Advisory Assistance to the Ministry of Energy of Georgia

PROJECT REPORT: KHUDONI HYDRO POWER FACILITY
PRE-FEASIBILITY REVIEW

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EXECUTIVE SUMMARY

This pre-feasibility study introduces Georgia's Khudoni Hydro Power Plant (Khudoni HPP) project concept as a potential investment opportunity. The study provides a short history of Khudoni HPP construction, information regarding the initial design and subsequent revision to improve environmental impacts, a brief summary of technical characteristics of the project, and a short overview of current conditions. We also give a general economic assessment of the project.

The Khudoni HPP is one of several major hydro power generation facilities planned under the Soviet Union, to use the large hydro power generation capacity of the Enguri River basin in western Georgia. While some other stations, including especially the major downstream Enguri Hydro Power Plant (Enguri HPP) and cascade of Vardnili I, II, III & IV Hydro Power Plants were completed, the upstream facility at Khudoni was only partially constructed. Construction was halted for a combination of political, environmental and financial concerns. Some of the original construction remains and may be in usable condition. Certain design changes were subsequently made to accommodate environmental concerns. The proven feasibility of use of the Enguri River flow for hydro power generation, together with the currently expected 630 MW peak capacity potential of a station at Khudoni, have generated recurring interest in completion of the Khudoni facility, and occasional updates of some of the supporting materials.

The essential economic result of this analysis is that Enguri could be financed if it were sold largely to the export (regional market), and/or if generation prices within Georgia were substantially higher than at present. However, the plant adds a significant volume of energy generation capacity and thus together with the existing Enguri HPP, enables much better system operation in winter months and substantial energy exports (especially in summer) from Georgia in excess of the country's domestic load.

The study is based on such existing materials as we were able to locate, a visual inspection of the facilities, discussions with knowledgeable persons, and our own model of potential Khudoni HPP operations in the Georgian power system. None of the sources were verified, and we have made no attempt to recompute any of the analyses, nor to assess the data and analysis contained in them. Our very preliminary estimates of the economic characteristics of the Khudoni HPP are based on the best data available to us, but we have not audited those sources.

INTRODUCTION

Georgia is believed to have a very large hydro power generation potential, estimated at up to 80 billion kWh annually, of which about 10 billion kWh is attributable to smaller rivers. Georgia currently has about 60 larger and smaller capacity power stations with an annual maximal output capability of about 9,5 billion kWh. That is, less than 15% of the theoretically usable hydro potential is currently used. At the same time, countries in the region (especially Turkey and Iran) are generally believed to be experiencing rapid economic growth and thus to offer large potential demands for electric power capacity and energy. When the Caucasus region, including Georgia, was part of the Soviet Union, the Georgian grid formed part of Southern Caucasus regional power system (united grid of three Caucasus republics – Armenia, Azerbaijan and Georgia), which often operated independently from the Russian grid. Georgian hydropower was used to cover peak demands while Armenia's nuclear and Azerbaijan's thermal power plants carried base load of the regional system. After the break up of Soviet Union each country started to operate its power system independently. As a result Georgia was left with insufficient power generation for the winter period, due to lack of water in rivers in winter and insufficient storage volume of reservoir hydro power plants. As for thermal power generation – it was always more expensive and problematic to arrange for uninterrupted fuel supply for the plants.

Soviet engineers believed that from among the theoretically possible stations in Georgia, one of the most realistic was construction of Khudoni power station, on the upper Enguri River in western Georgia. The 221km long Enguri originates from Ukhvan and Shkhara glaciers on the southern slope of Main Caucasus Mountain Range. Its hydrological basin area is 4 062 km^2, gross fall 2 600 m, average long-term runoff is 5.35 km^3, average annual flow rate at the Black Sea estuary 212 m^3/sec and at the village Jvari 155 m^3/sec. From an energy characteristics viewpoint, the Enguri River has long grasped attention. In 1912 two engineers from St. Petersburg, Rop and Bakhmetev, on the invitation of the Georgian public figure, Niko Nikoladze, arrived in Georgia with the purpose to build power plants on the Enguri River. In that same year a point for water level and speed observations of the Enguri river was set up in the village of Jvari. Starting in 1930, the United Power System of the (Southern) Caucasus region and the Energy Institute of the Academy of Sciences of Georgia intensively worked on establishing a concept for the use of Enguri's energy potential. Final review and approval of the elaborated Enguri's power resources plan was done by Tbilisi branch of the Soviet Union's Research-Design Institute "Hydroproject". This scheme (Appendix 1) foresees diversion of Enguri stream into Eristkali river basin. Under this plan, the following hydro power plants were constructed in the 1980's: Enguri HPP (see Photos 1-3) 1300 MW, Vardnili I – 220 MW, Vardnili II – 40 MW, Vardnili III – 40 MW, Vardnili IV – 40 MW. These plants are all located downstream from the proposed Khudoni HPP. Upstream from Enguri dam, Khudoni and Tobari Hydro Power Plants were planned.

According to Khudoni HPP project, the reservoir would flood 6 settlements: Khaishi, Upper Khaishi, Lower Khaishi, Lukhi, Tsvirminda and Tobari villages. 264 families with a total of 1000 people (according to 1990 data) had to be re-settled to the village

of Idleti. Older (1979) documents show slightly lower numbers, but give more details on re-settlement needs (Appendix 4.2).

Initial Khudoni HPP proposal was approved in 1978 and in 1979 construction began. However, due to political concerns, described in more detail below, construction was terminated in 1989.

During Enguri HPP construction and operation useful experience in building and operating large capacity power stations was gained. Many of the people and institutions involved in Enguri HPP construction could now successfully be used for potential completion of Khudoni HPP. Besides, during last decade number of scientific and design-construction organizations have been involved in rehabilitation of Enguri HPP. Currently rehabilitation of the Enguri HPP Arch Dam Stop Lock project is underway, with financing from the European Commission. That project is being carried out by the German Company "DSD". In addition, using financing from the European Bank for Reconstruction and Development, State Budget of Georgia and Enguri HPP sources itself, major civil and electro-mechanical rehabilitation works on Enguri HPP are being carried out by EDF, Siemens and other companies together with Georgian specialists.

1. SHORT HISTORY OF KHUDONI HPP CONSTRUCTION

Khudoni HPP represents the next step in development of the hydro power stations' cascade on Enguri river. The present cascade scheme (Appendix 1) was elaborated by Scientific-Research Institute of Energy and Tbilisi branch of United Design-Research Institute "Hydroproject" in 1960. Initially the scheme included Khudoni (together with small Khaishi HPP between Khudoni HPP and Enguri dam) and Tobari HPP plants with relatively large reservoirs upstream from Enguri HPP dam. Later, due to strong environmental and political opposition, only Khudoni HPP (with Khaishi HPP) with smaller reservoir was decided to be built.

The selected proposal with arch dam for Khudoni HPP construction was approved on August 31, 1978 with the Decree #110 ПС of the United Ministry of Energy of the Soviet Union. Construction of access roads and auxiliary infrastructure commenced in 1979 (after commissioning Enguri HPP). Khudoni HPP construction was carried out by the general contractor of Soviet Union's "HydroEnergoStroi" – "SakHydroEnergoMsheni" (currently "Sakhydroenergomsheni" Ltd) under the order from Georgian state energy company "Sakenergo".

According to the Decree #484 issued on June 9, 1980 by Presidium of the Council of Ministers of Georgia 687.4 Hectare land was provided for Khudoni HPP construction (Appendix 4)

On August 26, 1983 the Khudoni HPP project went through a state expertise and its estimated value – in the amount of 554.2 million Rubles[1] (1978 proposal estimate of 455.6 mln + 98.6 mln increase according to 1983 reassessment) was approved, by

[1] At 1983-85 official state exchange rate of 1.00 Ruble = $1.66 USD ($1.00 = 0.60 Rubles), this corresponded to $924 mln USD.

the Department of Budgets and Estimates Expertise of Power and Electrification Projects of the Soviet Union – Conclusion #Э-121 (Appendix 4.3 in Russian).

In parallel with construction of the access roads and other supporting infrastructure, the Khudoni HPP project documentation was being prepared by Tbilisi branch of United Design-Research Institute "Hydroproject" – "Tbil-Hydroproject". The project was approved by Resolution #2503-D, December 14, 1984, issued by the United Ministry of Energy. After this approval construction of main hydro-technical facilities and buildings started.

One complete set of the project documentation was transmitted to Khudoni HPP Construction Department. However, substantial part of the project was destroyed during the civil war of 1993-1994: the armed forces of "Mkhedrioni" were located in the building of Construction Department. The survived project documentation continues to deteriorate even nowadays due to bad storage conditions – storage areas are not ventilated, atmospheric precipitations reach storage rooms. A second copy of revised project is kept in "Energogeneratsia" archives and the third set of both (initial and revised) versions of the Khudoni HPP project and associated documents are kept in the archives of the "Hydroproject" Institute.

Khudoni HPP construction was terminated under Resolution #330 (see Appendix 2) dated June 30, 1989 issued by Council of Ministers of Georgia. The reason for termination was established by then public opinion in Georgia that hydro power plant reservoirs introduce negative environmental disbalance and pose risks. In addition, the December 1988 strong Richter 7 earthquake in Spitak, Armenia enhanced environmental concerns for the Khudoni facility in Georgia. "The latter was the main factor for making the decision regarding termination of Khudoni HPP construction" – stated the former Chairman of the Council of Ministers, Mr. Nodar Chitanava at the meeting of Power Engineers' Society in August of 1999. This concern reflected the environmental practices then used within the Soviet Union.[2]

To further investigate the impact of Khudoni HPP construction on the environment, a commission of specialists from 16 different organizations was established by Resolution # 234 (Appendix 3) dated May 18, 1989 adopted by Council of Ministers of Georgia. Little earlier Council of Ministers with Resolution # 949p (October 25, 1988) established a commission with 23 specialists (Appendix 3.1) to investigate the additional ecological aspects of Khudoni HPP. Based on those commissions' conclusions, a revision of the initial version of Khudoni HPP project was carried out by "Tbil-Hydroproject" in 1990-92. All possible versions of use of Enguri River energy potential between 510 m (highest point of Enguri HPP reservoir's water level) and

[2] As another example of such concerns and their consequences for revision of projects, consider the history of the Turukhansk HPP construction on Tungus river (a tributary of river Enisei). The Turukhansk HPP project was elaborated by "Leningrad's HydroProject" and considered construction of 12,000 MW power station with a 200 m high dam, which would cover 950 600 hectare land with water. Ecological impact of the project was estimated as 8.4 million rubles. The expert commission established by Siberian Branch of the Academy of Sciences of the Soviet Union in 1988, on the grounds of objective revision and deep analysis of ecological problems associated with this project, made decision, which was approved by Presidium of the Academy and according to which, the ecological damage was valued as 9.1 billion rubles – the difference was 1000 times more!!! As a result, the intention of building 200 m high dam was excluded and construction of 140 m high dam was considered acceptable, which would flood only 256 700 hectare land (instead of 940 600 hectare).

