

EFFECTIVE OPERATION ASSESSMENT OF MORE THAN 25 YEARS OLD AND NEWLY BUILT HYDRO POWER PLANTS



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DEFINITION

Sand and abrasive material follows the naturally flowing water, which causes damage to the hydro technical buildings and hydro turbine machines. Therefore, according to the rules and instructions of the technical exploitation (ter. article 14, P.1), all the pressure hydro power plants that have more than 25 years of exploitation period, despite their condition, must be periodically examined on its sustainability, steadiness and reliability. Based on those examinations power plants are provided with technical support and safety insurance activities.

The aim of the monitoring is to:

Provide condition assesment of the selected power plants (technical-economical indicator and rentability), reveal reserve exposure and give recommendations for the future rehabilitation purposes.

Result of the monitoring should be the fundament for each HPP project investment. Project will have pre-investment and exploitation sections, which itself will be divided into separate phases. Aim of the monitoring is to discover problems that are necessary for pre-investment project. Pre-investment phase consists of preliminary technical and economical assessment, analyzes, discovering and planning of essential rehabilitation nodes and activities, discussing alternative versions and assessment conclusions.

INTRODUCTION

World faces serious environmental challenges, that is caused by the human activities and climate changes. Amount of the natural disasters have been significantly increased during last decade, floods, landslides, forest fires and etc. caused by the climate change, became frequent. Eventually above -listed effected Georgia as well.

Georgia aims to achieve long-term safety in energy sector, but country still depends on imported resources and fossil fuel. Lack of renewable energy use and energy resource exploitation is still a problem. Meanwhile, in energy sector, during last six years, Georgia had average 5% increase in power consumption, it particularly increased up to 7% in last two years, before it was in the range of 4.5%. Increase in generation was only 3.8%, which means, that we consume more than produce, therefore import and its dependence increases. The figures are quite alarming.

A vague national strategy and political directions in energy sector, makes difficult to asses energy projects and sector in general. It's not quite vivid, how existing energy policy is applicable to national tendencies of power consumptions and supply and how it guarantees energy security. Long-term goals are also unclear, in term of negative energy influence reduction on the ecology. Considering the existing situation, Government in (2018) signed an agreement with a consulting company McKinsey & Company, nevertheless official information on their activities are still unknown.

Speaking about the regional policy of the energy sector, mutually profitable collaboration can be noticed. Particularly in the end of 2015 Russian, Armenian, Iranian and Georgian Officials, signed "Collaboration Memorandum", which exposed perspectives for the energy sector development in the above-mentioned countries. The signed document, is an approval of energy sector mutual operation in the transmission ssphere for those countries. The establishment of coordinative and regional dispatching council was planned, that would ensure timely and effective responses to crisis and emergency situations and regulate electro-energy trade and transition.

All technological systems, devices and buildings, including all HPPs that are the part of energy site, should be occasionally technical examined. Examination has to take place in fixed dates as defined in normative and technical documents, at least once in five years. (tech. article 6. P.2.)

The results of technical assessment should be included in technical passport of energy site. Regular technical examination of energy site is performed by the energy-site commission, under the supervision of technical head or deputy. Commission is composed by the head of energy site structural sub-division and its specialists. The aim of technical examination is to conduct condition assessment of energy machines and buildings, as well as determine necessary activities for energy site provision.

Georgian energy system has supply deficit 8 times per year, meaning that for the consumer demand satisfaction, electricity has to be imported. The situation gets particularly worse in the first quarter of the year, when dependence on import is 25-30%. During this period, on the one hand, is the highest level of power consumption and on the other hand, generation is on the lowest point, as at this period of winter, river flow in Georgia is minimal and hydro resources are short.

The following is huge challenge for our system, which actually has to become a stimulator in investment promotion for the power consumption balance and decrease import dependence. Current official statistics mainly speaks on electricity import, nevertheless 23% of energy generation are thermal power plants, meaning that we produce energy by thermal stations, that itself is imported gas and we should not forget this as well. Thermal stations have the biggest role in generation. This put country energy-independence and safety under the question.

According to the statistical data, during the 10 month of the current year, amount of power consumption reached 9.897,7 million kwh, from which national power plants provided 8.201,7 million kwh. (including hydroelectric power station 6.800,2 million kwh.) and the rest - 878 million kwh was imported electric energy.

Based on the above-mentioned it's obvious, that increase of national generation sources is essential. One of the ways for problem solution is to modernize and renovate old HPP park, that with less financial expenses and shorter period will increase the exploitation level and indicator.

Researches on six HPPs, showed that detailed technical audit has to be conducted on power plants condition assessment and determine specific activities for the effective operation and maintenance of the existing plants and machines.

KHRAMI POWER PLANT I

1. BRIEF DESCRIPTION OF THE POWER PLANT

Khrami Power Plant I — is mixed type high-pressure HPP regulator located in Georgia, Tsalka Municipality, on the river Khrami. Plant operates with the water flow of Khrami river. The starting point of the plant is located in the beginning of Tsalka valley and power knot of HPP is built in deep valley, former stream canal of river Khrami. HPP started operation in December 1947. Its power is 112.8 thousand KWh and project annual power generation is 184 million KWh per hour.



- a) Full name: JS "Khrami Power Plant I"
- b) Legal Address: Tsalka Region, village Khramhesi
- c) Postal and e-mail address: 0171, kguliashvili@khramhesi.ge
- d) Type of Property, Owner of the enterprise: Joint-Stock Company „Gardabani Holdings B.V"
- e) Information on main structure of the enterprise and their leaders:
- f) Structure and number of the employee;

Worker	31
Labor force	3
Specialist	22
Leader	7

2. MAIN TECHNOLOGICAL SOLUTIONS

- The list of main technological processes, devices, machines and mechanisms;
- Management structure and production operation schedule; HPP works according to the GSE- central dispatcher workload.
- Total amount of workers;
- Main decisions and indicators:

Turbine

Label of the turbine - KMW Sweden

Calculating water expenses - 36 m³/sec during the HPP full power workload

Calculating Pressure: Maximum – 420m. Minimum - 374m. Normal – 370m.

Calculating coefficient of efficiency - 89%

Stage power - 112.8 Mw.

Speed Ratio - 52.6

Number of nominal turnover - 375 turn per. Min.

Generator

Generator Label - ASEA/ Sweden

Nominal Power - 37,6 m² Mw.

Coefficient of efficiency - 97.3%

Number of speed turnover - 675 turn per. Min.

Nominal voltage of stator - 10500 v.

Stator power - 2585 a.

Anxious system, anxious power - multilayer semiconductor switch 980 a.

Anxious voltage - 220 v.



3. DATA'S ON ANNUAL ENERGY PRODUCTION AND ITS ANALYZE DURING LAST 10 YEARS

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Aver. Yearly
MM. kW h p.Year	243,2	220,5	227,7	297,3	298,6	267,4	186,7	205,2	228,3	226,2	195,3	194,2	240

4. DIFFERENCE BETWEEN PROJECT DESIGN AND EXISTING POWER

4.1. Amount of comprehensive researches:

On 7 HPP buildings and 3 Electric Machines during last 12 years.

4.2. Amount of diagnostic studies made on individual machines during 12 years:

4 on lifting crane; 4 on vessels, working under the pressure; 4 on hydro aggregates.

4.3. Fundamental rehabilitations or reconstructions, cost estimates and results made during last 12 years:

Fundamental rehabilitation of 2 power transformers; 2 fundamental rehabilitation of each aggregates; 6 fundamental rehabilitation in total; - reconstruction of 3 workload calculator; replacement of 2 self-used transformers.

4.4. Main machines emergency absence and electrical energy production workload during the time loss in last 12 years - 0



5. INFORMATION ON ABSENCE OR LIMITATION OF HPP POWER EXPLOITATION

Project existence and implementation for elimination or limitation of HPP power exploitation. (All changes made during the HPP exploitation has to be included in the instructions, drawings and layouts) – 0



6. CAUSES AND DURATIONS OF THE DISCOVERED ERRORS

Without errors

7. RESEARCHES MADE FOR ERRORS DISCOVERY, LIST OF THEIR ELIMINATION ACTIVITIES (TERMS AND RANGES) AND RESPONSIBLE, IMPLEMENTATION BODIES.

