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STUDY ON OPERATION OF HEP PLOPI

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Abstract: Hydropower of the lower course of river Strei is located in the west of Hunedoara county, between towns Simeria and Subcetate. Strei river hydropower on the Subcetate-Simeria will have seven plants with a total installed power of 84,23 MW. Of these, two plants are already in operation: HEP Subcetate and HEP Plopi. Investment "AHE Subcetate the River Strei - Simeria" includes three reservoirs (Subcetate, Strei and Simeria) and seven hydroelectric (Subcetate, Plopi, Bretea, Strei, Calan, Băcia, Simeria). The present paper discusses how operating flows machining levels of exploitations of HEP Plopi.

Keywords: hydroelectric plant (HEP), energy produced, correlation, functional analysis, machined flow.

1. INTRODUCTION

Hydrographic, the sector is defined by the confluence of rivers Strei and Raul Mare and relieve of river Strei in river Mures. The sector has a length of 32.5 km, with an average slope of 3.2%, making a level difference of 105 meters. Potential to produce electricity depends on both the net fall and the flow of water. HEP's Plopi operation principle consists in transforming potential energy into mechanical energy.

HEP Plopi is designed as a unit producing peak and half peak power and only during high waters can produce base power. It is the second hydropower of the waterfall river. Was received and put into operation, with both turbines, on 15 September 2010.

Is a plant on the by-pass channel in progressive supply, supply channel being continued the tailrace channel of the plant Subcetate. Main objectives that make up this stage of fall are Plant (which includes plant itself and soothing basin) and Derivation (which is composed of the by-pass channel, loading chamber, the connection area, lateral surge and tailrace channel).

They also executed a series of works adjacent namely: countergrooves along derivatives, regulation of Slivut River, overpass of creek Slivut through an aqueduct over the tailrace channel, technological and operational roads. Hydrotechnical node Plopi is 2 km downstream on HEP Subcetate, on the left bank of the Strei River. In the hydraulic node, the plant is located in retention front of the load camera, and downstream, through the stilling basin is connected to the tailrace channel. To ensure the operation of the plant from downstream (Hc Bretea, currently running), in case plant Plopi malfunction, was provided laterally bypass execution in the body plant with direct outlet from the load chamber.

2. GENERAL DATA - ARRANGEMENT OF RIVER STREI

Given that HEP Subcetate it is a plant – dam, and HEP Plopi is a derivation plant, section of interest to both hydropower plants is dam Subcetate section. In Table 1 are presented the morphological characteristics of the river Strei in the section of dam Subcetate.

Table 1 - Morphological characteristics

River - Section	F (km^2)	H_m (mdM)	L (km)
Strei - dam Subcetate	1.553	1.041	496

The notations used are:

F - reception basin surface, in km^2;

H_m - average altitude of the reception basin, in mdM; -

L - length of the river Strei from its source to the dam section.

Calculation and verification flows of accumulation HEP Plopi

According to STAS 4273/83, works related to HEP Plopi are classified as Class III of importance. For this class, according to STAS 4068/87, flow calculation corresponds insurance to 2% and verification flow corresponds insurance to 0.5% + ΔQ. The table below shows the projected flow calculation and those verified in 2007:

Table 2 – Maximum calculation and verification flows in natural regime for dam Subcetate

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Section	Providing p%	Q(m^3/s) project	Q(m^3/s) updated
dam Subcetate	2% - calculation	540	530
	0,5% +ΔQ - verification	950	893

Construction characteristics HEP Plopi

Hydroelectric plant Plopi is a plant above ground, located on the left bank of river Strei, equipped with two turbines Kaplan; is a derivation plant that is connected upstream with loading chamber and downstream with stilling basin.

Its main characteristics are: installed flow (100 mc/s), raw fall (15 m) and installed power (12 MW).

The energy produced is discharged into the national system by transformation lifting station from 6.30 kV to 110 kV placed on a platform to quota 267.50 mdM (+ 3.10 m). In order to ensure normal operation of the downstream plant (HPP Bretea) in the event of the failure of a group of HPP Plopi, its body was made a lateral bypass with direct outlet chamber loading and transit ensuring a flow of 50 mc/s to stilling basin.

In vertical, reference plane of plant (rate ± 0.00) is defined by the axis of the turbine rotor blade located at quota 264.40 mdM. Plant block sizes are: 39.35 m upstream - downstream and 37.40 m in the longitudinal direction, the minimum foundation rate is 255.90 mdM (- 8.50 m).