700 m elevation point (over the seal level) of the river were considered. As a result, preference was given to a two-step version. This concept foresees construction of 55 MW Khaishi HPP (at 522 m elevation) and 638 MW Khudoni HPP (with max pond level of 670 m). This concept considerably reduced the anticipated environmental impact. Although Khaishi HPP project documentation was never finalized, Khudoni HPP's project was re-designed as follows:

- Calculated earthquake resistance increased from Richter 8 to Richter 9.
- Dam height was decreased from 200m to 170 m.
- Water pond surface area decreased from 5.2 to 4.0 km^2
- Area to be flooded decreased from 528 to 406 Hectare.
- Generation capacity decreased from 700 to 638 MW.
- Estimated annual output decreased from 1 660 mln to 1 445 mln kWh (reduced only by 13%)

Finally, based on decree of the President of Georgia dated June 22, 1998, Khudoni HPP, as an inoperative enterprise with no income, was "transferred to conservation mode". Therefore it was exempted from property taxes. Khudoni HPP is currently on the balance sheet of "Energogeneratsia", under the name "Khudoni HPP Construction".

2. SHORT TECHNICAL DESCRIPTION OF KHUDONI HPP INITIAL (APPROVED) PROJECT

Khudoni HPP is designed as a reservoir, with an underground power station located near the dam.

General Data on Khudoni HPP	Unit	Initial Project (1984)	Revised Project (1992)
Design power	MW	700	638
Average annual generation	mln kWh	1 660	1 445
Head:			
Maximal	m	174.1	150.7
Nominal (Rated)	m	151.9	143.8
Minimal	m	117.5	118.8
Nominal (rated) flow rate through turbines	m^3/sec	500	490
Water flow rate per generated kWh	m^3/kWh	2.56	2.96
Total volume of the reservoir	mln m^3	364.5	230
Usable (active) volume of the reservoir	mln m^3	223	89
Water pond surface area	km^2	5.2	4.0
Flooded area	Hectare	528	406

The Khudoni power plant consists of the following structural complexes:

- Arch dam;
- Underground power station facilities;
- Construction tunnel;
- Open 500 kV substation switchyard;

- Diversion tunnel of river Lekhara flow into the reservoir;
- Permanent and temporary roads, tunnels and bridges;

Arch Dam	**Unit**	**Initial Project (1984)**	**Revised Project (1992)**
Construction height of the dam	m	200.5	170.5
Height of arch part of the dam	m	171.5	141.5
Total length of arch part the dam crest	m	445	420
Thickness of dam body at: 700.5 m elevation (1984 dam crest) 670 m elevation (1992 dam crest) 530 m elevation (dam base) dam's saddle (foundation)	 m m m m	 6.02 - 27.58 47	 - 6.0 25 45
Hydrostatic load on the dam	tons	4 mln	3.8 mln
Diameter of three deep water outlets in the body of the dam at 570 m elevation	m	3.9	Same
Dimensions of two spillways with flat gates on the crest of the dam	m	2 x 7	Same
Spill water surge shaft dimensions (Length x Width x Depth)	m	150x60x20	Same

Underground Power Station	**Unit**	**Initial Project (1984)**	**Revised Project (1992)**
Dimensions of three water intake gates	m	10 x 13	Same
Throughput of water intakes (intakes have trash racks and maintenance flat gates)	m^3/sec	500	490
Length of three thread pressure tunnels	m	284	Same
Pressure tunnel diameter	m	6.0	Same
Throughput of each pressure tunnel	m^3/sec	171	Same
Thickness of reinforced concrete walls of the pressure tunnel	m	0.8	Same
Underground power station building dimensions: Length Width Height	 m m m	 99 27 49	 Same Same Same
Power rating of each of three vertical hydro units (turbines)	MW	235	212.7
Overhead crane	tons	300	Same
Length of exhaust pipes (with dimensions of 8 x 24 m)	m	50.8	Same
Length of access tunnel to the underground building	m	130	Same
Dimensions of underground building for emergency gates	m	59.6x10.2x28.6	Same
Tailrace pressure tunnel length	m	914	Same

Construction (Bypass) Tunnel	Unit	Initial Project (1984)	Revised Project (1992)
Cross section dimensions	m	10 x 9	Same
Length	m	210	Same
Throughput	m^3/sec	1030	Same

Open 500 kV Substation Switchyard:
Construction of open 500 kV Substation Switchyard was planned downstream from the reservoir on the left bank of the river. Generator outlet bus ducts are connected to the substation transformers via shaft-gallery-tunnel complex. For proper operation of the substation, construction of four-story building for auxiliary services and workshop-laboratories was planned near the substation.

Diversion Tunnel of river Lekhara
Lekhara River was joining Enguri River exactly at the arch dam construction site. In order to divert its flow from the construction site, a tunnel was built 2 km upstream and Lekhara water was directed to the Khudoni HPP reservoir.

Permanent and Temporary Roads, Tunnels and Bridges.
Khudoni HPP project foresees construction of temporary and permanent roads, which except ensuring Khudoni HPP construction; improve living conditions of Mestia region population. The most important from those are: a 40 km concrete road from Jvari to Khaishi, six tunnels located on this road and a 100 m long bridge over river Lakhanistskali.

3. SHORT TECHNICAL DESCRIPTION OF THE KHUDONI HPP REVISED (1992) PROJECT

The reason for preparing the second, revised version of Khudoni HPP project, resulted from review of the ecological standards of the existing design of that time (as stated above). The second version was elaborated by “Hydroproject” in 1990-92. The revised project takes into account conclusions (Appendix 5) of the commissions which were created according to the Resolutions #234 and #949p (Appendix 3 & 3.1) of the Council of Ministers of Georgia. The project was revised according to the following criteria: “Reduction to the minimum of environmental impact and maximum usage of already invested funds and implemented construction works”.

As a result:
- Calculated earthquake resistance increased from Richter 8 to Richter 9.
- Dam height was decreased from 200m to 170 m. Thus, the possibility of moisturizing the loose ground on the left bank area of the dam and development of possible landslide effects were avoided;
- Water pond surface area decreased from 5.2 to 4.0 km^2
- Area to be flooded decreased from 528 to 406 Hectare.
- Generation capacity decreased from 700 to 638 MW.

- Estimated annual output decreased from 1 660 mln to 1 445 mln kWh (reduced only by 13%)
- Structures of the hydro complex, including technical (already designed) equipment (except minor changes), construction works planning, technology of arch dam construction, already built access and roundabout roads, underground structures, etc were kept unchanged (See: Appendix 6 & 6.1).

The second version of the project was not approved by relevant state official bodies. The technical and financial data of the revised (1992) version of Khudoni HPP project are provided in the appendices:

- Appendix 6 – Passport of the revised (1992) project;
- Appendix 7 – Album with drawings of major structures;
- Appendix 7.1 – Color sketches of Khudoni HPP structures;
- Appendix 7.2 – Illustrations of completed works on major structures;
- Appendix 8 – Combined costs of Khudoni HPP construction;
- Appendix 9 – Evaluation of Khudoni HPP construction, "Energogeneratsia" – 2001;
- Appendix 10 – Major indicators of Khudoni HPP construction business plan, "Hydrospecgvirabmsheni", 2003.

4. CURRENT CONDITION OF THE KHUDONI HPP

The intent of terminating Khudoni HPP was a temporary suspension of activity. However events precluded proper execution of that intent. Of 46.5 million rubles needed for closing down, only 17 million was spent. For this reason, the works previously completed at a cost of $186.7 million USD were valued in 2003 as worth approximately $56 mln USD (See: Appendix 10). According to "EnergoGeneratsia" current value on their books shows 41.3 mln Lari.

Current conditions of Khudoni HPP major structures are as follows:

- Among major structures, construction (bypass) tunnel (Photo No. 5-6) deserves the highest attention. Its operation term has expired in 1991. By means of this tunnel Enguri water is diverted away from dam construction zone and its reliability has a big importance for safe construction of the dam. Hence in accordance with Resolution #24 (Appendix 11) dated May 14, 2004 issued by Government of Georgia, Ministry of Energy in August 2004 financed the works for returning Enguri water flow into its original riverbed and bypass tunnel inspection. But due to resistance from the local population the works were stopped (explanation: when Enguri river's bed was blocked to dry the construction area and water was directed through bypass tunnel, the local population started to use this block as a transportation bridge over the river. Now when the bypass tunnel has to be inspected and these blocks have to be removed to let the water flow in its original bed, the local population demands a bridge to be built instead.).

- The tunnel that diverts river Lekhara in Khudoni HPP reservoir is blocked. Water flows in old riverbed, exactly where left wing of the dam adjoins the mountain, and already built concrete foundation is being damaged (Photo No. 7). It is also

undesirable that sediment brought with river Lekhara accumulates on the area of dam foundation construction.

- Some information concerning scope of works completed for underground structures as of May 1, 1989 are shown on color schemes provided in Appendix 7.2:
  - Completed concrete and steel-concrete works are shown in yellow.
  - Completed ground and rock works are shown in brown.
  - Temporarily suspended works are shown in red.

The current state of underground structures was not determined at this stage due to existing conditions of the entrance portals (Photo No. 8-9): Due to landslides, entrance into the galleries is complicated and thus access to underground tunnels and storage areas is unsafe. The entrances should be inspected by a rock-climbing team before letting engineers into underground structures.

- On the territory of the open 500 kV substation and laboratory building an individual entrepreneur has set up a small private saw mill.

- Buildings and other structures of supporting infrastructure are also in poor condition. Another saw mill is set up on the territory of auto transport mechanical workshop (Photo No. 9.1)

- The concrete factory is completely robbed – steel constructions are stolen; only concrete bed and walls with concrete lining are left.

- Hostel lodging accommodations (Photo No. 10-11) are robbed and left without attention.