- a) Hydro-technical building (condition and exploitation) – Without errors
- b) Hydro – turbine mechanisms and machines; (in compliance with the drawings). Unrestricting operation of the Hydro-turbine machines, during the exploitation, has to be guaranteed with possibly maximum coefficient of efficiency in accordance with their workload and pressure. Long-term operation of hydro-aggregate with the elevated vibration level is forbidden. - Without errors
- c) Electro-technical Machines; - Without errors
- d) Other buildings and machine - aggregates; - Without errors

Technical and technological monitoring on energy sites exploitation means, that all technological systems, machines, buildings or plants, including all HPPs under the energy site consistence, should apply to the regular technical assessments once in a 5 year, considering all the necessary activities for guaranteeing power plan determined resources. Applies accordingly.

8. POSSIBLE AMENDMENTS OCCURRED DURING THE OPERATION, (CONSIDERING ECOLOGICAL AND SAFETY CONDITIONS)

Permissible water speed regime for filling and emptying reservoirs; sediment monitoring and performing appropriate activities for its reduction; Oil leakage from hydro and electro technical machines and power plants.

Special device has been purchased for cleaning the sediment.



9. MAIN TECHNOLOGICAL SOLUTIONS

- The list of technical processes, main devices, machines and mechanisms;
- Management structure and production operation schedule;
- Total amount of workers;
- Main decisions and indicators:

10. CIVIL PROTECTION TECHNICAL-ENGINEERING ACTIVITIES

- Description of civil protection technical-engineering activities.;
- Use of civil protection areas in normal conditions of economic activities.

11. ENVIRONMENTAL PROTECTION

General ecological description of the region:

For the general description of ecological conditions of Khrami Power Plant professional literature and Fund Materials as well as: Wikipedia, general physical geography (M. Alpenidze, E. Elizbarishvili, K. Dakharadze) , Georgian Rivers Hydrography (T. Kikilashvili), Ecological Principles of Environmental Protection (G. Kajaia), Environment and Sustainable Development (N. Pepelashvili, L. Klimiashvili, and K. Magradze), Atlas of natural disasters and risks characteristic of the Georgian territory are used.

Khrami is the right feeder of river Mtkvari and its upper reach is called Ktsia. River Khrami starts from the ridges of Trialeti mountains and flows to the deep canyon. Length of the river is 201km; basin range - 83402 km²; average water consumption - 51 cub, maximum 448 m³/sec. River is mainly filled with snow, not frizzed during the winter and its down reach is used for irrigation. Tsalka Reservoir is built on river Khrami and two Hydro Electro Power Plant: Khrami HPP I and Krami.

River Khrami basin has continental climate, at the end of winter and summer humidity is minimal. In the highland part of Khrami basin (2000 – 3000m.) grows subalpine grass, with step elements. Highlands are divided with the following vegetation zones: mountain step plants, coniferous, oaks and hiccups forests; On lower level, forests are getting thinner and replaced with bushes and forest elements. Even on the lower level of the basin (on Alluvial Valley), across the river are steps and thatcher small forests.

River Khrami has vital importance for Kvemo Kartli and the flow of its almost every cubic meter is counted. River Krami is currently used as a drinking water and even more villages are planning their exploitation. Thousand hectares of land are irrigated with this water, despite the current lack of water supply, additionally thousands of lands are planned to be irrigated [2]. Villages, that are connected to river Khrami are populated with Azerbaijanians, whose total amount grows agricultural products and collecting harvest three times per year.

Considering the fact, that the main activity for local population is agriculture, even partial flow reduction of River Khrami's will significantly worsen their living conditions.



Environment site impact assessment

JSC "Khrami Power Plant I" protects environment and holds ISO 14001:2015 certificate. When the dam of Khrami Power Plant was built in 1947, whole basin of River Khrami was blocked, which significant impacted ecosystem.



- Activities for the rational usage of natural resource and environmental protection:
Technical and drinking water drainage systems are installed
- Decisions made for the prevention of industrial safety and possible emergency situations:
Enterprise has its emergency plan. Employees are provided with personal training.
- Results of the site public discussion and public opinion:
1 EIA of JS Krami Power Plant is not repaired .
- Activities for the protection of normative and technical requirements of governmental inspection and supervision of site sanitary hygiene regime maintenance and labor safety conditions:
Document for the labor safety - protection has been adopted. Its regularly under review.
- Technical decisions for the protection of personal staff working on hazard and green enterprises (noise, vibration, electromagnetic emission , radiation and etc.):
Personal protective equipment's and noise protection headsets for the labor force are purchased. Presence on the site without hamlet is forbidden. All sites are equipped with protective facilities

CONCLUSIONS

General conclusions of the Site:

- When the dam of Khrami Power Plant was built in 1947, whole basin of River Khrami was blocked, which significant impacted ecosystem.
- After reconstruction and modernization of the plant no energetic test has been conducted.

Currently the station is technically tuned and it provides electricity according to the non-stop dispatcher regime.

Its planned to perform, rehabilitation works on stators, relay protections and automatics with the purpose of stations working ability increase.

KHRAMI POWER PLANT II

1. BRIEF DESCRIPTION OF THE POWER PLANT

Khrami Power Plant II — is diversion daycare regulatory HPP located in Georgia, Dmanisi Municipality on river Khrami. It is a second step of Khrami Power Plants cascade. Plant uses the water flow from Khrami Power Plant I, additional flows from the dam in between Khrami Power Plant I and II and mutual flows from River Karabulakhi and Chochiani. Construction of the plant started in 1954. Both its aggregates have been in exploitation since 1963. According to the project its power is 110 thousand Kwh and annual power generation is 350 million Kwh.



- a) Full name: JSC “Khrami Power Plant 2”
- b) Legal Address: Region Dmanisi, Village Khramhesi
- c) Postal code and e-mail address: 0171, kguliashvili@khramesi.ge
- d) Type of Property, Owner of the enterprise: Joint –Stock Company LTFD Ltd „Gardabani Holdings B.V”
- e) Information on main structure of the enterprise and their leaders:
- f) Structure and number of the employee:

Leader	7
Specialist	28
Labor Force	3
Worker	38

2. MAIN TECHNOLOGICAL SOLUTIONS

- The list of main technological processes, devices, machines and mechanisms:
- Management structure and production operation schedule: HPP works in accordance with to the GSE-central dispatcher workload.
- Total amount of workers: 76
- Main decisions and indicators of the layout drawings:

Turbine

Label of the turbine - Radial axial vertical

Calculating water expenses - 41 m³/sec during the HPP full power workload

Calculating Pressure:

Maximum – 324 m.

Minimum - 297 m.

Normal – 370m .

Calculating coefficient of efficiency – 92 %

Stage power- 118,8 MW.

Number of Nominal turnover - 428,6

Calculating Suction Ratio - 0,87 m.

გენერატორი

Generator Label - Synchronic – Vertical 430/210-14

Nominal Power - 59,4 MW.

coefficient of efficiency - 97,6%

Number of nominal turnover - 428,6 turns per min.

