THE HYDROENERGETIC POTENTIAL OF THE PRUT RIVER – MOLDOVA REPUBLIC

P. PLEŞCA[1]

ABSTRACT. – ***The Hydroenergetic Potential of the Prut River – Moldova Republic.*** On the basis of studying of water funds, of the regimes and characteristics of flow of the Prut, of those internal larger and smaller ones, taking into consideration what basins exist and the ones with perspective can demonstrate the hydroenergetical potential values of Republic of Moldova for the current time and on long-time period. The basic variant of the scheme of arrangement on the Prut on the basis of the requirements of today's impact with the environment, the ecologic flows, hydroenergetical equipments chosen for the parameters of sufficient operation, and the hidrotehnical unit must have an appearance of a complex utilization. The assurances of the flows and head of the hydro-electric plants with operation in cascade on rivers is caused by the strength of the given data and the hydrologic calculations after interstate normatives applied now. Suggested scheme foresees to build dozens of hydro-electric plants with small head on the Prut from which an unit functions as the minimum on the ecologic flow. The potential of the basins of existing accumulation on little rivers must be capitalized first because it requires only the power equipment. Prof. D. Pavel proposed some schemes with the arrangement of MCHE on the rivers Prut, Răut, Bîc.

Keywords: hydrological data, the potential hydroenergetical, the Prut, the basins.

1. INTRODUCTION

The partial solving of the energetical safety in the Republic of Moldova can be performed by development of potential of the boundary river Prut and by fitting the hydrotechnical structures provided on small rivers for hydroenergetical porposes. The mounting of turbines on these structures permits to supply with electric energy small objective in agro-industrial farms, mills etc. This method of obtaining electric energy allows to reduce expenses for capital structures and operation. The hydro power unit operation depends on the river flow, which varies during one year and the Moldavian rivers have not been equipped to obtain electric energy. This factors do not permit to use the whole water flow and the whole hydro power unit power. Therefore it appears a difference between the hydro unit power and the possible flow power. The solution is to provide several turbines, depending on the minimum and maximum flow in the storage basin. For the turbine dimension selection it is necessary to determine the optimum conditions for a maximum efficiency; i.e. design load and discharge. For the first time researches of potential of the rivers were carried out by Prof. D. Pavel who proposed some schemes with the arrangement of MCHE on the Prut, Răut and Bîc (Fig.1, Table 1.) [1].

[1] State Agrarian University of Moldova, Faculty of Cadastre, Hydrotecnics end Fhisics Department, 2049. Chişinau, Republic of Moldova, e-mail: petrple@yahoo.com

Table 1. ***Stations on the Prut proposed by D.Pavel***

Station HE, r. Prut	N,kW	H,m	Q,m^3/s	E,kWh
Rădăuţi-Şireuţi	4200	5	110	16000
Tăut-Pererîta	8400*	10	110*	32000*
Gremeşti	3400	4	110	14000
Iaşi-Ungheni	4500	6	110	24000
Prisăcani-V Mare	2200	3	110	12000
Măcăreşti-Grozeşti	2000	2,5	110	11000
Vladnic-Zberoaia	2600	2,5	130	14000
Galaţi-Giurgiuleşti	5100	5-4,3	140	32000

In the years 1930 -1950 basin and river water energy has been used in water level lifting installations, to operate mechanisms.The first micro power units have been constructed on the following rivers Bîc, Răut, Cubolta, Camenca, Cainari, Ciuhur,Vilia, Racovat etc. Nowadays beside high power station there are used micro hydro power stations with small turbines. Up to date automation sistems allow a higher level operation of small turbines especially when the energy users are located near the small hydro power stations. Nowadays none of the aprox.20 power stations do operate. They have been put out of order because high power stations have been used.