- Khudoni HPP storage and warehousing areas, buildings and hoisting-transportation means in the village of Jvari are in technically poor conditions (Photo No. 12-15). Warehouse buildings don't protect from atmospheric precipitations.

- Metal constructions of 100 m long bridge to be built on the river Lakhanistskali are relatively well preserved and could be used for completion of the bridge.

- Railway track from Zugdidi to village Jvari (Photo No. 17) and access concrete roads and tunnels from Jvari to Khudoni HPP construction site (Photos No. 18-20) are in relatively better conditions. There are some landslide and local type damages on the roads (Photo No. 20), which is approximately 3-5% of the total road length.

5. ECONOMIC ASSESSMENT OF THE KHUDONI HPP

5.1. Underlying Assumptions

Initial Assumptions: Major research works needed for Khudoni HPP construction are already completed and certain materials exist. We have not attempted to assess the analysis contained in them, Design works have been completed twice and therefore the time and cost for preparation for construction continuation may be significantly lower than if a new concept were proposed. Qualified personnel needed for design,

construction and further maintenance may exist. For example, Georgian specialists were employed in construction and rehabilitation works of 1300 MW Enguri HPP, 24 MW Khadori HPP built in eastern Georgia by a Chinese state power company, in oil-pipeline projects, oil-terminals and related linked infrastructure.

Estimated Completion Costs: Over the life of the Khudoni project concept total construction costs have been estimated and revised on several occasions by diverse entities and interests. One of the estimates done by "Hydroproject" gives construction cost estimates in 1984 (565.2 mln Rubles) and 1991 (871.2 mln Rubles) prices (Appendix 8).

The first of these was the initial plant cost estimate done in the Soviet Union in 1984, which estimated a total cost of 565.2 mln Rubles, or at an exchange rate of 0.6 Ruble = $1.00, about $924 million. This however was probably an overly optimistic belief of the value of the ruble at that time, so this estimate must be considered high. In 1991 a revised estimate was created, also by essentially Soviet methods, and gave a value of 871.2 million rubles; we do not attempt to convert this to USD, as the exchange rate conditions are not known, and at that time, probably very unstable. The 2003 re-estimate of the completion costs given in Appendix 10, attached, is that the plant would have had an initial total construction cost of $684.3 million (including hydro-technical and plant construction works of $439.2 million) and that a value of construction worth $186.7 million was completed (including about $135.9 million in completed hydro-technical and plant construction works). However subsequent neglect and damage from warfare have reduced the value of the completed plant to approximately $56 million.

It is difficult to know the reliability of any of these estimates, nor whether any of them are different from the first by application of any new analysis. However, taken at face value, we can use them, especially the 2003 values, to estimate a range of completion cost estimates. The apparent implication of the 2003 values is that initial construction reduced the remaining cost to $684.3 - $186.7 = $497.6. But, deterioration and war have diminished the completed value to only $56 million. Thus, the additional construction might be estimated as $186.7 - $56 = $130.7. Adding this to the $497.6 yields a remaining cost of $638.3 million. Or, if we believe the proper diminution starts from the physical plant completed, then an additional $135.9 - $56 = $79.9 million, and thus a total remaining cost of $577.5 million.

Given this range, from $577.5 million to $638.3 million, for computational purposes in this report we take the remaining completion cost to be about $600 million.

Current Tariffs: The current tariffs on electricity generated by Georgia's large power plants are set by the Georgian National Energy Regulatory Commission, and as of today average 2.667 tetri (1.5 US cents). The Enguri HPP tariff is 2.13 tetris, which certainly for newly built power plant is totally unacceptable. However, it should be noted that for newly constructed Khadori HPP (in eastern Georgia) the tariff (although temporary) set by Georgian National Energy Regulatory Commission (2004) was 3.5 cents. After rehabilitation of Vartsikhe HPP (Rehabilitation cost was 63 million German marks) under agreement also 3.5 cents were foreseen and the export of significant amount of electricity in Turkey was considered (The import price of peak energy in Turkey is believed to be at least about 4 cents).

Additional Export Market Information: Following a Turkish initiative, the development of a plan for a 500 kV transmission line "South Georgia" was forecasted in the late 1990's at 2.5 billion kW/h power supply from Georgia and Azerbaijan into Turkey during 2000-2005, and from 2005 increased export to 5 billion kWh. Georgia's share in that earlier study was about 1.5-2 billion kWh. We have not examined that study nor do we make any assessment of its conclusions. In recent months, the United Energy System of Russia several times expressed its wish to participate in the construction of this transmission line with the purpose to export electricity to Turkey. The potential demand for energy and power from Iraq or other regional countries is also believed possible but was not estimated.

5.2. Current and Anticipated Wholesale Electricity Market Structure in Georgia:

Present Wholesale Power Market In Georgia The present structure of the wholesale electricity market of Georgia is a partially centralized market, in which all transactions are made through a single market operator, the GWEM. While originally structured only to manage transactions by others, instead, the GWEM has become much more like the supplier to the market. As there are certain "direct sales" made by generation companies or importers to larger industrial companies or to distributors, the market is not a true "sole supplier" market. None the less in many ways it acts like one. Major supply contracts are made to the GWEM, not to direct buyers. The generation prices which comprise the average price are based on tariffs, which in turn are set by the sector regulator, the GNERC. Actual prices charged by the GWEM however are not the hourly or even monthly transaction clearing prices normal to such markets. Instead, the GWEM price is set by rule as an annual average price, of 2.667 tetri (1.5 US cents) per kWh. Due to market rules, this price is effectively charged even to the direct contract buyers. Thus, despite some diversity in the market transactions, no price competition is allowed to exist. In addition, the underlying tariffs have not been changed since 2001.

Ministry of Energy Proposed Market Structure To correct these conditions, the Ministry of Energy of Georgia has proposed that the market should operate as it was designed, with the GWEM as the market operator of a bi-later transactions based market. In such market, the distribution companies and other wholesale customers transact directly with generators, importers, exporters or other suppliers. Therefore, the Ministry has proposed to create three forms of sub-markets, with somewhat different pricing rules.

- Non-competitive plants are any thermal plants, any imports, and any new construction hydros for their first seven years. The non-competitive plants will be free to contract with any party at any price up to a price cap set by the GNERC. Each market buyer will be required to take annually a minimum percentage of non-competitive power, which percentage also to be set by GNERC. Khudoni HPP would therefore be classified as a "non-competitive" plant. As estimated below, this could result in a somewhat higher price cap for operation of the Khudoni HPP with present pricing;
- Controlling plants are any hydro units large enough to control the market; at present this essentially means the Enguri hydro facility. The price for controlling plants will be set at the market average for all other plants; and

- Competitive plants, which effectively means all other existing hydro capacity. These will be able to compete at any price up to a price cap set by the GNERC.

Analysis of the Proposed Market Structure To compare the impact of these and other pricing and market structures, CORE has created a simulation model of the operation of the Georgian power market. The base case of that model computes pure hourly least price dispatch of the all of the generation units, and import capacities to Georgia, and summarizes the results for 12 months. The base case model is based on estimated monthly plant availabilities, estimated unit output prices, and uses actual Georgian power system typical daily load patterns for each month. For purposes of this analysis, we set as the unit prices, the tariffs set by the GNERC for each plant. We then computed three different base scenarios, which are subsequently compared to cases with Khudoni.

- First, we looked at what the total costs would be if the rates paid to each generation unit (or import) were based on the tariff rates. We have summarized the annual total revenues thus generated to each plant classification at the tariff rates;
- Second, we estimated generation unit revenues using hourly marginal prices (based on present tariffs), and summarized that data into annual total revenues by unit and sub-market classification
- Finally, we estimated price caps for the major sub-markets, competitive and non-competitive power. We then looked at the "sub-market marginal price" for each classification, defined as, the unit price of the highest cost unit of that type, dispatched in each hour. That is, we estimate the price cap method to be used for simulated sub-market marginal price. We then computed unit revenues as if priced at their relevant sub-market marginal prices.

Results of Base Case Analysis: The results of this analysis are summarized on an annual basis in the table below. Both the pure market (pure marginal cost) and the sub-market price cap marginal cost models have higher revenues that the pure tariff model. We used average hourly price here simply to characterize impact; we do not advocate nor endorse average annual cost as a pricing method. Increased revenues are one intended effect of the change to proper market operations. The results of the base case condition are:

- The estimated impact of least cost tariff based pricing with current tariffs shows an average annual wholesale market cost of 31.13 Lari/MWh (or 3.1 Tetri/kWh). This is higher than the existing GWEM weighted average generation tariff of 2.667 Tetri/kWh, indicating that existing tariffs in Georgia are not even adequate to pay for a least cost dispatch of the system. This is one key motivation for the pending wholesale market reforms.
- The marginal cost pricing method estimates the total revenues that would occur from a pure market. This would increase the average annual cost to of 44.95 Lari/MWH (or, 4.5 tetri/kWh). This would increase total revenues to generators by about 44%.
- The sub-market marginal costs using price caps, estimate the maximum impacts if that method is used to set the price cap. If all generator prices went only to the price caps, the effect would be to increase wholesale prices on average by 29% to 40.09 Lari/MWH (or, 4.0 tetri/KWH).

5.3. Khudoni Case Comparisons:

We begin this section by noting that the documents of the revised Khudoni project reference an output capacity of the plant of about 1.4 billion kWh annually. At a capacity of 630 MW the theoretical maximum annual output, ignoring water availability conditions, would be that capacity times 8760 hours, or about 5.5 billion kWh. In our simulation runs, using the existing actually scheduled availability of the Enguri plant to estimate availability for the Khudoni plant, the model "dispatches" about 2.7 billion kWh from Khudoni. Since the model availabilities are existing actual values, and since the Khudoni plant would be operated in parallel to the Enguri operation for water flow purposes, these are realistic estimates of availabilities for Khudoni. When the scenarios below use corrected (increased) monthly availability values for Enguri, reflecting intended near term rehabilitation of that plant, the expected output from Khudoni is even higher. As we have not examined the original documents underlying the 1.4 billion kWh estimate, nor assessed their analysis, we can not be sure of the source of this discrepancy. But as our estimates are based on actually used operating availabilities, we infer the project document estimated output energy values may be based on outdated water flow, plant dispatch, or other operational assumptions.

To assess the operation of the Khudoni HPP we considered several alternative scenarios: Khudoni HPP at Enguri HPP availability and price; Khudoni and Enguri at enhanced availability; Khudoni and also the presence of 300 MW of new gas fired generation capacity; and variants of Khudoni pricing.