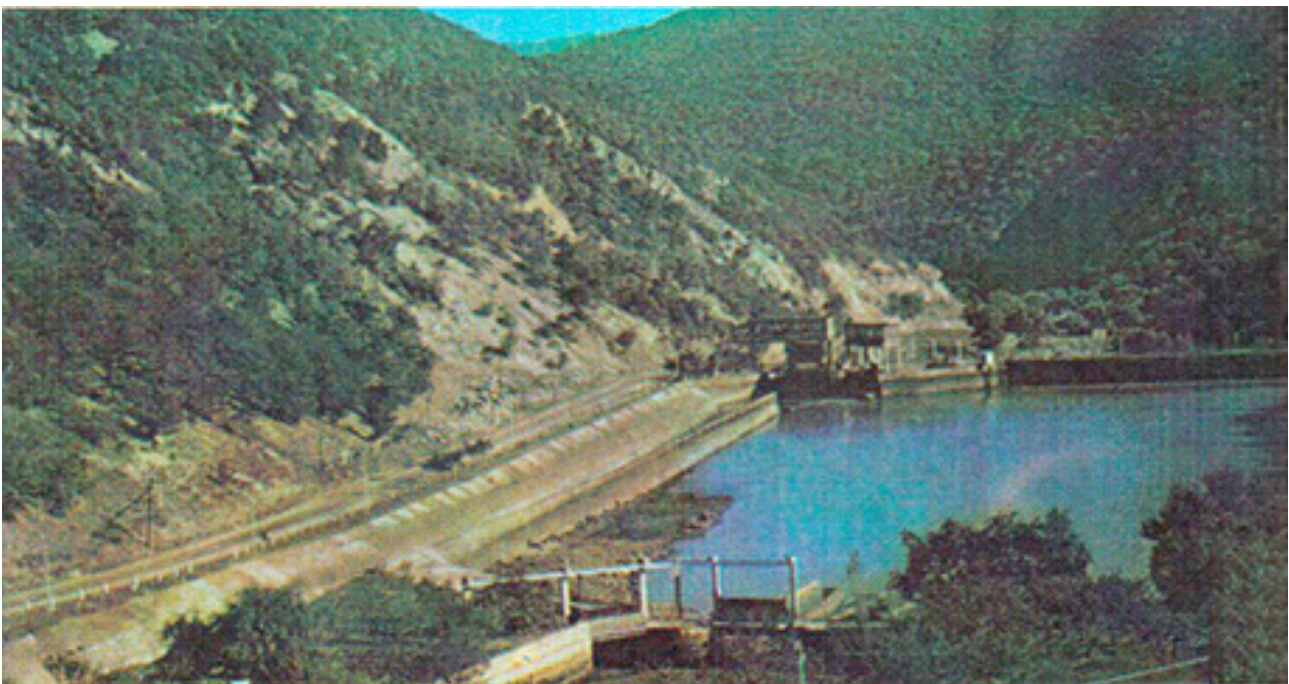
Number of speed turnover - 725 turns per min.

Nominal voltage of stator - 10500 v.

Stator power - 4088 a.

Anxious system, anxious power - 900 a.

Anxious voltage - 440 v.



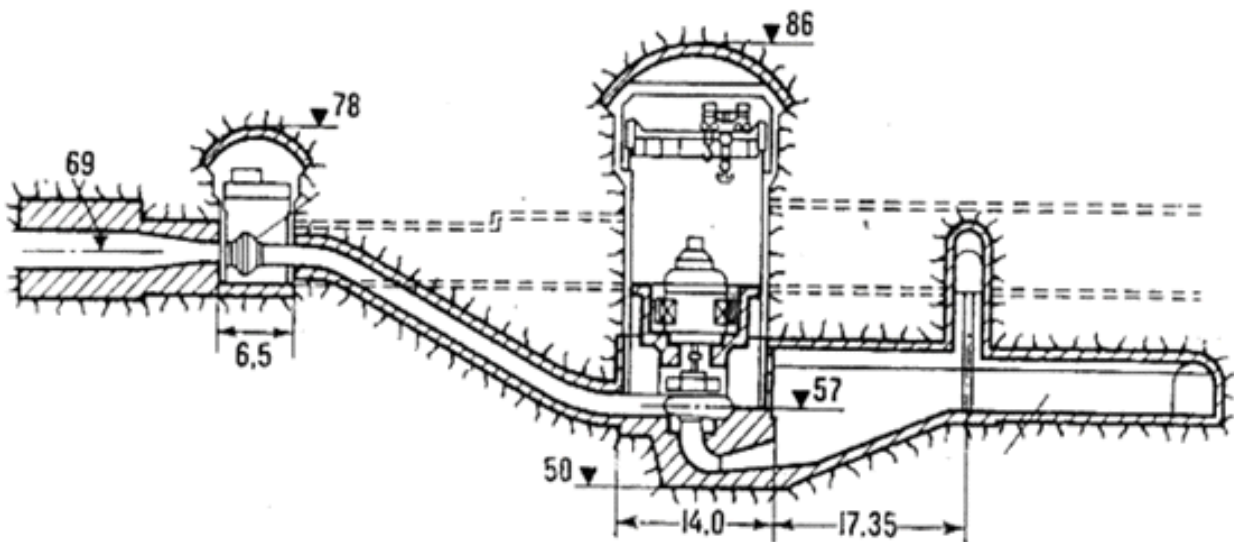
Khrami Power Plant II headquarter and 24 hour regulatory basin

3. DATA ON ANNUAL ENERGY PRODUCTION AND ITS ANALYZE DURING LAST 10 YEARS

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Aver. Yearly
MM. kW h p. Year	184,5	347,2	325,8	385,5	409,8	363,0	299,2	316,8	346,0	338,9	298,3	311,0	350

4. DIFFERENCE BETWEEN PROJECT DESIGN AND EXISTING POWER

Power of each aggregate has been increased in 8% after rehabilitation.



Section of the power plant

5. INFORMATION ON ABSENCE OR LIMITATION OF HPP POWER EXPLOITATION

Project existence and implementation for elimination or limitation of HPP power exploitation. (All changes made during the HPP exploitation has to be included in the instructions, drawings and layouts).

G-1 power is restricted up to 45 m². due to stator antiquity. Currently replacement of old stator and claves are into process, which finishes approximately at the end of the year.

6. CAUSES AND DURATIONS OF THE DISCOVERED ERRORS

Operates without errors.

7. RESEARCHES MADE FOR ERROR DISCOVERY, LIST OF THEIR ELIMINATION ACTIVITIES (TERMS AND RANGES) AND RESPONSIBLE IMPLEMENTATION BODIES

- a) Hydro-technical building (condition and exploitation) – Main diversion operates without errors. Karabulakhi free-flow tunnel needs to be rehabilitated.
- b) Hydro – turbine mechanisms and machines (in compliance with the drawings). Unrestricted operation of the Hydro-turbine machines, during the exploitation, has to be guaranteed with possibly maximum coefficient of efficiency in accordance with their workload and pressure. Long-term operation of hydro-aggregate with the elevated vibration level is forbidden: Operates without errors. Due to the central dispatcher request, its often not possible to operate with the maximum coefficient of efficiency, as the biggest number of aggregates are loaded with 10 – 30 kW h.
- c) Electro-technical Machines: Operate without errors.
- d) Other buildings and machine - aggregates; Operate without errors.

Technical and technological monitoring on energy sites exploitation means, that all technological systems, machines, buildings or plants, including all HPPs under the energy site consistence, should apply to the regular technical assessments once in a 5 year, considering all the necessary activities for guaranteeing power plan determined resources.

- Amount of comprehensive researches during last 12 years;
- Amount of diagnostic studies made on individual machines during 12 years ;
- Fundamental rehabilitations or reconstructions, cost estimates and results made during last 12 years;
- A Main machines emergency absence and electrical energy production workload during the time loss in last 12 years;



Machine Hall

Following repair works are performed:

Year 2008

- Sloping pipe examination;
- Renovation of day and night water supply regulatory tank headlights;
- Total repair of breaker set BMT 220 type 2.

Year 2009

- Rehabilitation of N 1 Hydro;
- Total rehabilitation of circle locker working congestion of Hydro-aggregate N 1;
- Rehabilitation of day and night regulatory tank mechanism.

Year 2010

- Installation of new oil pressure system of the circle locker Hydro-aggregate N 1;
- Repairing commercial accounting system of HPP lines with 220/110 kW h;
- Kharabulahi HPP renovation.

Year 2011

- Renovation and arrangement of oil machine and stock houses;
- Rehabilitation of HPP Chochiani;
- Rehabilitation of MMO 110, 4 pieces oil switcher.

Year 2012

- Rehabilitation of HPP underground section;
- Automation of commercial calculation system;
- Total renovation of HPP N 2.

Year 2013

- Rehabilitation of disk locking oil pressure system;
- Total rehabilitation of 220/110/10 kW h. Distributor (Hub);
- Ongoing repair of HPP N 1 and N 2.

8. POSSIBLE AMENDMENTS OCCURRED DURING THE OPERATION, (CONSIDERING ECOLOGICAL AND SAFETY CONDITIONS)

Permissible water speed regime for filling and emptying reservoirs; sediment monitoring and performing appropriate activities for its reduction; Oil leakage from hydro and electro technical machines and power plants.



Spherical lock building

9. MAIN TECHNOLOGICAL SOLUTIONS

- The list of main technological processes, devices, machines and mechanisms:
- Management structure and production operation schedule:
- Operation of the plant is managed by the on duty engineers during 24 hour. In total its 4 shifts per engineer in 8 hours.
- Total amount of workers: 76
- Main decisions and indicators:

10. CIVIL PROTECTION TECHNICAL-ENGINEERING ACTIVITIES

- Description of civil protection technical-engineering activities.
- Use of civil protection areas in normal conditions of economic activities.