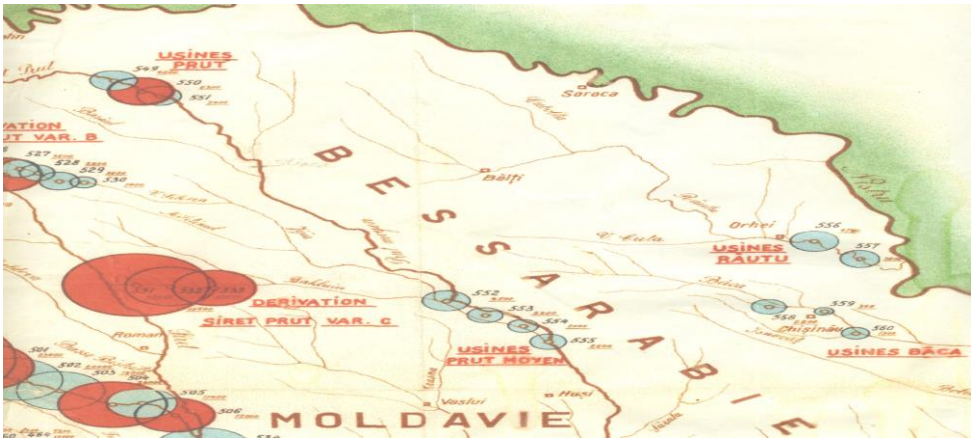

Fig. 1. ***Site of the Prut r., Prof. Pavel proposed some schemes with the arrangement HES***

Profesor Dorin Pavel the founder of Romanian hydroenergetics in his book "Plan general d'amenagement des forces hydrauliques en Roumanie", published in 1936 invents all the possible hydropower dams to be done in the country inclusively the Prut river. There were calculated all the important indexes and parameters of hydropower plants. This way he noted 19 hydropower plants with a total installed power of P_i = 182600 kW and a production of energy of 675 millions kWh per year. Concerning to the average current of the Prut river foresaw hydropower plants at Rădăuţi,Cremeşti, Iaşi, Prisăcani, Vladnic, Măcăreşti and other places.

2. THE HYDROENERGETICAL ANALYSIS

Im Moldova there are many geographical areas in which unused hydropower potential exists of large volume accumulation reservoirs. The importtand encreasing of the energy cost it necesary to come valorification of river water. An other important problem is the allocation of water resources in order to obtain a maximum valorification to the necessities of the energetic system. Analyzing the possibilities of the use of hydropower potential of the Prut river in average current we can ascertain that some possibilities to increase the production capacity of the energy could be done at the existent dam of Stânca-Costeşti, where now are in work two hydro units by 16 MW at CHE for the both parts at a hydrotechnical system. Hydroturbines convert water pressure into mechanical shaft power, which can be used to drive an electricity generator, or other machinery. The power available is proportional to the product of head and flow rate. The general formula for any hydro system-s power output is:

$$N = \eta \rho g Q H; \qquad (1)$$

where: N - is the power produced at the turbine shaft (W). η -is the hydraulic efficiency of the turbine. ρ - is the density of water (1000 kg/m3). g- is the acceleration due to gravity (9.81 m/s^2). Q-is the volume flow rate passing through the turbine (m^3/s). H- the effective pressure head of water (m) [2].