However, the first of these analyses essentially reveals the results of all other analyses, as we now explain. First, as noted just above, we estimated that the monthly availabilities of the Khudoni units will be the same as those currently applied for the Enguri units. Because the Enguri units will be downstream from the Khudoni units, this reflects the necessary relationship between the operations of both stations due to water flow linking them and it is a reasonable starting assumption. In running Khudoni, we initially set the price of Khudoni at the same (present) price as for Enguri. In five months, the marginal unit in the least cost dispatch resulted to be Enguri or Khudoni, and in all other months, an import, usually over the Kavkasioni line from Russia. In most months in which import is the marginal unit, both Khudoni and Enguri units are also fully dispatched to their available capacity.

The consequence of this analysis is as follows. First, since in all months the estimated internal load for Georgia is fully met, if additional output is made available, the only available market is in exports. In the months however when import is the marginal unit, then not only is Khudoni fully dispatched, in most hours, so also are all units of Enguri. (The seasonal import displacement effect of operating Khudoni is explored separately below). This means that in nearly all hours, any additional output from Enguri or Khudoni - such as might result from improvements at Enguri, changes in availability of the units due to improvements at Enguri, or other interaction effects noted briefly below – can be accommodated only by either an increase in exports, or, a decrease in imports. From a pricing point of view, those two effects have equivalent value. Both would add to the revenue (that is, to the economic value of production) potential of Khudoni (or equivalently, Enguri) at the import price, times the estimated unit volume increase. Because the economic value of additional

export or decreased import is at least 4.5 tetri per kWh, then the economic value of each additional MWH of increased production at either Enguri or Khudoni is at least 45 Lari per MWH. Thus, an increase in effective capacity of 100 MW at either plant for one hour has the potential value of at least 4,500 Lari, assuming an export market exists.

For a similar reason, the same analysis applies to the possible impact of adding new gas fired generation. Surely, the price for this would not be less than the prices set for existing thermal units in Georgia. In no month, using least cost dispatch, was any internal thermal unit dispatched at all. This implies that the real economic function of existing thermal generation units in Georgia is in system reliability, against failures in the transmission system. These units may also be providing system voltage and frequency stability. However, as we are not here studying the economics of thermal powered generation, it is sufficient to note that the primary economic value of any such generation is in the imports it might displace, and/or the export potential it might create.

Finally we summarize the overall economic analysis of the Khudoni HPP, in Table 1 below. The data given here result from assuming the existing Enguri availability also applies to Khudoni, and in three of the four scenarios summarized in the next table, the dispatch level pricing of the two plants is the same. Therefore note from the above, that this analysis also represents a form of “worst case analysis” since all of the adjustments considered above would only increase the potential economic value of the plant.

The assumptions of this analysis are listed on the top of the table. All monetary values in Table 2 are in $US. The assumptions summarized at the upper left of the table are largely self-explanatory, except that the per MWH operation costs, apart from cost of capital, are simply estimated as $2.00/MWH. This value is approximate to the hydro power tariff set in Ukraine and which covers only operational costs for diverse units, including some quite large ones. The total capital cost of $600 million is justified above. The other numbers are simply convenient estimates.

Four revenue estimates for the Khudoni HPP are given in the table. Three of these are from the three forms of pricing directly generated by the dispatch model: present tariffs, pure marginal cost, and sub-market marginal cost. Note that since for purposes of sub-market classification (within the Ministry’s proposed partially deregulated market model), Khudoni is a “non-competitive” plant, the pure marginal cost and sub-market marginal cost rates and total revenues for Khudoni are the same.

The fundamental economic conclusion of this analysis thus emerges quickly from examining the bottom of the table, “Expected Economic Rents or Revenue Deficits”. None of the three pricing models from the domestic Georgian market produces sufficient revenues to cover the estimated annual economic costs of operation of Khudoni HPP. Therefore, for convenience Table 2 also estimates the revenue value if the entire Khudoni output were sold for export. Note that only by doing so is the full economic cost of the Khudoni HPP covered. (Alternatively, the internal Georgian market price might be allowed to rise to the monthly import price; that scenario was not evaluated for this study).

Recall from the above that the entire available Khudoni capacity is dispatched in the underlying analysis used here. So the implication of the assumption that all of the Khudoni output is sold for export, is that instead, in the spring-summer and fall months, Enguri units are dispatched, at the same cost to the internal Georgian market as already estimated in Table 2 for the three domestic pricing methods. In winter however, the resulting deficit would need to be replaced either by additional imports to Georgia, thermal unit generation within Georgia, or additional Enguri expansion. However, since those are the existing methods used to cover winter power requirements, on an economic basis all of the revenue created by the Khudoni unit from export is new revenue, and thus, all of it may be considered an economic benefit of the Khudoni HPP.

Table 2: Khudoni With Enguri Base Case Availabilities

Khudoni Operating Cost and Revenue Estimate First 10 years

Khudoni Operating Costs Estimate Factors:

Operating Costs Per Mwh estimated $	$ 2.00
Construction cost to be capitalized $ Millions	$ 600.00
Depreciation Period of construction cost, years	30
Interest Rate on Construction Loan	5%
Share of Construction cost from Private Capital	50%
Desired after tax rate of Return on private equity	10%
Income Tax Rate	20%
Depreviation Method:	Flat
Annual Depreciation, $ millions:	$ 20.00

Year	1	2	3	4	5	6	7	8	9	10
Plan Accounts:										
Net Undepreciated Plant, Start of Year:	$ 600.00	$ 580.00	$ 560.00	$ 540.00	$ 520.00	$ 500.00	$ 480.00	$ 460.00	$ 440.00	$ 420.00
Net Ownership Equity	$ 300.00	$ 300.00	$ 300.00	$ 300.00	$ 300.00	$ 300.00	$ 300.00	$ 300.00	$ 300.00	$ 300.00
Net Debt After Apply Depreviation to Amortization	$ 300.00	$ 280.00	$ 260.00	$ 240.00	$ 220.00	$ 200.00	$ 180.00	$ 160.00	$ 140.00	$ 120.00
Cost of Capital										
Cost of Equity	$ 30.00	$ 30.00	$ 30.00	$ 30.00	$ 30.00	$ 30.00	$ 30.00	$ 30.00	$ 30.00	$ 30.00
Income Tax on Equity Earings	$ 6.00	$ 6.00	$ 6.00	$ 6.00	$ 6.00	$ 6.00	$ 6.00	$ 6.00	$ 6.00	$ 6.00
Annaul Interest Cost of Debt	$ 15.00	$ 14.00	$ 13.00	$ 12.00	$ 11.00	$ 10.00	$ 9.00	$ 8.00	$ 7.00	$ 6.00
Subtotal, Cost of Capital:	$ 51.00	$ 50.00	$ 49.00	$ 48.00	$ 47.00	$ 46.00	$ 45.00	$ 44.00	$ 43.00	$ 42.00
Annual Operating Costs	5.37	5.37	5.37	5.37	5.37	5.37	5.37	5.37	5.37	5.37
Total Annaul Costs	56.37	55.37	54.37	53.37	52.37	51.37	50.37	49.37	48.37	47.37
Expcted Revenues at:										
Set Khudoni Tariff at Enguri Tariff	$ 31.74	$ 31.74	$ 31.74	$ 31.74	$ 31.74	$ 31.74	$ 31.74	$ 31.74	$ 31.74	$ 31.74
Marginal Cost Tariff	$ 39.23	$ 39.23	$ 39.23	$ 39.23	$ 39.23	$ 39.23	$ 39.23	$ 39.23	$ 39.23	$ 39.23
Sub-Market Marginal Cost Tariff	$ 38.97	$ 38.97	$ 38.97	$ 38.97	$ 38.97	$ 38.97	$ 38.97	$ 38.97	$ 38.97	$ 38.97
Import Tariff as Estimate of Regional market	$ 61.45	$ 61.45	$ 61.45	$ 61.45	$ 61.45	$ 61.45	$ 61.45	$ 61.45	$ 61.45	$ 61.45
Expected Economic Rents or Revenue Deficits at:										
Set Khudoni Tariff at Enguri Tariff	$ (24.62)	$ (23.62)	$ (22.62)	$ (21.62)	$ (20.62)	$ (19.62)	$ (18.62)	$ (17.62)	$ (16.62)	$ (15.62)
Marginal Cost Tariff	$ (17.13)	$ (16.13)	$ (15.13)	$ (14.13)	$ (13.13)	$ (12.13)	$ (11.13)	$ (10.13)	$ (9.13)	$ (8.13)
Sub-Market Marginal Cost Tariff	$ (17.40)	$ (16.40)	$ (15.40)	$ (14.40)	$ (13.40)	$ (12.40)	$ (11.40)	$ (10.40)	$ (9.40)	$ (8.40)
Import Tariff as Estimate of Regional market	$ 10.45	$ 11.45	$ 12.45	$ 13.45	$ 14.45	$ 15.45	$ 16.45	$ 17.45	$ 18.45	$ 19.45

5.4. Additional Economic Considerations:

The total current rated capacity of the four operating units at Enguri HPP is 840 MW, while the rated capacity of Khudoni HPP is 630 MW. The combined total is thus 1470 MW. The peak operational hourly load of Georgia is presently only about 1800 MW, and in most non-winter months, the peak may be only about 1000 MW. Because the combined capacities of Enguri and Khudoni are so large compared to the total Georgian demand, this means that if both plants were operable, essentially all other capacity in Georgia, and much of the combined capacity of those two plants, would be available for export in much of the year. And, as noted above, with the presence of Khudoni, even in winter Georgia could be able to export energy, though from the remaining units, especially, thermal units. The potential revenue impact from this, if only the Khudoni HPP capacity were added and operated at the present Enguri availabilities, is estimated by Table 2. If additional measures are taken that can improve Enguri operations, and when taking account of the interactive effects of the two units, additional export revenues (not estimated here) can be expected.

The active storage volume of Khudoni HPP reservoir is estimated as 89 mln m^3. Due to this additional reserve at the source of the Enguri river, output of the power plants located below Khudoni HPP will be increased in autumn-winter period:

- Enguri HPP – 89 000 000m^3 / 1.26m^3/kWh = 70,6 mln.kWh
- Vardnili HPP cascade - by approximately 17.7 mln.kWh (approximately four times less than at Enguri HPP, as average head for Varnili cascade is 101 m – 4 times less than that for Enguri HPP – approximately 4 times more water flow needed per kWh generation)

In addition, the Enguri HPP reservoir maintenance term will be increased, thanks to holding certain amount of sediment by the Khudoni HPP reservoir. These effects should be considered in a more complete feasibility analysis of the Khudoni plant.