11. ENVIRONMENTAL PROTECTION

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Khrami is the right feeder of river Mtkvari and its upper reach is called Ktsia. River Khrami starts from the ridges of Trialeti mountains and flows to the deep canyon. Length of the river is 201km; basin range - 83402 km; average water consumption - 51 cub, maximum 448 m/sec. River is mainly filled with snow, not frizzed during the winter and its down reach is used for irrigation. Tsalka Reservoir is built on river Khrami and two Hydro Electro Power Plant: Khrami HPP I and Krami.

River Khrami basin has continental climate, at the end of winter and summer humidity is minimal. In the highland part of Khrami basin (2000 – 3000m.) grows subalpine grass, with step elements. Highlands are divided with the following vegetation zones: mountain step plants, coniferous, oaks and hiccups forests; On lower level, forests are getting thinner and replaced with bushes and forest elements. Even on the lower level of the basin (on Alluvial Valley), across the river are steps and thatcher small forests.

River Khrami has vital importance for Kvemo Kartli and the flow of its almost every cubic meter is counted. River Krami is currently used as a drinking water and even more villages are planning their exploitation. Thousand hectares of land are irrigated with this water, despite the current lack of water supply, additionally thousands of lands are planned to be irrigated [2]. Villages, that are connected to river Khrami are populated with Azerbaijanians, whose total amount grows agricultural products and collecting harvest three times per year.

- Activities for the protection of normative and technical requirements of governmental inspection and supervision of site sanitary hygiene regime maintenance and labor safety conditions: Document for the labor safety - protection has been adopted. Its regularly under review.
- Technical decisions for the protection of personal staff working on hazard and green enterprises (noise, vibration, electromagnetic emission , radiation and etc.): Personal protective equipment's and noise protection headsets for the labor force are purchased. Presence on the site without hamlet is forbidden. All sites are equipped with protective facilities.

CONCLUSIONS

General conclusions of the site:

When the dam of Khrami Power Plant 2 was built in 1963, whole basin of River Khrami was blocked, which significant impacted ecosystem.

After reconstruction and modernization of the plant no energetic test has been conducted.

Currently the station is technically tuned and it provides electricity according to the non-stop dispatcher regime.

Its planned to perform, rehabilitation works on stators, relay protections and automatics with the purpose of stations working ability increase.

JINVALI HYDRO POWER PLANT

1. BRIEF DESCRIPTION OF THE POWER PLANT

- a) Full name, Jinvali complex HPP LTD “Georgian water and power” Jinvalhesi Department.
- b) Legal Address: Dusheti Municipality, Village Jinvali, Jinvalhesi;
- e) Postal code and e-mail address: Tbilisi, Kostava str. N1 corner 33; info@georgianwater.com;
- d) Legal name: LTD Georgian Water and Power;
- c) Type of Property, Owner of the enterprise;
- d) Information on main structure of the enterprise and their leaders: Power plant is completed with: administration, electro-machine factory, electro-technical laboratory, hydro-technical factory, rehabilitation site, monitoring group, technical department of the enterprise, administrative and logistical groups, technic safety and emergency situation groups.
- e) Number of employees 72 employees

Jinvali Complex HPP started operation in 1985. There are 4 hydro-aggregates in the machine hall of the plant building, each of them has 32.5 thousand kWh power. Generators produce 110 and 220 kWh power and it supplies open lift underground station, which is located on below bench of the plant. Stations annual generation is 390 kWh.



Jinvally water reservoir is located on the east part of Goergia, Dusheti Municipality, northern part of Jinvally Village, 70 km. far from Tbilisi, in the middle of River Aragvi, surrounded by Alevi, Gudamakari and Kartli Mountains. Area is 11.5 km², water volume is 520 million m³, usable volume – 370 million m³. maximum depth is 75m [2]. Reservoir was constructed in 1986 into the river Aragvi canyon, for Jinvally HPP construction. The part of river Aragvi, where the HPP was built, has been abolished and currently there is no river ecosystem. Jinvally reservoir plays essential role in Tbilisi water supply. It provides half of the city population with drinking water. During the construction of the HPP, XII century Jvaripatiosani Church had been drawn under the water. Even today the church 6 month per year is under and 6 months beneath the water.

Jinvally complex hydro-network consists of Jinvally HPP and Bodori buffer basin. Hydro – network main function is water and energy supply.

Jinvally HPP is diverse, mixed type underground electrical station located near the dam, which has seasonal regulatory water reservoir on river Aragvi.

Jinvally Hydro Power Plant consists of local embankment clay dam, deep drainage, deep and idle spillway, culvert and drain, and Bodorni concrete gravity disintegrated dam.

2. MAIN TECHNOLOGICAL SOLUTIONS

- a) Type of electro station – underground, located close to dam
- b) Stage power - 130,0 MW
- c) average annual power generation as per project – 530 million kWh per hour, average during last 15 years – 404.016 million kWh per hour.
- d) Design calculated expenses of the HPP water flowing turbine. – 115 m³/min
- e) HPP Pressure:
 - calculated– 128 m.
 - maximum – 155,9 m.
 - minimum – 108,5m.
- f) water tank indicator:
 - normal flooding - 810,0 m.
 - maximum - 812,0 m.
 - minimum - 770,0 m. (766,0 m. δ . – minimal benchmark, under which operation of the tank is forbidden)
- g) Water tank volume
 - Total design – 520,0 million m³
 - Profitable – 370,0 million m³.
- h) Amount of hydro-aggregates - 4.

Hydro - turbines and machine aggregates

Hydro-turbines

In the HPP building is installed PO-170-B-180 4 vertical radial-axis (Frensis) type of turbines, each nominal power is 33.5 MW, strength of suction – 8.45, its water calculating expenses are 29.3 m³/per min and has metal spiral scroll with 3450 turnover angle.

Disk locker

In front of each turbine is installed a 2,2 m diameter, 33Дп 200-166 type of disk locker.

Water Intake Pipe

Bent, toroidal knee ventilation pipes are covered from below by repair shields, sized 4,55x3,80 m, serviced by an electric hoist.

Elevators

Gantry crane with 2x80t lifting power is operating for the water drainage. Stable rope crane, with 1x250t (2p) and 2x63t (2p) power operates for the deep-well discharge pipe lamps. For proper working of hydro-aggregates is installed bridge crane with 125/20t lifting power, its span is 14.0 m. Lifting shaft works with 100 tone lifting power gantry crane. Jinvally HPP buffer basin water drain lamp, operates with 2x50t (1p)

lifting power crane. Buffering basin water drain operates with 1x63t (1p) and 2x5t (2p) crane.

Hydro-aggregate speed regulators

Hydro turbine regulatory system for the turbine N1 (with double regulation) consists of oil pressure machine МНУ 8 - 1/40 and electro hydronic regulator ЭГРК - 1Т -100-4 with rotating power, and the hydro – turbines N 2, 3 and 4 (with double regulation) consist of oil pressure machine МНУ 4 - 1/40 and electro hydronic regulator ЭГР-1Т-100-4 with rotating power.

