ESIA process the Trans Electrica Ltd will undertake consultation meetings with statutory stakeholders and the population within the project area of influence.

The next stages of ESIA process will be Impact Assessment and Environmental and Social Management Planning, which include, among others, the following activities:

- Detailed studies of baseline conditions in the project area of influence;
- Assessment of impacts and risks on the different components of the physical, biological and human environment in terms of their direction (positive or negative), significance, likelihood, duration and reversibility;
- Impact modeling;
- Development of avoidance, protection, minimization and mitigation measures;
- Assessment of residual impacts of the project;
- Elaboration of monitoring measures, including indicators and frequencies of measurements;
- Elaboration of emergency procedures and management plans to address safety issues;
- Carrying out stakeholder engagement activities based on the Stakeholder Engagement Plan to be developed in accordance with the recommendations of IFIs;
- Preparation of ESIA report including Environmental and Social Action Plan (ESAP); and
### 7.0 Project information public disclosure and stakeholder involvement

The public disclosure and stakeholder involvement procedures within the framework of the Khudoni Hydro Power Project will be implemented according to the Georgian legislation and the regulations and requirements of the World Bank and EBRD:

- September 1, 2005 N154 Resolution of Georgia on Approval of Rules and Conditions of Issuing of Environmental Permit;
- Georgian law on “Licenses and Permits”;
- Georgian law on “Environmental Protection”;
- The World Bank requirements (2010); and

Georgian requirements related to public consultation for a project of this nature include public hearings once the draft EIA is available.

The World Bank requires environmental assessment of projects proposed for Bank financing. According to the criteria of the World Bank Operational Policy 4.01 the project are divided into the categories A, B and C by their environmental impact. The Khudoni HPP belongs to the Category A. For the Category A projects the project proponent consults project affected groups and local nongovernmental organizations (NGOs) about the project’s environmental aspects and takes their views into account. The project proponents shall initiate such consultations as early as possible stage of environmental assessment.

For Category A projects, the project proponent consults these groups at least twice: (a) at the scoping stage; and (b) once a draft EA report is prepared. In addition, the project proponent consults with such groups throughout project implementation as necessary to address EA related issues that affect them.

For meaningful consultations, the project proponent provides relevant material in a timely manner prior to consultation and in a form and language that are understandable and accessible to the groups being consulted.

EBRD requires consultation at the scoping stage and during the ESIA public disclosure period, to seek input from stakeholders:

1. **At scoping stage:**
   - on the Project itself
   - on the proposed scope for the ESIA

2. **Once a draft ESIA is available:**
   - on proposed environmental and social assessment and management measures.
The following activities and communication tools will be used after the Scoping Meeting to ensure maximum involvement of the project stakeholders in the Khudoni Hydro Power Project development and implementation processes:

**Consultations with stakeholders during ESIA preparation**

- Consultations with the population the residential houses of which will be flooded as a result of project implementations (population within the flooded zone)
- Consultations with the population the residential houses of which are located in the vicinity of the flooded zone
- Consultations with the population the residential houses of which are located in the vicinity of the project zone

The meetings are planned to be held in the first week of November, 2011.

**Engaging stakeholders on ESIA report public hearing and consultations stage**

- Public hearing meeting for institutional stakeholders, such as the different ministries and their regional agencies, Mestia Municipality Administration (Gmgeoba), Mestia Municipality Council (Sakrebulo), scientific community, Patriarchate, utilities and companies
- Public hearing meeting for the general public in the following districts: the village Khaishi and Mestia.

It is envisaged that the hearings on the outcome of the ESIA will be undertaken in February 2012.

Trans Electrica Ltd will make announcement of public meetings in due time in advance via the media. The information on consultation meetings will be published in central and local newspapers: “24 Saati”, “Kviris Palitra” and local media.

During the Project planning, construction and operation, Trans Electrica Ltd will inform stakeholders and collect feedback from them on the project related issues.

The stakeholders could address Trans Electrica Ltd to bring their concerns and complaints to the project implementation agency/ Trans Electrica Ltd for consideration and reaction at this address:

Trans Electrica Ltd.  www.transelectrica.com
# 43 Apt., # 41 Chavchavadze Ave.,
Tbilisi 0162, Georgia

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12 Consultation with the population living in the areas where the population from the project study area will be resettled shall be carried out if this area is finally specified during the process of development of ESIA report.
Trans Electrica Ltd. will make Comments & Suggestions Forms available in the local communities. Forms can returned to the above mentioned representative of Trans Electrica Ltd. by e-mail or in a hard copy. Further, in front of the buildings of Mestia Municipality Administration (Gamgeoba) and Mestia Municipality Council (Sakrebulo) as well as in the village Khaishi, boxes will be installed where stakeholders will be able to submit their completed forms.

During meetings, stakeholders will be informed that Comments & Suggestions Forms are available.