6. ADDITIONAL STEPS

To restart Khudoni HPP construction, completion of the following tasks is believed necessary.

1. Expert conclusion on the current technical and environmental impact of the project;
2. Obtaining a license (permit) for construction renewal (site allocation);
3. Creation of draft project (based on technical conditions and engineering-tool inspection results and taking into account modern technological tools and operation systems) and its approval;
4. Preparation of tender documents for assigning the investor for Khudoni HPP construction;
5. Announcement of tender and selection successful participant;
6. Negotiations between the successful company and state.

Proceeding with these stages in parallel with each other, for preparing the draft project and obtaining the permit for construction continuation, approximately 15-18 months will be needed. We believe the required financing for these tasks and required financing may be approximately $1.5 million. The estimated time for the construction is 5 years.

7. ADDITIONAL INFORMATION

7.1. Khudoni HPP Project Design Selection History and Alternative Design with Earth-Fill Dam

At the initial planning stages two potential sites were selected for Khudoni HPP. Lower site being considered was at river Larakvava conjunction with river Enguri 24 km upstream from Enguri HPP dam and upper site at 32 km up from the dam (Khudoni HPP's current location). There were two types of dams proposed for both locations arch dam and land-fill dam. The lower site had a narrower canyon gate and was better suited for arch dam construction. It also allowed better utilization of Enguri's energy potential as the project was foreseeing, besides its normal operation, using the plant as a pump storage facility, which would pump water in off-peak hours from closer Enguri HPP reservoir up into Khudoni HPP pond. Unfortunately, detailed geological survey discovered a tectonic crack 800 meters below the proposed dam construction site, increasing the risk in case of seismic activity. Thus, the upper site (current location) was selected for the project. In order to compensate this decision and not to lose river's potential between Khudoni HPP power house and upper level of Enguri HPPs pond, additional relatively small (50MW) Khaishi HPP was designed between those two. The project documentation was never completed though.

The chosen upper site canyon gate was little wider and better suited for a land-fill dam. Also, top part of the mountain, where left wing of the dam had to adjoin the rock, had softer layers and created quite a bit of problems for designers to guarantee needed dam resistance and stability. Nevertheless, taking into account shorter construction time for an arch dam and engineering experience gained at Enguri HPP dam construction, arch dam option was decided for Khudoni HPP too.

Although after 1990-92 revision of the project and lowering the dam height by 30 meters the above described problem is not as pressing, still alternative land-fill dam option for Khudoni HPP is also being considered among some engineers. The land-fill dam option is not without cons either: although needed major rock-ballast land is sufficient upstream from the proposed dam, clay needed for the central filling part of the land-fill dam was only found at the village Skormeti and this would require the village re-settlement to another area. Alternatively polymer filling may be used too but this would probably increase the construction costs. Also, land-fill dam would cover part of current constructions and extension of water intake/outlet and other underground access tunnels will be needed.

7.2. New Design for Khudoni HPP Dam Stop Lock

In the body of Khudoni HPP arch dam, where three deepwater gates should be located, usage of flat Stop Locks is foreseen, which slides down from the side of the reservoir and locks the outlet. Enguri HPP arch dam uses similar gate. Its operation was initially accompanied by accidents. In 1986 the first Stop Lock, which weighed 165 tons, sunk in the reservoir. The hoisting structure of the Stop Lock also fell in the water and 5 persons died due to this accident. Currently the same type of Stop Lock is being manufactured, which will be tested in 2005 and will weigh 200 tons. In the

ensuing 8 year period Georgian engineers have worked out an idea to use a spherical-segment gate instead of a flat stop lock, which will weigh 2 to 2.5 times less and its operation will be much safer. Georgian patent #U926 protects this innovation. Authors (Employees of “Energogeneratsia”: Simon Bakhturidze – Head of Hydro-Technical Department and Temur Mamiashvili – Head of Equipment Department) are willing to offer this new concept.

P H O T O S

Photo 1: Enguri HPP - Reservoir

Photo 2: Enguri HPP - Arch Dam

Photo 3: Enguri HPP - Arch Dam

Photo 4: Enguri HPP - Power House

Photo 5: Khudoni HPP – Entrance portal of the construction (bypass) tunnel

Photo 6: Khudoni HPP – Exit portal of the construction (bypass) tunnel

Photo 7: Khudoni HPP – Left wing of the Dam. Concreted part.

Photo 7.1: Khudoni HPP – Place of right wing of the Dam

Photo 8: Khudoni HPP – Entrance tunnel of the underground Power House of the Station

Photo 9: Khudoni HPP – Different entrance tunnels of underground facilities

Photo 9.1: Khudoni HPP – Mechanical Workshop for Auto Transport (currently a private entrepreneur has a saw mill)

Photo 10: Khudoni HPP – Lodging (Hostel)

Photo 11: Khudoni HPP – Lodging Buildings (Hostels)

Photo 12: Khudoni HPP – Storage area in Jvari village

Photo 13: Khudoni HPP – Storage area in Jvari village

Photo 14: Khudoni HPP – Warehouse facilities in Jvari village

Photo 15: Khudoni HPP – Warehouse facilities in Jvari village

Photo 16: Khudoni HPP – Office of the Khudoni Construction Management in Jvari village

Photo 17: Khudoni HPP – Railway from Zugdidi to Jvari (to the warehouse & storage facilities)

Photo 18: Khudoni HPP – Concrete road from Jvari to Khudoni HPP

Photo 19: Khudoni HPP – Concrete road from Jvari to Khudoni HPP

Photo 20: Khudoni HPP – Damaged parts of the road

Advisory Assistance to the Ministry of Energy of Georgia

PROJECT REPORT: KHUDONI HYDRO POWER FACILITY
PRE-FEASIBILITY REVIEW

June 30, 2005

Ver 3.0

Volume II

USAID
FROM THE AMERICAN PEOPLE

CORE INTERNATIONAL Inc.
Consultants for Resources Evaluation

A P P E N D I C E S

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APPENDIX 2 – RESOLUTION #330 (30 JUNE 1989) OF COUNCIL OF MINISTERS OF GEORGIAN SSR REGARDING KHUDONI HPP CONSTRUCTION TERMINATION

High seismic activity areas have been outlined during draw-up of new seismic area map of the republic. Along with that, as is in conformity with recommendations of professionals, the Hydro Power Plant with large water storage reservoir, may negatively affect surrounding environment.

Considering public opinion, currently dominating in the republic, regarding construction of Khudoni HPP, as well as insistent demands of population living in Mestia, Tsalenjikha, Zugdidi regions, settlement Jvari and entire population of the republic, the Council of Minister of Georgian SSR hereby declares its resolution, as follows:

1. Immediately suspend construction operations of Khudoni power plant and work out relevant measures for complete liquidation of any adverse consequences caused by construction operations.
2. Industrial enterprise GruzEnergo, scientific institute TbilHydroProject, industrial construction & erection company GruzHydroEnergoStroy, be obliged to execute following:
    a) throughout the year accomplish liquidation operations, in conformity with approved list of scheduled works, and taking into account technical features of their execution;
    b) by year end elaborate project for complete liquidation (conservation) of the site and define terms and volumes for accomplishment of these works.
3. The above-mentioned works to be implemented under public supervision.

N. Chitanava (applied round seal)
Chairman
Council of Ministers
Georgian SSR

Z. Makharadze
Head of Management Office
Council of Ministers
Georgian SSR

APPENDIX 3 – RESOLUTION #234 (18 MAY 1989) OF COUNCIL OF MINISTERS OF GEORGIAN SSR REGARDING ADDITIONAL INVESTIGATIONS ON KHUDONI POWER PLANT'S ECOLOGICAL IMPACT

The Council of Ministers of Georgian SSR, hereby decrees following:

1. Approve recommendation of Commission, studying ecological and other aspects of hydro power plant cascade construction on river Enguri, regarding suspension of construction and erection works at Khudoni Power Plant, before final ecological conclusion of the Commission is submitted, except for those works that should to be executed and completed, in order to enable conservation of the construction site.

2. By June 1, 1989, industrial enterprise SakEnergo, scientific institute TbilHydroProject, industrial construction & erection company SakHydroEnergoMsheni be obliged to draw up a full list of works and constructions that are required to ensure safety and reliability at construction area.

3. Have Commission, studying ecological and other aspects of hydro power plant cascade construction on river Enguri, expedite submission of preliminary recommendations for conclusion of ecological expertise within 10 days.

N. Chitanava
Chairman, Council of Ministers
Georgian SSR

Z. Akhvlediani
Head of Management Office
Council of Ministers
Georgian SSR

(applied round seal)

APPENDIX 3.1 – ORDER #949P (25 OCTOBER 1988) OF COUNCIL OF MINISTERS OF GEORGIAN SSR REGARDING ADDITIONAL INVESTIGATIONS ON ECOLOGICAL IMPACT OF KHUDONI HYDRO POWER PLANT'S CONSTRUCTION

In order to carry out additional studies of ecological aspects related to project design and construction of Enguri cascade power plants (Khudoni HPP, Tobari HPP), a Commission to be set up with the following (23) members:

(list of 23 members with respective positions)

Commission is obliged to present materials to the Council of Ministers of Georgian SSR within one month.

O. Cherkezia (signed and sealed)
Chairman
Council of Ministers
Georgian SSR

APPENDIX 4 – RESOLUTION #484 (9 JUNE 1980) OF COUNCIL OF MINISTERS OF GEORGIAN SSR REGARDING PROVISION OF TERRITORY FOR KHUDONI HPP CONSTRUCTION

Allocation of 687.4 hectares of the Khaishi Forestry land plot for construction site of Khudoni HPP.

Georgian SSR Council of Ministers hereby decrees as follows:

1. Approve Decision #275 dated August 30, 1979, of Mestia Executive Committee of People's Deputies Council and in conformity with it, have 687,4 hectares of Khaishi Forestry land plots allocated to Construction Directorate (management) of Enguri hydro power cascade, for construction site of Khudoni hydro power plant, as indicated in attached appendix.
2. Construction Directorate of Enguri hydro power cascade to reimburse in Mestia Regional Budget a fixed value of timber corresponding to the forestry on the land plots allocated for construction site of Khudoni HPP.
3. Timber, cut at allocated land plot, to be distributed by Mestia Executive Committee of People's Deputies Council, so that to satisfy local demand according to the approved forest logging pool.