Generators

#	Description	G-1	G-2	G-3	G-4
1	Type	СВ 425/135 УХЛ4	СВ 425/135 УХЛ4	СВ 425/135 УХЛ4	СВ 425/135 УХЛ4
2	Production Number	22161	22162	22163	22164
3	Manufacturer	„ЭЛЕКТРОТЯЖМАШ“ Harkiv, Ukraine			
4	Year of Production	1980	1980	1982	1983
5	Year of commissioning	1985	1985	1985	1985
6	Rated Power kWa/kW.	40600/32500	40600/32500	40600/32500	40600/32500
7	Rated Voltage, v.	10500	10500	10500	10500
8	Power Coefficient	0,8	0,8	0,8	0,8
9	Frequency, Hz.	50	50	50	50
10	Rated Speed, Turns/Min	428,6	428,6	428,6	428,6
11	Acceleration Speed, Turns/Min	900	900	900	900
12	Stator Rated Current, A	2235	2235	2235	2235
13	Rotor Idle Current, A	450	450	450	450
14	Excitement Rated Current, A	800	800	800	800
15	Rotor Flutter Kg/m ²	5X10 ⁵	5X10 ⁵	5X10 ⁵	5X10 ⁵
16	Total Mass, T	240	240	240	240
17	Maximal Assembly Mass, T	120	120	120	120
18	Maximal Transport Mass, T	90	90	90	90
19	Stator Bore Diameter, mm	4250	4250	4250	4250
20	Stator Actice Steel Length, mm	1350	1350	1350	1350
21	Water Consumption in Oil Cooling of Step Bearing, L/Sec.	8,4	8,4	8,4	8,4
22	Water Consumption in Oil Cooling of Bearing, L/Sec.	2,9	2,9	2,9	2,9
23	Water Consumption in Air Cooling, L/Sec.	41,7	41,7	41,7	41,7
24	Cooling Water Temp. °C	25	25	25	25

3. Data's on annual energy production and its analyze during last 10 years

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Design Prod.
MM. kW h p. Year	371,6	415,0	456,1	526,5	406,0	297,3	394,0	378,4	410,5	339,1	292,8	279,9	470

Electro energy generation depends on filling the water reservoir, water flow and amount of the snow in mountains. Reduction of electro-energy generation for the last years can be explained with the increase of sanitary expenses in reservoir bed. For the solution of the mentioned problem law strength electro station (Pshavela HPP) has been installed on the turbine water pipe.



4. DIFFERENCE BETWEEN DESIGNED AND EXISTING POWER

The difference is caused by the narrow intersection between tunnel 17+68 PK and tunnel 21+75 PK, hydro-electro station cannot supply fixed 130.0 MW power and annual average 530.0 million kW h. per hour. Its current parameters are 70.0 MW. Annual average power generation for the last 15 years is 404.0 million kW h. per hour.

4.1. Amount of comprehensive researches during last 12 years: Information has not been provided;

4.2. Amount of diagnostic studies made on individual machines during 12 years: Information has not been provided;

4.3. Fundamental rehabilitations or reconstructions, cost estimates and results made during last 12 years: 220 kW h. oil switcher has been replaced with the new gas-insulated switcher, breakers has been replaced as well. An old el-hydraulic turbine regulator on hydro-aggregate has been replaced with new modern regulator. Old electro-mechanic stimulating system is planned to be replaced with thyristor stimulating system.

The reservoir water filling speed during the normal exploitation is limited till not more than 2m³. in 24 hours. Annually bathymetrical shooting takes place for the identification of sediment Nathan on the bottom of the reservoir.

With the purpose of avoiding oil leakage into the water from the turbine, proper reconstruction activities has been conducted, the system has totally transferred from the oiling into water usage one.

4.4. Main machines emergency absence and electrical energy production workload during the time loss in last 12 years: Not applicable .

5. INFORMATION ON ABSENCE OR LIMITATION OF HPP POWER EXPLOITATION;

Project existence and implementation for elimination or limitation of HPP power exploitation. (All changes made during the HPP exploitation has to be included in the instructions, drawings and layouts).

6. GENERAL DESCRIPTION

6.1. Technical Passport of the station and its content: Slight inaccuracy exists.

6.2. Amount of generated oil from transformer and turbine, their cost estimate, secondary oil collection, record delivery and usage during last 12 years: No records exist.

6.3. Existance of protecting fences around the transformers, during oil crash flow, condition of the stones layer under the transformer, salt water collection and treatment (cleaning), existence of the collecting reservoir: Protecting fences around the transformers are built respectively to the norms. Salt water collection and treatment is not documentary recorded.

7. RESEARCHES MADE FOR ERRORS DISCOVERY, LIST OF THEIR ELIMINATION ACTIVITIES (TERMS AND RANGES) AND RESPONSIBLE, IMPLEMENTATION BODIES.

a) Hydro-technical building (condition and exploitation): Water flaw tunnel has to mention, which repair activities (for the purpose of flow increment) occurred to be ineffective and unimplemented (additional tunnel construction).

b) Hydro – turbine mechanisms and machines; (in compliance with the drawings). Unrestricting operation of the Hydro-turbine machines, during the exploitation, has to be guaranteed with possibly maximum



coefficient of efficiency in accordance with their workload and pressure. Long-term operation of hydro-aggregate with the elevated vibration level is forbidden. After the turbine renovation, machine does not apply to any testing activities in order to determine coefficient of efficiency, therefore no actual amount of generated waste water is counted per 1 kW h.

c) Electro-technical machines and mechanisms: It is to mention, that the MMO-110 type of oil switcher in 220/110 kW h. underground station, is potentially explosive.

d) Other building and machines: Technical and technological monitoring on energy sites exploitation means, that all technological systems, machines, buildings or plants, including all HPPs under the energy site consistence, should apply to the regular technical assessments once in a 5 year, considering all the necessary activities for guaranteeing power plan determined resources.

Jinvally HPP hydro technical buildings are under permanent monitoring.

8. POSSIBLE AMENDMENTS OCCURRED DURING THE OPERATION, (CONSIDERING ECOLOGICAL AND SAFETY CONDITIONS)

Permissible water speed regime for filling and emptying reservoirs; sediment monitoring and performing appropriate activities for its reduction; Oil leakage from hydro and electro technical machines and power plants.

9. CIVIL PROTECTION TECHNICAL-ENGINEERING ACTIVITIES

Description of civil protection technical-engineering activities:

10. ENVIRONMENTAL PROTECTION

General ecological description of the region:

- Environment site impact assessment;
- Activities for the rational usage of natural resource and environmental protection:
- Decisions made for the prevention of industrial safety and possible emergency situations. Enterprise has its emergency plan. Employees are provided with personal training.
- Results of the site public discussion and public opinion:
- Activities for the protection of normative and technical requirements of governmental inspection and supervision of site sanitary hygiene regime maintenance and labor safety conditions.
- Document for the labor safety - protection has been adopted. Its regularly under review.



- Technical decisions for the protection of personal staff working on hazard and green enterprises (noise, vibration, electromagnetic emission , radiation and etc.).

CONCLUSIONS

General conclusions of the Site:

Jinvaly HPP operates according to the technical rules. Addition to that group of experts assume, that effective production increase can be reached by performing following activities:

- Working wheel check, after the total renovation (this issue has to be expanded);
- Replacement of anxious machine system with the thyristoric ones;
- Examining and getting amount of iron waste in generator starters.
- Landslide overthrow power from Pshavi Aragvi side.
- River bank protection activities
- Dam case (Ananuri)
- Power lose cases in electro-technical machines: For the hot spots discovery, electrical connections have to be diagnosed, by thermostat. Diagnostic testing measurements has to be performed on harmonic inexistence on aggregate lamps N 3, 5 and etc.
- Conduct detail, technical audit, on the basis of which energy plant conditions and the length working abilities will be assessed. In order to insure resources that are necessary for the proper functioning of energy plants and hydro technical buildings, essential determination and preparation activities has to be performed in accordance to the rehabilitation-reconstruction design.

ADJARA WATER HPP

1. BRIEF DESCRIPTION OF HPP

“AW HPP” went into exploitation in 1937. With its construction started Adjara Water river energetic usage between the section points 105-160 m. Based on drawings, annual water expense from the top section of the building is 45.5 m³/sec., min and max water expenses are in between 6.5 m³/sec. and 479 m³/sec, huge water expense equals to 2500 m³/sec on which the discharge building are counted.

- a) Full name – Adjara Water HPP
- b) Legal Address – Georgia, Keda Municipality, village Makhunceti
- c) Postal address and e-mail addresses: Tbilisi, Z. Anjalaridze str. 19, e-mail: info@energo-pro.ge
- d) Type of Property, Owner of the enterprise; - private; owner - JSC “Energo-Pro Georgia”
- e) Information on main structure of the enterprise and their leaders: -
- f) Structure and number of the employee: -

2. MAIN TECHNOLOGICAL SOLUTIONS

The list of main technological processes, devices, machines and mechanisms;
Hydro technical plants, mechanical and electro technical machines are presented as following:

- Plant starting point: Sandy dam with length of 106.0 m and height of 5,0 m, built near village Koromkhe, two-side water drain with length of 20,0 m, height of 11,2 m; length of each side 7,0 m . 80,0 m water pipe washer with three section pool, Length of each is 12,0 m. and pressure pool with its water washer.
- Pressure Tunnel: Total length – 2892,0 m. Consists of three sections: left bench with the length of 2360,0 m. and diameter 4.4 m; right bench- 418.0 m. with diameter of 3.9 m. located on 81.9 m. aqueduct.
- Power node: Equalizer reservoir with 12,5 m. diameter; pressure pipe total length - 69,3 m. and variable diameter of 4,4 m; 3,9 m. and 3,0 m. HPP building with two radial-axial turbines installed.
- Mechanical device: elevating mechanism, which works as for the starting point and water discharge plant also for the hydro aggregates are installed in HPP building. During the observation their condition was normal for the exploitation.