Trans Electrica Ltd. will register all comments and suggestions submitted during the planning stage and reply to all stakeholders in due time. The topics raised and the project response will be documented in the ESIA report. During project implementation, i.e. construction and operation, Trans Electrica Ltd. will follow-up any complaints or grievances received. This Grievance mechanism will be described in details in the ESIA.
Annexes
Annex 1. Draft ESIA Table of Contents

The following draft Table of Contents is proposed for the Environmental and Social Impact Assessment study of the Project:

- Appendices
- List of Tables
- List of Figures
- Acronyms

1.0 Introduction and Background
   1.1 Purpose and Need for the Project
   1.2 Project Proponent
   1.3 Scope of the ESIA
   1.4 Methodology for the ESIA
   1.5 Organization of this Report

2.0 Project Description [selected alternatives]
   2.1 Planning Process and Status
   2.2 Project Alternatives and Comparison
   2.3 Main Features and Design Elements
   2.4 Construction of the Project
   2.5 Operation of the Project

3.0 Legal and Institutional Framework
   3.1 National Legal and Regulatory framework
      3.1.1 Administrative framework
      3.1.2 Environmental legal framework
      3.1.3 Environmental permit issuance procedure
      3.1.4 Land use and labour laws applicable to the project
      3.1.5 Other relevant national strategies and plans
   3.2 International requirements
      3.2.1 Requirements of International Finance Institutions
      3.2.2 International conventions and agreements

4.0 Baseline Environmental and Socioeconomic Conditions
   4.1 Environmental Baseline
      4.1.1 Climate
4.1.2 Major Landscapes and Ecosystems
4.1.3 Geology and Geomorphology
4.1.4 Hydrology and Hydrogeology
4.1.5 Geohazards
4.1.6 Flora and vegetation
4.1.7 Fauna
4.1.8 Environmental pollution
4.1.9 Noise
4.1.10 Land use

4.2 Baseline Socioeconomic Conditions
4.2.1 Demographics
4.2.2 Infrastructure
4.2.3 Economic conditions
4.2.4 Health
4.2.5 Cultural Heritage and Archaeology
4.2.6 Tourism

5.0 Potential Environmental and Socioeconomic Impacts (during construction and operation phases) and mitigation measures

5.1 Potential Environmental Impacts
5.1.1 Potential Impacts on Land Use
5.1.2 Potential Impacts on Air Quality
5.1.3 Potential Impacts on Surface Water and Groundwater
5.1.4 Potential Impacts on Ecosystems, Animals, and Plants
5.1.5 Potential Issues Related to Geology and Geohazards
5.1.6 Potential Visual Effects on Landscape
5.1.7 Potential Impacts on Soil
5.1.8 Waste Generation
5.1.9 Noise

5.2 Potential Socioeconomic Impacts (during construction and operation phases) and mitigation measures
5.2.1 Communities and People Potentially Affected
5.2.2 Potential Social and Economic Impacts
5.2.3 Public and Occupational Health and Safety

5.3 Potential Impacts on Cultural Heritage and Archaeology (during construction and operation phases) and mitigation measures
6.0 Risk of Accidents and Safety

7.0 Environmental and Social Management Plans
   7.1 Environmental and Social Action Plan
   7.2 Environmental and Social Monitoring Plan

8.0 References Cited
## Annex 2. Comments & Suggestions Form

| Comments & Suggestions Form | №  
| (to be completed by Trans Electrica Ltd) |
| Date of receiving the Form | (to be completed by Trans Electrica Ltd) |

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<tr>
<th>Name</th>
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If you would like to stay anonymous while submitting this Comments & Suggestions Form please share with us the reason for this

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<tr>
<th>Please tick and indicate the best way to contact you on the communication you are submitting</th>
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<tr>
<th>Please tick the language in which you prefer to receive a response to your communication</th>
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<td>☐ Georgian</td>
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<th>Please tick and indicate the type of your comment</th>
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<td>☐ suggestion</td>
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What is your comment / suggestion? Please describe the key issues you have with the Project (what happened, when, where, with whom)
### Scoping document

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<thead>
<tr>
<th>In your opinion what was the reason of this issue?</th>
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<tr>
<td>In your opinion how should the issue of your communication be resolved?</td>
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<tr>
<td><strong>Signature:</strong></td>
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<td><strong>Date of the communication form:</strong></td>
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Please send the completed form to the address of the Trans Electrica indicated in the form or post it in the Comments & Suggestions box labelled as "Comment Box for Khudoni Hydro Power Project" installed in front of the buildings of Mestia Municipality Administration (Gamgeoba) and Mestia Municipality Council (Sakrebulo). Comments & Suggestions box is also available in front of the Tbilisi office of Trans Electrica.

### Contact Information:

- **Trans Electrica Ltd.**  
  # 43 Apt., # 41 Chavchavadze Ave.,  
  Tbilisi 0162, Georgia  
  Tel/Fax: +995 32 2258868  
  E-mail: salogogiberidze@transelectrica.ge  
  Vladimer Gogsadze Tel.: +995599 537599  
  Zurab Erkvania Tel.: +995599 101848  
  Giorgi Makharadze Tel.: +995599 967777

- **Mestia Municipality Administration (Gamgeoba)**  
  1 Sesti sq., Mestia

- **Mestia Municipality Council (Sakrebulo)**  
  12 Tamar Mepe str., Mestia
Annex 3.  Map of project area