Z. Pataridze
Chairman, Council of Ministers
Georgian SSR

Z. Akhvlediani
Head of Management Office
Council of Ministers
Georgian SSR

(applied round seal and signed)

Appendix to Resolution #484, dated June 9, 1980
Council of Ministers of Georgian SSR

List of Forestry lands that allocated 687.4 hectares of plots for construction works of Khudoni HPP.

Forestry	# Allocated Land Quadrants (Sections)	Area (Hectare)	Including for Temporary Road Construction (7-year period)	Timber to be Cut (Thousand m^3)	
				Total	Usable Timber
Khaishi Forestry	24-26, 30, 50-53, 62-66, 75-76, 78, 79, 81-84, 93-100, 144	592.1	29.3	46.1	13.2
Chuberi Forestry	108, 121	48	45	6.4	1.9
Ormeleti Forestry	95, 110-111, 116-118	47.3	14	7.9	4
	TOTALS:	**687.4**	**88.3**	**60.4**	**19.1**

Z. Akhvlediani
Head of Management Office
Council of Ministers of Georgian SSR

(signed and applied round seal)

APPENDIX 4.1 – DECISION #275 WITH TWO ATTACHMENTS ON LAND PLOT BREAKDOWN (30 AUG 1979) OF EXECUTIVE COMMITTEE OF PEOPLE'S DEPUTIES COUNCIL OF MESTIA REGARDING PROVISION OF LAND FOR KHUDONI HPP CONSTRUCTION; ACT ON LAND SELECTION; AGREEMENT FORM MESTIA AGRICULTURAL DEPARTMENT; AGREEMENT FROM KHAISHI FORESTRY; AGREEMENT FROM KHAISHI SOVIET STATE FARM

APPENDIX 4.2 – LETTER OF DEPUTY MINISTER OF AGRICULTURE ON RESETTLEMENT OF POPULATION

APPENDIX 4.3 – CONCLUSION #Э-121 (26 AUG 1983) OF USSR MINISTRY OF ENERGY AND ELECTRIFICATION'S DEPARTMENT OF PROJECT DESIGN EXPERTISE AND BUDGET ESTIMATES

The USSR Ministry of Energy and Electrification
Department of Project Design Expertise and Budget Estimates

103974 Moscow
7, Kitaiskiy Avenue
Tel.: 220-41-19

26.08.1983 - Moscow

C O N C L U S I O N # Э-121

(Excerpt form the first page of the 32 page document)

1.1. Introduction
Project of Khudoni HPP on river Enguri is elaborated by Tbilisi branch of institute "Hydroproject" (Chief Engineer of the Project - V. Kobakhidze) on the grounds of USSR Ministry of Energy's order dated 22 December 1978 and in accordance with Technical-Economic Justification of the construction of this HPP, approved by the Decree N 110 ПС dated 31 August 1978 of the Ministry of Energy of USSR.

Hydro Power Plant is for power generation purposes.

According to the more exactly defined scheme of use of river Enguri, approved in 1972 by GEK GosPlan (central planning body) of USSR, Khudoni HPP is located in mid-flow of the river. Out of two competing canyon gates for Khudoni HPP, located respectively on 32 and 24 km above Enguri HPP dam, higher gate was chosen based on construction and technical-economic consideration.

In Khudoni HPP project, use of level drop between points of 700 m and 510 m was chosen a two-step rather than one-step option previously defined in Technical-Economic Justification.
…
(Excerpt form the last page of the 32 page document)

3.3. Taking into account completeness and detailed technical design solutions used for the hydro power plant construction, to be built in complex natural conditions, Khudoni HPP project is noted as a high quality design, which has similar to Enguri HPP characteristics.

A. Vakhrameev,
Department Chief Engineer

S. Pokrovskiy,
Department Chief Expert

APPENDIX 5 – CLARIFICATION MINUTES #1 (9 JAN 1990) AND #2 (1 FEB 1991) OF KHUDONI HPP ECOLOGICAL IMPACT ASSESMENT REVIEW AND CONCLUSION OF THE ECOLOGICAL COMMISSION

The USSR Ministry of Energy and Electrification

Scientific-Research and Design Institute “HydroProject”
Tbilisi Branch
Technical Council

Protocol #1, (09.01.1990), Protocol #2, (01.02.1991)
Conclusion with four attachments.

Total: 52 pages

Signed by all members of the Committee.

APPENDIX 6 – KHUDONI HPP REVISED (1992) PROJECT PASSPORT

Republic of Georgia
Ministry of Fuel and Energy

Project Design and Prospecting Institute
TbilHydroProject

P A S S P O R T

(Technical Certificate)

Of Khudoni Hydro Power Plant on River Enguri

Approved Project Design

Chief Engineer of the Project V. Kobakhidze

1992

A. General Information

1. Khudoni Hydro Power Plant Project on river Enguri

2. Construction site: Mestia and Tsalendzhikha regions, Republic of Georgia

3. Ordering Organization (Customer): SakEnergo

4. Project order approved by: SakEnergo; Date of approval: 07 May, 1992

5. Protocol for construction site area approved by: the USSR Ministry of Energy with the order # 110 ПС dated 31 Aug 1978.

6. Power Plant Technical-Economic Assignment (Feasibility Documentation) prepared by the TbilHydroProject scientific institute.

7. Power Plant Complex Purpose: power supply (generation)

8. Power Plant Full Capacity Commissioning Year: 1999; rated output 638 MW

B. Water Supply Unit: Technical Specification:

##	Description	Unit	Quantity
1.	2.	3.	4.
Power supply			
a. installed capacity		MW	638
b. rated capacity		MW	42,10
		(64.9 through Enguri power plants)	
c. annual power generation (several year average)		million kWh	1444.8
d. installed capacity running hours		hours	2265
e. major power consumers			
C. Economic Factors			
Total constructing value (construction and erection operations indicated in brackets)	million rubles	1984:565.2(369.3) 1991:871.8(628.3)	
including:			
a. industrial objects	million rubles	1984:526.4(337.8)	
1991:818.9(578.1)			
including:			
water storage reservoir	million rubles	1984:86,90(61.70) 1991:135.90(108.3)	
b. accommodation and civil engineering constructions	million rubles	1984:35.0(28.2) 1991:52.7(44.5)	
D. Capital Investments:			
a. in power generation	million rubles	1984:561.3(369.3) 1991:866.0(628.3)	
b. in other industries	million rubles		
Annual generation sale prices (rate of 10 kopecks/kWh)	million rubles	1991:123.0	
Annual generation expenses	million rubles	1991:23,59	
Power generation cost price	kopeck/kWh	1991:1.63	
Water	kopeck/cu m		
Annual expenditure on hot houses (provisional)	million ton	1991:0,50	
Annual profit	million rubles	1991:99.41	
Extra capital investments:			
Pay-back period	year	7.2	
Profitableness	%		

1.	2.	3.	4. 4.
Specific Capital Investments:			
a. 1 kW installed capacity	ruble/kW	880.0/1355.0	
b. 1 kW several years average of power generation	ruble/kW	38.90/60.0	
Capital Investments in Construction per Years: (construction and erection operations indicated indicated in brackets):			
1st year	million rubles	1991:77.45(62.94)	
2nd year	million rubles	1991:121.86(100.44)	
3rd year	million years	1991:135.29(102.99)	
4th year	million years	1991:161.03(107.28)	
5th year	million years	1991:163.20(109.66)	
6th year	million rubles	1991:46.40(25.24)	
Per capita sale price of annually generated power (excluding security staff)	thousand rubles	1991:1370.0	
D. Hydrological Water Supply Factors			
Water scoop area			
Annual water drainage (average of several years)	sq m	2780	
Annual water flow-rate:			
a. average of several years	cu m/sec	130.8	
b. max. estimated consumption- - % supply	cu m/sec	2609	
c. max. observed/actual	cu m/sec	1190	
Max. consumption on construction- % supply	cu m/sec	2414	
Annual sanitary water flow-rate	cu m/sec		
Max. consumption of construction period - % supply	cu m/sec	1030	
Designated Level:			
a. standard water supply level (swsl)	m	670	
b. lower lever capacity (dead level)	m	645	
c. max. throughput period at upper (water)	m	671.96	pond
d. max. throughput period at tail	m	530	water
e. min. throughput period at tail	m	520,7	water
Specific Pressure:			
a. max. static pressure	m	150,7	
b. min. working pressure	m	118,8	
c. rated pressure	m	143,8	

1.	2.	3.	4.	5.
Designated Water Storage Surface (mirror)Area at SWSL		sq m	4.0	
Total water storage capacity		million sq m	230	
Applicable capacity of water storage		million sq m	89	
Water drainage regulation efficient			0,25	
Water drainage generation efficient			0,987	
E. Construction Specification				
	Buildings and Premises	construction tunnel, arched dam, water intake, pressure delivering tunnel, pumping waterways, power plant house, delivery tunnels and others		
	Capitalization class	I class		
Hydro Power Plant				
a. type		underground, adjacent to dam		
b. number of plants		units	3	
c. foundation soil type			rocky	
d. rated water throughput capacity, max.:				
turbine		cu m/sec	490	
overflow water section		cu m/sec	1924	
Dam				
a. type - arched				
b.constructing material – concrete		spillway: closed – bordered		
c. estimated spillway flow-rate		cu m/sec	1924	
d. estimated low pressure		m	140	
e. construction height		m	170	
f. upper (crown) length		m	532	
g. foundation soil			rocky	
h. seismic		magnitude	9	
i. down apron specific flow-rate		cu m/sec	107	
Spillway				
a. type		depth, inside arch		
b. estimated consumption		cu m/sec	1924	
Derivation Water Intake				
a. type		coastal, depth		

1.	2.	3.	6. 4.
Sediment Pit (Sump)			
Intake Derivation		tunnel, 3 plant pressure	
a. type			
b. throughput capacity	cu m/sec	490	
c. length	m	878,7	
d. slope		0,1	
e. bottom length, diameter	m	6	
f. max. flow-rate	m/sec	5,8	
g. coating		concrete	
Surge Reservoir			
a. type		underground, hydraulically resistant	
b. water level fluctuations amplitude	m	14	
Delivery Derivation			
a. type			
tunnel, 3-plant		pressure	
b. length	m	270	
c. bottom length, diameter	m	8	
d. max. flow-rate	m/sec	3,2	
e. coating		concrete	
E. Operations at Water Storage Area and Lower Water			
Flooding area including:	thousand ha	0,355	
a. agriculture lands	thousand ha	0,1387	
1. arable land	thousand ha	0,015	
2. orchards	thousand ha	0,077	
3. pastures & meadows	thousand ha	0,047	
b. forests & bushes	thousand ha	0,216	
Number of inundated settlements/villages and homesteads	village/homestead	6/264	
Number of relocated settlers	men	1000	
Roads reconstruction:			
motorways	km		
railway	km		

7.