Turbine

In HPP are installed two Russian Production ЛМ3 radial-axial turbines, each with strength of 8800 kW h. After many years of exploitation their working ability has been radically decreased, that caused required repair of aggregate N1.

Technical parameters of old aggregate were:

Turbine Strength - 8800 kW h.
Design water flow rate - 22,5 m³/sec.
Design Pressure - 41,0 m.
Maximum - 47,0 m.
Minimum - 39,0 m.
Coefficient of efficiency – 88, 0 %



As a result of reconstruction performed in 2014 – 2015 years, hydro-aggregate N1 has been totally replaced. Instead of old one, new Czech produced radial-axial „FRENSIS 1900“hydro-tourbin, Czech produced hydro-generator, management systems were installed. Ventilation pipe has been reconstructed, instead of vertical tube, a bent draught tube was installed, that caused reconstruction-rehabilitation activities in below supply channels.

Technical parameters after the reconstruction of the aggregate N1:

Turbine strength - 10 700 kwh.
 Design water flow rate - 26,0 m³/sec
 Pressure 26,0 m³/sec; during expenses 45.3 m³.
 Maximum coefficient of efficiency– 93 %
 Rotating Speed - 272,7 turns per min.

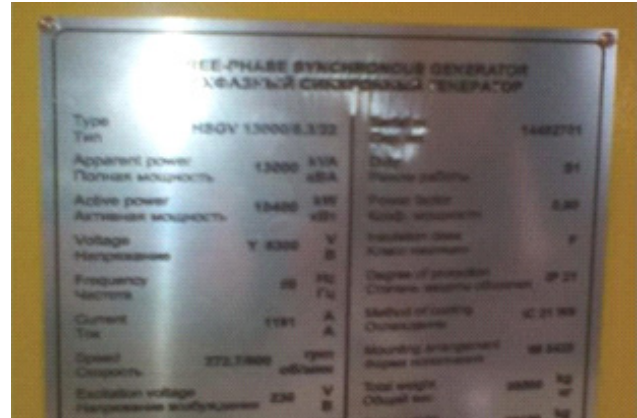
Generator

Reconstructed generator type is - HSGV 13000. 6,3. 22; Generator is produced according to the EN00034 standard.

Technical parameters after the reconstruction of aggregate N 1 are:

Active strength of generator - 10 400 kW h.
 Total strength of generator - 13 000 kW h.
 Stator voltage - 6,3 v.
 Stator power - 1191 a.
 Maximum coefficient of efficiency – 97, 2 %.

Replacement of the old generator with the new one, caused the increase of the coefficient of efficiency, water drainage from the below supply channels has been improved, which naturally caused more effective operation of the plant. On the other hand, the increase of water pipe drainage from 22.5 m³/sec to 26.0 m³/sec increased the pressure loss in water supply plants: instead of 45.0 m³/sec as per project design, tunnel water flow became 48.3 m³/sec, that essentially will decrease HPP pressure during the workload of both hydro-aggregates and received positive effect will be low.



Production label stamps of reconstructed N1 aggregate turbine and generator



Photos (taken during the working process) of upper side of old and new generator №1

3. DATA'S ON ANNUAL ENERGY PRODUCTION AND ITS ANALYZE DURING LAST 10 YEARS

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Design Prod.
MM. kWh p. Year	81,3	54,5	80	44,5	70,9	74,1	80,1	80,3	58,9	104,1	93,6	89,3	85

4. DIFFERENCE BETWEEN PROJECT DESIGN AND EXISTING POWER

4.1. Amount of comprehensive researches made during last 12 years: Not applicable.

4.2. Amount of diagnostic studies made on individual machines during 12 years: Adjara HPP complex diagnostic was performed in 2008, after which the special reconstruction activities were planned, research – design works have been conducted, hydro-electro aggregate was produced and installed in Czech Republic, according to modern standards.

4.3. Fundamental rehabilitations or reconstructions, cost estimates and results made during last 12 years: No information has been found.

4.4. Main machines emergency absence and electrical energy production workload during the time loss in last 12 years: No information has been found.

5. INFORMATION ON ABSENCE OR LIMITATION OF HPP POWER EXPLOITATION

Project existence and implementation for elimination or limitation of HPP power exploitation. (All changes made during the HPP exploitation has to be included in the instructions, drawings and layouts) Currently plant is working according to the standards.

6. GENERAL ISSUES

6.1. Technical Passport of the station and its content: No information has been found.

6.2. Transformer and turbine oil amount, its expenses, secondary oil collection, appropriate notes on its delivery or exploitation during last 12 years: No information has been found.

6.3. Records in case of oil crash flow, during existence of protecting fences around the transformers, conditions of stones layer under the transformer, salty water collection and treatment (cleaning), existence of collecting reservoir: No information has been found.

7. RESEARCHES MADE FOR ERRORS DISCOVERY, LIST OF THEIR ELIMINATION ACTIVITIES (TERMS AND RANGES) AND RESPONSIBLE, IMPLEMENTATION BODIES

- a) Hydro-technical building (condition and exploitation);
- b) Hydro – turbine mechanisms and machines; (in compliance with the drawings). Unrestricting operation of the Hydro-turbine machines, during the exploitation, has to be guaranteed with possibly maximum coefficient of efficiency in accordance with their workload and pressure. Long-term operation of hydro-aggregate with the elevated vibration level is forbidden;
- c) Electro-technical Machines;
- d) Other buildings and machine – aggregates.

Technical and technological monitoring on energy sites exploitation means, that all technological systems, machines, buildings or plants, including all HPPs under the energy site consistence, should apply to the regular technical assessments once in a 5 year, considering all the necessary activities for guaranteeing power plan determined resources.

8. ENVIRONMENTAL PROTECTION

- General ecological description of the region;
- Environment site impact assessment;
- Activities for the rational usage of natural resource and environmental protection;
- Decisions made for the prevention of industrial safety and possible emergency situations. Enterprise has its emergency plan. Employees are provided with personal training.
- Results of the site public discussion and public opinion;
- Activities for the protection of normative and technical requirements of governmental inspection and supervision of site sanitary hygiene regime maintenance and labor safety conditions;
- Technical decisions for the protection of personal staff working on hazard and green enterprises (noise, vibration, electromagnetic emission, radiation and etc.).

CONCLUSIONS:

General conclusions and site recommendations:

- Due to reconstruction, coefficient of efficiency of aggregate N 1 has increased in 5.7 % and water expenses – 3.5 m³/sec, which gave annual power increase in 2400 kWh.
- Considering the fact that technical-economic indicator of the Adjara Water HPP aggregate N 2 is low, the reconstruction should be the same as in case of aggregate N 1.
- According to the technical exploitation rules, each plant has to be observed and results has to be illustrated in technical passport of HPP.

- In order to explore hot spots, electro connection diagnostic has to be conducted by using the thermostat.
- Diagnosing testing measuring has to be conducted on aggregate lamps N 3, 5 and etc. and on the harmonics existence as well.

BAKHVI POWER PLANT 3

1. BRIEF DESCRIPTION OF THE PLANT

Derivative Bakhvi HPP with the power of 9,8 MW was built in 2013, in Ozurgeti Municipality, near Mtispira and Ukanava villages, on the river Bakhvi Tskhali, in between 510 m – 290 m benchmarks. River with the length of 42 km, flows on the territory of Ozurgeti and Chokhatauri Municipalities, left feeder of river Supsa, basin area is 156 km². River connects more than 90 small feeders, with the length of 127 km and is filled with rain, snow and underground waters. Flooding time is in spring (highest level and expenses is in May), leakage is at the end of the summer and in the beginning of Autumn (lowest level and expenses in August). Annual average expense is 6,18 m³/sec. Bakhvi HPP started practical exploitation (in Georgian electro system) in 2015.