Figure 1. HEP Plopi

Figure 2. Dam and HEP Subcetate

Functional characteristics HEP Plopi

- plant category: HEP Plopi fall into the category hydroelectric plant with 10 <Pi <100 MW (according to the levels of power group made by SC HIDROELECTRICA SA);
- lifetime of the installed power in the hydrological environment is 2121 hours/year. Note that this term is not the actual number of hours of function of the plant because plant not works only on installed capacity, but also to lower powers. Lifetime of the plant depends on the plant operation;
- plant is equipped with two Kaplan turbines KVB type;
- flows and group and total installed power plant:

$Q_{i/group}$ = 50 m^3/s, respectively
$Q_{i/plant}$ = 100 m^3/s;
$P_{i/group}$ = 6 MW, respectively
$P_{i/plant}$ = 12 MW.

- energy production in the characteristics years:
  - Very rainy year - 33.85 GWh / year;
  - Rainy year - 29.13 GWh / year;
  - Normal year - 24.95 GWh / year;
  - Dry year - 21.40 GWh / year;
  - Very dry year - 18.49 GWh / year.

Water use is the energetic (Qi = 100 mc/s). Note that energy production varies from year to year, depending on hydrological character of that year and the amount of water taken out from the upstream power circuit.

Table 3 – Machined flow depending on fall net and load

H [m]	Q [m^3/s]						
Loading [%]	40	50	60	70	80	90	100
H_{max} = 16,2 m	18,41	22,64	26,98	31,44	36,00	40,64	45,38
H_c = 14,3 m	20,62	25,49	30,55	35,69	40,93	46,33	52,00
H_{min} = 11,13 m	17,56	21,49	25,52	29,67	33,95	38,38	43,03

3. FUNCTIONAL ANALYSIS OF HEP PLOPI

Hydroelectric Plant Plopi was put into operation in 2010 and its functioning analysis was performed for the period 24.12.2012-27.08.2013. It was decided by 208 daily measurements of water levels upstream of the plant, machined flow and energy produced. The characteristic values of these parameters are shown in Table 4.

Table 4 –Machined flow and energy produced by the characteristic values of the water level upstream of the plant

Values	**Upstream level [mdM]**	**Flow [m^3/s]**	**Energy produced [kWh]**
Minim	268,63	23	4994,6
Medium	280,47	51,10	46633,83
Maxim	289,67	94,8	232171,4

It is noted that the energy produced is directly proportional to the machined flow and hence the water level upstream of the plant.

Table 5 presents the correlation expressions of test functions between the energy produced and machined flow, also squared values of correlation coefficient. This relationship is best described by the polynomial equation (fig. 4), for which the square of the correlation coefficient has a value of 0.5137.

Table 5 – Correlation functions tested between energy production and machined flow

Function	Expression	R^2
Exponential	$y=8786,8\,e^{0,0289x}$	0.3157
Linear	y=1738x-37987	0.4698
Logarithmic	y-91612ln(x)-306021	0.4213
Polynomial	$y=31,755x^2-2048,6x+64592$	0.5137
Power	$y=86,377\,x^{1,5662}$	0.2995

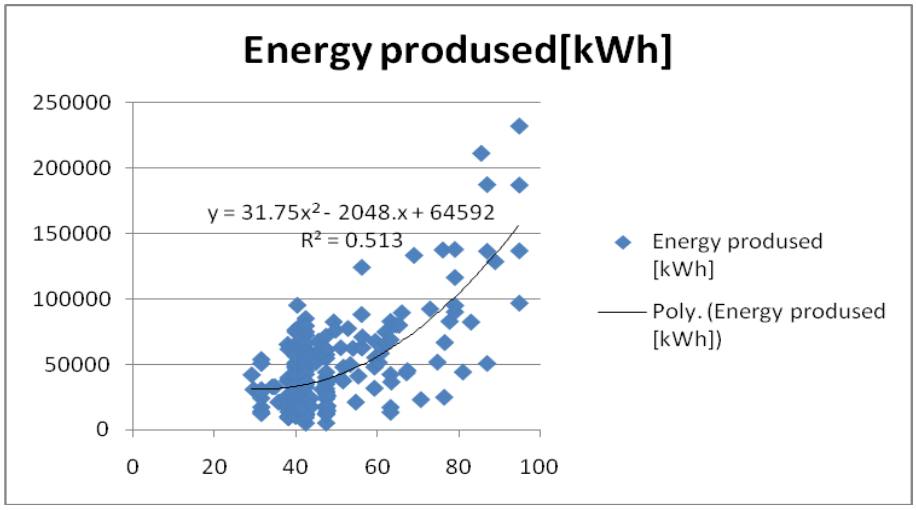

Figure 3. The energy produced depending on the flow machined

4. CONCLUSIONS

Functional analysis of HEP Plopi in the analyzed period showed that the energy produced is greater with higher flow machined and load on the plant, which ranged from 3 to 11 MW.

Proper functioning of equipment from dam and hydroelectric plant not lead to pollution of water and hence the occurrence of changes in physical, chemical or biological properties of the water.

In the analyzed period there were produced 9700 GW.

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