1.	2.	3.	4.

F. Hydro Power Generating Equipment

Turbine	three	
a. quantity	unit	3
b. type	PO170/803a	
c. estimated pressure	m	143,8
d. rated capacity	cu m/sec	163,3
e. suction height	m	-6.6
f. output capacity	MW	215.9
g. rotation speed	r/sec	214,3
h. turbine weight	ton	450
i. manufacturer		LMZ

Generator		
a. type	CB800/232-28YxL4	
b. output capacity	MW	220
c. voltage	kW	15,75
d. p-cosine		0,85
e. generator weight	ton	1220
f. manufacturer		SIBETM

Transformer		
a. quantity	units	4
b. type	TDC-250000/500	
c. net weight (excluding oil)	ton	270
d. manufacturer		ZTZ

Electricity main lay-out hook up				PTL
a. circuit-breaker type	1.	2.	3.	4.
b. power transmission line locations	Enguri power plant	500 kW Stavropol hydro plant		Georgian power supply system
c. PTL voltage	kW	500	500	500
d. PTL circuit number		1	1	1
e. PTL length	km	47	376	50
f. PTL power supply	MW	1000	800	1000

G. Volume of Operations (excluding accommodation constructing operations)

including all constructions

		dam	other major constr.	roads	etc.	
		1.	2.	3.	4.	5.
Earth-moving	thousand cu m	3699	165	451	3083	
including:						
hydro-mechanical	thousand cu m	rock drilling/boring				
	thousand cu m	8141.5	577	1158	6406.0	–

1.	2.	3.				8. 4.
including:						
underground	thousand cu m	540.3	--	380	160.3	--
filling dam	thousand cu m	200	--	200	--	--
including:						
aggradation	thousand cu m	--	--	--	--	--
Concrete and Reinforced Concrete including:	thousand cu m	2386,5	1186,8	359,3	840,4	--
prefabricated	thousand cu m	38,30	11,0	22,0	5,3	--
underground	thousand cu m	267,07	0,7	179	87,37	--
Cementing	thousand sq m	352,2	145,0	92,2	115,0	--
Metal Structures and Equipment including:	thousand ton	8.14				
safety guards, lattice, grids	thousand ton	2.62				
truck-mounted cranes	thousand ton	1.21				
pipelines	thousand ton	1.3	--	1.3	--	--
hydro-power equipment	thousand ton	4.95	--	--	--	--
re-bars	thousand ton	--	40,00	--	--	--
cement	thousand ton	--	699.6			
timber including:	thousand cu m		43.3			
cut materials	thousand cu m		35.5			
Number of construction workers during rush periods	men		5124			
Accommodation area at settlements	thousand sq m		59.36			
a) temporary	thousand sq m		2,76			
b) permanent	thousand sq m		56,6			

Back-up Information:

1. Number of servicemen and workers	- 90+39=129 men
2. Amount of supplies and operations for temporary construction	- shearing 512.7 thousand cu m, including rocky ground of 195.0 thousand cu m; soft soil- 318.0 thousand cu m; timber- 1.0 thousand cu m, including cut material of 0.8 thousand cu m; cement- 0,61 cu m; re-bars- 0.61 thousand tons.
3. Amount of supplies and operations for specified settlements	- re-bars- 4.9 thousand tons; timber- 12.0 thousand cu m, including cut materials of 10.6 thousand cu m; cement- 48.1 thousand tons.

APPENDIX 6.1 – LIST OF REVISED (1992) KHUDONI HPP PROJECT DOCUMENTATION

List of Contents of the Project for Khudoni HES

Documents

Part 1

General data of the Project

Book 1, General explanation note

Book 2. Brief explanation note

Book 3. Passport

Book 4. Patent search

Annex: New technical progressive solutions introduced in the Project

Part II.

Natural conditions

Book 1. Climate and hydrology

Book 2. Topographic conditions

Annex:

1* Program for carrying out control over shrinking of arch dam and other constructions and horizontal moving by geodesic methods

Book 3. Engineering-geological conditions

Annex:

1* - Engineering-geological conditions

2* . Ditto. Drawings

3. Geological-structural study of the region of building of Khudoni HES

4. Analysis of progressing the processes of silting and filling of water reservoir.

5. Effect of Inguri and Khudoni reservoirs on the development of exo-dynamic processes of the surrounding landscape.

6. Additional seismologic studies in the river Inguri cascade region.

7*Calculation of maximum elevation of water level during landslides

8. Additional study of stability of loose ground located over the left post/support of arch dam of Khudoni HES

Part III

Water-economy calculations and energy economics

Book 1. Water-economy calculations

Book 2. Substantiation of parameters and economic efficiency

Part IV

Principal constructions

Book 1. Hydro unit buildings and their amalgamation

2. Ditto, drawings

Annex:

1. Principal buildings of hydro unit

2. Substantiation of expediency of energetic application of this section of a river in connection with the liquidation of building of Khudoni HES.

3. Model trial of building tunnel and its joining with the tail water. Theme No 83

4. The same, additional stage. Theme No 83

5. Hydraulic studies of the water-discharge tunnel.

6. Calculation of dynamic pressure of water in the Khudoni HES Pressure leading system at non-settled regimes and seismic vibrations

7. Calculation of Khudoni HES arch dam at 9 point seismic action, by the provision of gravitation supports/columns.

8. Hydraulic calculation of exploitation water drainage

8. Study of filtration in the dam base and its body. Theme No 242.

10. Calculation of model study of filtration in the base of Khudoni HES constructions

11. Materials for the Project for natural control and studies of Khudoni HES engineering. Theme 65.1.

12. Cementation and drainage jobs in the base of the arch dam and underground constructions of hydro unit.

13. Monolithing of arch dam with temperature cementation of setting joints.

Book 2. Technological equipment

Annex:

1. Technical project of hydro turbine

Explanation note

Book 3. Electro technical part

The same drawings

Annex:

1. Scheme of joining of Khudoni HES to electro systems
2. Calculation of electric regimes and stability
3. Relay security
4. Automated system against accidents
5. Joining of 500 kW lines to Khudoni HES
6. Dispatchers' and technological management means
7. Accounting documents of general system designation departments
8. Rough drawings of hydro generator

Book 4. Fire preventive measures

Part V

Book 1. Exploitation of organization

Part VI

Book 1. Engineering-technical measures (confidential)

Book 2. Calculation of water burst wave

Part VII

Water reservoir, environment protection

Book 1. Measures connected with tail water of water reservoir

Annex:

1. Allocation of land plots for engineering

2. Technical-economic calculation of volumes of jobs and resources for moving population from the alienated territory, that for building, engineering and amenity jobs.

3. Materials for inventory making of building and perennial plants..

4. Technical working plan for wood cutting and cleaning on the territory under the Khudoni HES water reservoir construction.

5. Calculation documents for wood cutting and cleaning on the territory under the Khudoni HES water reservoir construction.
6. Substantiation of archaeological study on the territory of engineering of Khudoni HES.
7. Water reservoir. Environment Protection. Book 1.
Book 2 – Water reservoir. Environment Protection. Changes in natural conditions in connection with building of hydro unit.
Annex:

1. Prospecting jobs for the study of the effect of Ingury cascade on the region climate, within the frames of demands for building of this cascade.
2. Analysis of development of processes of silting and filling of Khudoni HES.
3. Prognosis of water quality in Khudoni water reservoir.
4. Modern sanitary-hygiene study of Inguri water reservoir and river Inguri within the frames of Khudoni water reservoir to study the possible effect of cascade on the health of population of neighboring territories.
5. Prognosis of anti-malaria measures.
6. Prognosis of the effect of cascade of water reservoir on the radio-ecological state of Inguri basin.
7. Influence of Inguri and Khudoni water reservoirs on the development of exo-dynamic processes of neighboring landscape.
8. Prognosis of effect of r.Inguri cascade on the transformation of soil cover of the neighboring territory.
9. Study of water-preservation and soil protection capacities of river Inguri basin forests and elaboration of recommendations for strengthening those data.
10. Study of vegetable cover of middle section of River Inguri basin and estimation of its ecological role with respect to building of cascades of hydroelectric stations.
11. Prognosis of influence of building of cascade of water reservoirs on the state of vegetable cover of Inguri.
12. Prognosis of influence of Inguri water reservoir cascades on the fauna of the region.
13. Study and estimation of possible economic and social consequences induced by construction of Khudoni HES.
14. Water reservoir. Environment Protection. Book No 2

Part VIII.

Architecture of constructions and housing engineering.

Book 1.

Architecture of constructions and housing engineering.

Part IX.

Sanitary-technical equipment

Book 1. Water, sewerage, heat provision and ventilation of principal constructions and building foundations of hydro unit.

Part X

Organization and work execution of hydro unit engineering

Book 1. Organization of construction/engineering

Ditto, drawings

Annex:

1. Engineering control over thermal regime of reinforced concrete.
2. Study of means of cooling of reinforced concrete structure of arch dam.
3. Study of mechanical characteristics of reinforced concrete of arch dam.
4. Study of strength and deformation indices of reinforced concrete of arch dam.
5. Selection of mark 200 reinforced concrete composition during using reinforced concrete by concrete pump.
6. Water lowering project for the arch dam opening.
7. Project for drilling-explosion jobs for treating arch dam opening.
8. Technical provisions for concrete jobs of arch dam.
9. Project of arch dam building by non-stop conveyer technology.
10. Ditto. Account of Designing-Construction Bureau for Mechanization of Power Engineering.(Moscow).
11. Exploitation of concrete conveyer equipment in winter conditions.
12. Methodological recommendations for calculation of costs for exploitation of concrete conveyer machinery.
13. Non-stop conveyer technology for building Khudoni arch dam.

Book 2. Realization of open jobs.

Ditto, drawings.