- a) Full name - Bakhvi Power Plant 3
- b) Legal address – Georgia, Ozurgeti Municipality, village Mtispiri;
- c) Postal and e-mail address of the head office - Tbilisi, Chavchavadze Ave. 33e; zviad.chubinidze@silkroad.ge;
- d) Type of Property, Owner of the enterprise; - private, owner - Ltd “Bakhvi Hydro Power”
- e) Information on main structure of the enterprise and their leaders -
- f) Structure and number of the employee; Number of employees - 25



2. MAIN TECHNOLOGICAL SOLUTIONS

The list of main technological processes, devices, machines and mechanisms:

Description	Dimension	Quantity
HPP Type		Derivational
Installed Power	mW.	9,8
Average Yearly Capacity	MM. kW/h.	38,0
Duration of Operation with Installed Power	h.	3877
Design Consumption	m ³ /sec.	6,0
Rated Damming Up Level	m	500,0
Statical Pressure	m	200,0
Design Pressure	m	195,0

Hydro technical plants, mechanical and electro technical machines are presented below:

Description	Dimension	Quantity
Head Node		
Dam Type	-	Hybrid Type, Reinforced Concrete, Low Threshold Dam
Dam Height	m	9,5
Dam Lenght	m	15,7
Dam Rated Seismic Resistance	Ball	8
Water Intake Type	-	Open Type
Water Intake Threshold Level	m	497,5
Water Intake Entrance Crossection	m	7,0 x 1,3
Clarifier Type	-	Batch Washer
Clarifier Chamber Count	Ø	2
Clarifier Size	Ø	40,0 x 7,5
Derivational System		
Type	-	Closed Canal

Description	Dimension	Quantity
Length	m	2600
Crossection Size	m	1,8 x 1,8
Inclination	-	0,0025
Rated Consumption	m ³ /sec	5,0
Pressure Tank		
Length	m	20,0
Max. Width	m	5,0
Pressure Pipeline		
Single-lead Pressure Pipeline Type	-	Ground Buried GRP Pipe
Length	m	920
Diameter	mm	1800-1600-1400
Power Node		
Turbine Type	-	Francis
Turbine Count	Pc.	3
Rated Consumption	m ³ /sec	2,4 x 2 + 1,2 x 1
Power	mW	4,0 x 2 + 1,8 x 1
Generator Type	-	Synchronous

Mechanical device: elevating mechanism, which works as for the starting point and water discharge plant also for the hydro aggregates installed in HPP building. During the observation their condition was normal for the exploitation.

Turbine - three hydro-energy aggregate are installed in the HPP:



Generator



3. DATA'S ON ANNUAL ENERGY PRODUCTION AND ITS ANALYZE

Year	2013	2014	2015	2016	2017	2018	2019, 10th Mo.	Design
MM kW/h	0,003	0	10,0	46,7	39,1	39,8	30,1	38,0

4. TECHNICAL PASSPORT OF THE STATION AND ITS RECORDS

No information has been found

5. ENVIRONMENTAL PROTECTION

General ecological description of the region:

- Environment site impact assessment;
- Activities for the protection of normative and technical requirements of governmental inspection and supervision of site sanitary hygiene regime maintenance and labor safety conditions;
- Decisions made for the prevention of industrial safety and possible emergency situations. Enterprise has its emergency plan. Employees are provided with personal training;
- Technical decisions for the protection of personal staff working on hazard and green enterprises (noise, vibration, electromagnetic emission, radiation and etc.).

REMARKS ON BAKHVI HPP 3 AND RECOMMENDATIONS FOR THE INCREASE OF ITS PRODUCTION

- No minimal expenses of river flow are determined.
- No pool washing process is determined (would increase producing)
- Water calculating expenses of HPP is 6m³/sec. Feed channel size is calculated on 4.5 m³/sec, during particular working regimes its diversion is under pressure, which can cause the risk of damage.
- Launching of necessary expenses in the below beef of the river are not recommended during various expenses.
- Electrical connections have to be diagnosed for the hot spots discovery by the thermostat.
- Diagnostic testing measurements has to be performed on aggregate lamps N 3, 5 and etc. and on the harmonic inexistence.

NABEGLAVI HYDRO POWER PLANT ON RIVER GUBAZEULI

1. BRIEF DESCRIPTION OF THE HPP

Gubazuli is left feeder of river Supsa in Chokhatauri Municipality. River starts from the north slope of Meskheti ridge, near Gamostikhe mountaint 2210 m. from the sea level. The river length is 47 km. range of the river basin is 371 km. Main feeders are Khanistskali and Kalashi. River is filled with snow, rain and underground water. Flooding is in spring time, leakage in winter. Average annual expense is 13.7 m³/sec.

- a) Full name - Nabeglavi Hydro Power Plant
- b) Legal Address – Georgia, Chokhatauri Municipality, village Buksieti, river Gubazeuli upper bench mark 303.5m.
- c) Postal and e-mail address – Head office:
- d) Type of Property, Owner of the enterprise; – private, owner – JSC “Aliance Energy”
- e) Information on main structure of the enterprise and their leaders;
- f) Structure and number of the employees – 25

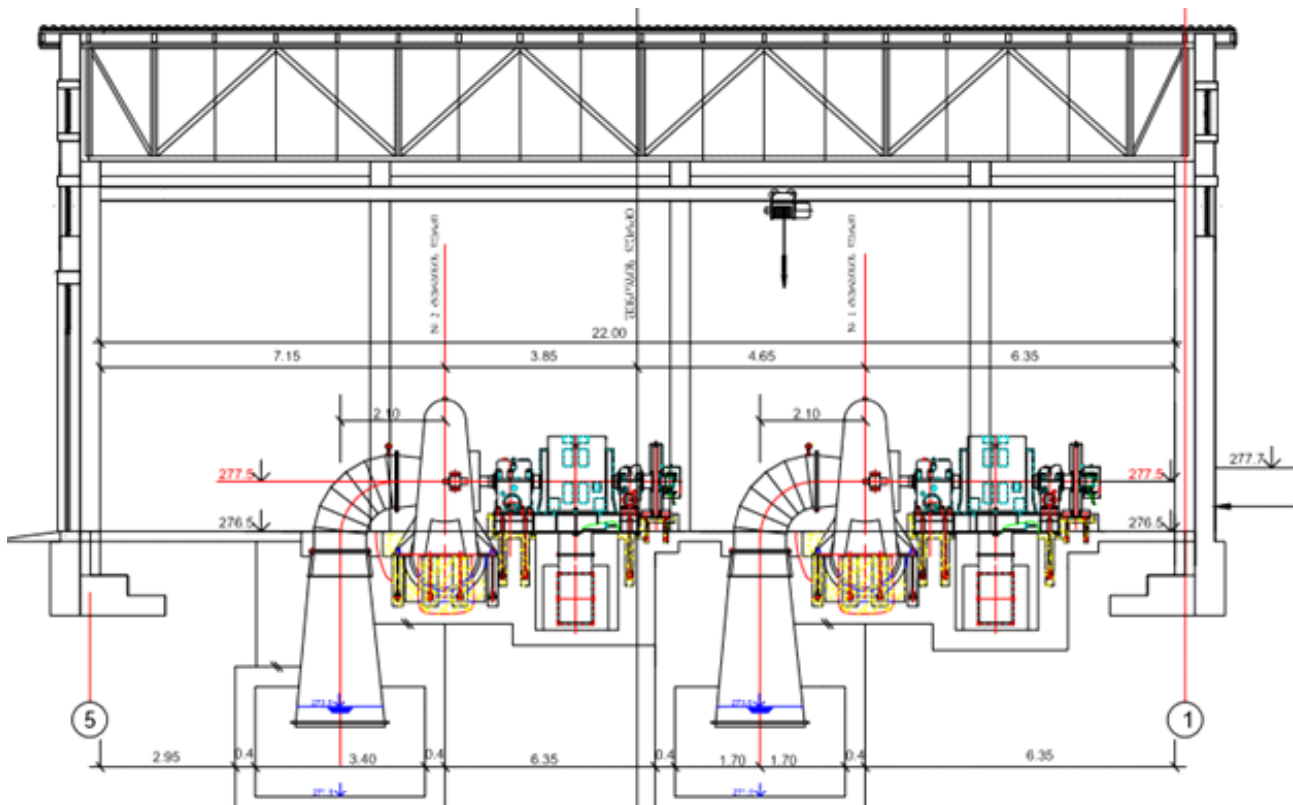


2. MAIN TECHNOLOGICAL SOLUTIONS

Hydro-technical Plants:

- a) main plant complex is on 298,5 above sea level, located into river basin: 5,5 m concrete water dam is constructed, the length of its trench is 40 m. Construction of water discharge and drainage is also considered.
- B) Diversion is presented by 1192 m. tunnel, with 2,3 m internal diameter, ending with pressure basin. Plant receives water from pressure basin, located on the ground, with two 40 m. pressure discharge pipes, with 1.3 m internal diameter.

In the HPP with 1.99 Mw power , two pressure turbines are installed.



HPP complex also includes 10/6 kwh underground station and 10 kwh electro transformer, which connects HPP to the system.

The list of main technological processes, devices, machines and mechanisms:

Mechanical device: elevating mechanism, which works as for the starting point and water discharge plant also for the hydro aggregates is installed in HPP building. During the observation their condition was normal for the exploitation.



Turbine

Chinese production with the following parameters:

- Number of Turbines - 2 pieces ;
- Turbine Label - HLD41-WJ-84;
- Water Calculating Expenses - 4.0 m³/sec;
- Calculating pressure - 31.1 m;
- Calculating coefficient of efficiency - 90.0%;
- Stage power - 1100 Kwh
- High-speed coefficient - 100;
- Rated turnover - 604 turn over. Per. sec
- Calculating Suction Ratios - +1.45.

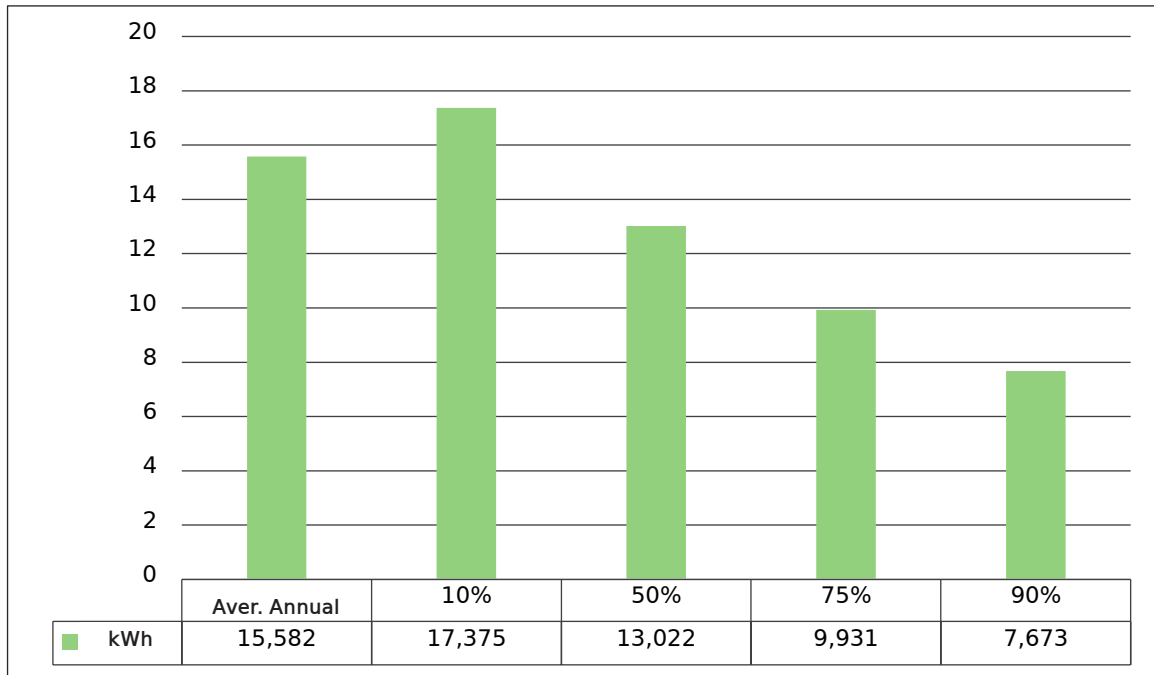


Generator:

- Label of generator - SFW 1600-10/1430;
- Rated power - 1000 Kwh;
- Coefficient of efficiency - 91.0%;
- Rated turnover - 600 turn over per min
- 1000 turn over per min
- Stator rated voltage - 6300 volt;
- Stator power - 74 a;
- Anxious power - 74 a ;
- Anxious voltage - 250 v;
- Rated speed - 50 hertz;
- Power Coefficient φ - 0.8

3. DATA'S ON ANNUAL ENERGY PRODUCTION AND ITS ANALYZE

Year	2017	2018	2019, 10 033	Design
MM kW/h	3,6	10,0	7,8 (9,2)	15,582



Average power generation::

- Average annual generation- 15.582 mil. kW. per hour;
- during 10% coverage- 17.375 mil. kW. per hour;
- 50% coverage- 13.022 mil. kW. per hour;
- 75% coverage- 9.931 mil. kW. per hour;
- 90% coverage - 7.673 mil. kW. per hour;

4. TECHNICAL PASSPORT OF THE STATION AND ITS RECORDS

No information has been found.

5. ENVIRONMENTAL PROTECTION

- Environment site impact assessment;
- Activities for the protection of normative and technical requirements of governmental inspection and supervision of site sanitary hygiene regime maintenance and labor safety conditions.
- Decisions made for the prevention of industrial safety and possible emergency situations. Enterprise has its emergency plan. Employees are provided with personal training.
- Technical decisions for the protection of personal staff working on hazard and green enterprises (noise, vibration, electromagnetic emission, radiation and etc.

REMARKS ON NABEGLAVI HPP 3 AND RECOMMENDATIONS FOR THE INCREASE OF PRODUCTION

Launching of necessary expenses in the below beef of the river are not recommended during various expenses, without involvement of workers on duty with automatic regulation of pressures on the aggregate. This will stabilize HPP energy generation increase.

Electrical connections have to be diagnosed for the hot spots discovery by the thermostat. Diagnostic testing measurements has to be performed on aggregate lamps N 3, 5 and etc. and on the harmonic inexistence.

FINAL CONCLUSIONS AND RECOMMENDATIONS ON THE CONDUCTED RESEARCHES

1. Georgian HPPs that are already under the long-term exploitation are out of exploitation and could not generate project power. According to the Georgian law on energetic and natural gas, (which is still in force) the Ministry of Energy of Georgia monitors Power Plants technical conditions and their safety service activities. (Article 2, point 8). With the following purpose, a- “ ... all the technological systems, machines, buildings or plants, including all Hydro Power Plants, should regularly go through technical check. Checking has to be performed in fixed dates, according to the acting normative-technical documents, but no later than once in a five year. (Article 6, p.2.) The following request of the regulation is practically not fulfilled.
2. All HPP water drain plants, knots or machines, that are out of exploitation, need to be observed for the waste resource determination, which can be performed by the technical audit.
3. After the reconstruction–modernization or fundamental rehabilitation for the determination of coefficient of efficiency, none of the site turbines or generators have passed technical checking on energy efficiency.
4. Mainly HPPs have no information about water flow range on site, that puts water efficiency usage under the question.
5. Electrical connections have to be diagnosed for the hot spots discovery by the thermostat.
6. Diagnostic testing measurements has to be performed on aggregate lamps N 3, 5 and etc. and on the harmonic inexistence.
7. About all particular sites, except general points 1-4:
 - 7.1. About Khram HPP 1 – due to the central dispatcher received regime, turbines workload is not optimal;
 - 7.2 Same about Khram HPP 2;
 - 7.3. Same about Jinvally HPP. Addition to that: make landslides monitoring obligatory from the side of Pshavi-Aragvi river; preform bench protection activities on water basin; Dam monitoring on Ananuri castle.
 - 7.4. Adjara Water HPP: Turbine N2 should be reconstructed.
 - 7.5. about Bakhvi HPP N3 - Indestructible diversion tracts has to be checked and regime has also to be changed on single pressure one; Auto operator system has to be installed on the dam for the optimal usage of river flow.

According to our simple estimates, assessment of the above-listed issues on the project level, will increase the power generation minimum in 5%.

IMPRESSUM

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