Book 3. Underground jobs
Ditto, drawings
Annex:
1. Underground jobs
Ditto, drawings
2. Taking of motor road Jvari-Khaishi-Mestia - out of the flooded zone, 40-50 km.
Tunnels (text, drawings).

Book 4. Motor roads
Explanation note
Ditto, drawings. Calculation of costs for AG 15 and AG 5' tunnels.
Annex 1. Building of snow-slip protecting galleries on the motor road Jvari-Mestia on the 0-40 km section.

Book 5. Temporary power supply and communications

Part XI.
Calculation documents
Book 1. Summed up expenditures and aggregate calculations.
Book 2. Objective calculation.
Book 3. Calculation of local costs
Book 4. Calculation of local costs (chapters 1,3,5,6-11)
Book 5. Calculation of local costs (chapter 12)
Book 6. Aggregate calculation of costs (chapter 13).
Book 7. Objective and local calculations of costs for civil dwelling engineering.
Book 8. Catalogues for unit prices.
Book 9. Constitutive documents (subsidiary tables and additional pricing)
Book 10. Calculation of costs of products of subsidiary economy
Book 11. Inventory of the costs of implemented jobs
for 01.01.1992

APPENDIX 7 – GENERAL PLAN AND MAJOR DRAWINGS OF KHUDONI HPP

APPENDIX 7.1 – COLOR SKETCHES OF KHUDONI HPP MAJOR STRUCTURES

APPENDIX 7.2 – ILLUSTRATIONS OF WORKS COMPLETED ON MAJOR STRUCTURES

APPENDIX 8 – TABLE OF COMBINED COSTS OF KHUDONI HPP CONSTRUCTION

APPENDIX 9 – LETTER OF "ENERGOGENERATSIA" TO THE PRESIDENT OF GEORGIA ON COMMERCIAL PROPOSAL FROM "ARCTIC TIMBER (UK) LTD"

Attn: T.Gogava
A. Jakeli

_____

Interesting proposal.
Request to submit reasonable
suggestions, together with
Property Management Ministry and
Generation, by November 27; in case
of necessity arrange draft of President's order

signed/22.11.01

PRESIDENT OF GEORGIA

Attn.: N. Uplisashvili
G. Pruidze
M. Nikolaishvili

Review. Submit agreed proposal.
(signed and stamped)

E. Shevardnadze

November 18, 2001
#777/15

(applied oval stamp of Georgian Ministry of Fuel and Energy.;#4870, dated 19.11.2001)

Georgia
Legal Entity of Public Law
ENERGOGENERATSIA

1, Vekua Street, 380005 Tbilisi
Tel.: (99532)98 06 66/98 02 02
Fax: (99532)99 06 02
E-mail: mamukanikolaishvili@usa.net

Ref.#01-08/595
Date: 08.11.2001

His Excellency,
President of Georgia
Mr. Eduard Shevardnadze

Dear Mr. President,

Present severe economic and political crisis in Georgia, has hit power supply industry of this country as well, being rather a painful burden borne by majority of its population.

Would like to underline, that among numerous individual and objective causes of existing hardship, the unfinished constructing of Khudoni electricity generating power plant, should be named as one of them. Different potential investors have approached with recommendations on the matter, but much to regret, the issue up to now is not yet settled.

The President of Georgia's order #74 dated February 29, 2000, has stipulated necessity to set up a power generation company – EnergoGeneratsia, and the latter has now on its balance unfinished construction of Khudoni power plant; consequently our current intention is to resume constructing operations of this rather significant object for Georgian power supply system.

Our opinion is to take advantage of any, even slightest opportunity that may come along and may expedite solution of the problem.

In connection with above-mentioned, we would like to attach to this letter the proposal of the Arctic Timber (UK) Ltd., being ready to invest US$500 million in constructing operations of power plant.

Will you kindly assist and support us, so that to get all concerned ministries and departments, be involved in reviewing of said proposal.

Faithfully Yours,
M. Nikolaishvili (signed)
Chairman

APPENDIX 10 – MAIN INDICATORS OF KHUDONI HPP CONSTRUCTION BUSINESS PLAN - “HYDROSPECGVIRABMSHENI”

THE GYDROSPETSGVIRABMSHENI JOINT-STOCK COMPANY

THE KHUDONI ELECTRICITY GENERATING POWER PLANT
Location: Enguri river, Republic of Georgia

Project Design and Business Plan Major Indications

Tbilisi-2003

1. Brief Description

Construction project design OF THE Khudoni Electricity Generating Power Plant (EGPP), has been elaborated and approved by the TbilHydroProject scientific institute, in conformity with Directive of the USSR Council of Ministers (Directive #2503-D, dated December 14, 1989).

Construction value of the Khudoni EGPP is US$684,3 million, including US$439,2 million covering both construction and erection works. Construction to be performed within narrow gorge having rounded slopes, and to be located upstream the arched dam of the Inguru EGPP. The constructions of the power-plant were designed to incorporate: arched dam, construction tunnel, water intake and turbine water lines, EGPP building, discharge tunnel, operational overflow tunnel.

The EGPP building would house three hydro-plants, with total output capacity of 700 MW, to generate electrical power supply of 1444,8 million kWh annually.

Major technical and economical factors are indicated in attached appendices.

2. The Object (EGPP): Present Technical Conditions

Construction works of the Khudoni power plant had started in 1979 and later suspended in accordance with resolution #330 dated June 30, 1989 issued by the Council of Ministers of Georgia.
Construction works estimated at US$186,7 million, and including US$135,9 million worth of construction and erection works, had been accomplished by the time this construction declared suspended.
The following jobs had been completed and namely:
- accomplished 60% of earth-moving and rock drilling operation for power unit foundation area;
- completed 80% of earth-moving and rock drilling operations for underground profile of arched dam, as well as 60% of concrete placing works;
- accomplished 60% of earth-moving and rock boring operations for underground construction of
  power unit, as well as 45% of concrete and reinforced concrete placing works;
- construction tunnels completed and water run in;
- completed 76% of road-construction works;
- 83,5 thousand cu m of concrete placed within foundation area at the left wing of arched dam;
- accomplished 40% of works within flooding area;
- completed lower and upper cofferdams.

Terminating of the Khudoni power plant construction had been caused at that time through negative public opinion directed against power-plant erection. The Spitak earthquake in Armenia was referred to as an official reason to suspend construction operations at Khudoni. Consequently, seismic prospecting was urged for constructions sire of the Khudoni EGPP.

There were 16 different companies involved in project designing; conclusions and recommendations provided by these organizations prove viability of project design solutions, as well as confirmed its economic and ecologic mission.

3. Inguri river Khudoni EGPP: Funds Required to Complete Construction

Total budget construction value of the Khudoni power plant is US$684,3 million, including US$439 million for construction and erection works.

Value of works accomplished during constructing period, had amounted to US$186,7 million, including US$135,9 million spent for construction and erection works.

Whatsoever construction works at the Khudoni EGPP had been terminated there in 1989, and presently nearly 30% of previously completed works now require renovation and recovery, in terms of current prices amounting to US$56 million, and it will cover only construction and erection works.

4. Financial Support

In conformity with resolution (dated 20.03.2003) of the supervisory board of the JSC HydroSpetsGvirabMsheni, it will require to arrange a US$300 million credit so that to complete construction of Khudoni power-plant, whereas another US$253,6 million will be financed from local funds.

5. Feasibility Calculations

Below indicated feasibility estimations are based on current world market prices for construction/building materials, equipment and machinery, construction and erection operation
Works, as well as currently applicable tax payment regulations and existing Labour Code of Georgia.
Credit pay-back will start two (2) years after the fund-raising investments (see table below).

Budgeted Expenses:

#	Description	Amount in US Dollars
I Running Expenses		
1	Salary fund	0,45 million
2	Insurance	2,0 million
3	Current repairs and agree/liquidated expenses	1,5 million
4	Average tax on property, 0.8%	5,4 million
	Sub-Total	9,3 million
II Other Expenses		
1	VAT	8,6 million
2	Renovation payment	28,2 million
3	Production tax	0,3 million
Total Expenses		17,9 million

STATEMENT

Required credit amount of US$300 million, is based on above-mentioned estimated calculations and feasibility study, and will ensure guaranteed 14-year pack-back period of credit.
Present statement is based considering that currently under construction the Khudoni power plant is located within shortest distances to complex of power supply systems of neighbouring countries, such as Russia, Turkey and East Europena nations.

M.N.Chaava (signed and stamped)
Director-General
JSC HydroSpetsGvirabMsheni

APPENDIX 11 – ORDER #24 (14.05.2004) OF GOVERNMENT OF GEORGIA REGARDING KHUDONI HPP TECHNICAL CONDITION STUDY

SETTING UP AD HOC STATE WORKING GROUP FOR ASSESSMENT OF TECHNICAL CONDITIONS AT THE KHUDONI POWER PLANT

1. Ad hoc state working group to assess technical conditions of the Khudoni power plant shall have included following members and namely:

- Vakhtang Topuria- First Deputy Minister, Georgian Ministry for Energy, Group Director;
- Vasil Gogolashvili- Deputy Minister, Georgian Ministry of Finance;
- George Imnadze- Deputy Minister, Georgian Ministry for Environment and Natural Resources Protection;
- Konstantin Odishvili- Specialist, Georgian Ministry of Infrastructure and Development;

2. Following companies and institutes will have to participate in committee' work as:
   HydroProject Ltd.- scientific-research and design-prospecting institute (Anzor Chitanava, Nodar Emukhvari);
   JSC EnergoGeneration- (Simon Bakhturidze, Temur Mamiashvili);
   Directorate of Khudoni Construction;

3. Working Group shall be responsible to assess, within two-week period, actual conditions of construction tunnel of Khudoni power plant, and submit proposals on urgent execution of repair/rehabilitating operations;

4. Minister N. Gilauri, Georgian Ministry of Energy (power supply), will be responsible to Supervise fulfillment of Resolution.

Zurab Zhvania (signed and stamped)
Prime-Minister

APPENDIX 12 – LETTER FROM ENERGOGENERATSIA ON CURRENT VALUE OF KHUDONI HPP

Legal Entity of Public Law
ENERGOGENERATSIA

09 June 2005

In response to your letter form May 27, 2005 we would like to let you know following:

1. “Khudoni HPP Construction” is on the balance sheet of “Energogeneratsia”;
2. It’s current balance sheet value is 41.3 million GEL;
3. Khudoni HPP is on long-term conservation and it’s property tax is not being paid by us.

Chairman (Signed)
G. Trokashvili