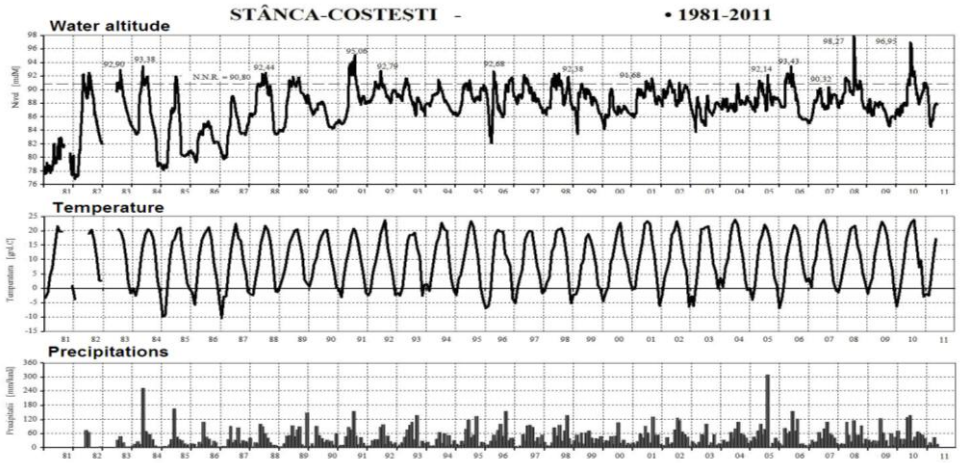

Fig. 2. ***Varition water level and parametrs of the Prut river basin***

From the analisys of these data we can notice that represents an year average of 65 GWh and an average for a hour 7,5 MW from which we can make a conclusion that the unit worked with an average power twice less than that installed. From the other point proceeding from hydrological data and watching the study of the capacity enlargement of production at hydropower plant Stânca–

Costeşti, results an evacuated volume through the evacuation of the bottom and plugs reserve of grand volume of water.

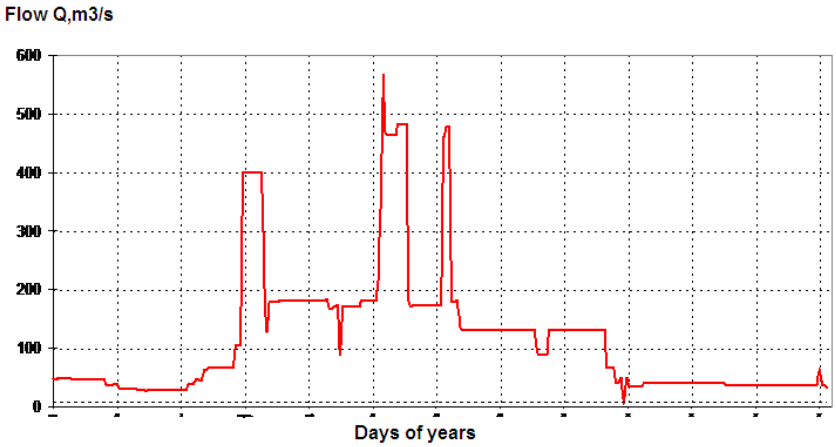

Fig. 3. ***The hydrograph basin accumulation Costesti –Stinca in 2006 of r.Prut***

In the same time the water evacuation through the bottom galleries, during work , with water levels more bigger than those normal , are till 1250 m^3/s. In this case the obstacles were submited to some vibrations and other negative moments, this made the evacuation debits to be limited. For this , the section from two of the four bottom evacuation galleries was redused from 15,76 m^2 to 9 m^2.

Table 1. ***Station hidrometrice of river Prut from Moldova.***

Nr	*River*	*Station*	*Bazine, km²*	*Year*	*Republic.*
1	Prut	or. Cernăuţi	6890	1895-2015	Ucraina
2		or. Lipcani	9200	1946-1980	Moldova
3	Prut	s. Şireuţi	9230	1946-2015	Moldova
4	Prut	s. Corpaci	11000	1946-1978	Moldova
5	Prut	s. Brăneşti	12000	1946-1964	Moldova
6	Prut	s.Valea	14600	1946-1980	Moldova
7	Prut	or. Ungheni	15200	1920- 1971; 1944-2015	Moldova
8	Prut	s. Leuşeni	16000	1974-2015	Moldova
9	Prut	or. Leova	23400	1923-1979-	Moldova
10	Prut	or. Cahul	25500	1958-1973	Moldova
11	Prut	s.Brănza	26500	1970-2015	Moldova

The reducing of the section has achieved between the down obstacle and place of access from hydropower plant, with a length of 2,75 m, by the construction of a wedge frame , from a hydrodinamic form. From these moments

we can study the problem where should be placed the hydro units with bulb turbines from the bottom part of the evacuation galeries , which will work on settled debuts having a size of 15 m^3/s.

So, the water volume , which was evacuated in the period when the hydro units didn't work , should have a debit of 52000 m^3/h or approximate,that what corresponds to the necessary debit, which would be always ensured when the essential turbines don't work. The power with which this turbine should work can be established from the relation N =8QH= 8x15x25=3000 kW. Where (head) H=25 m, is the fall that corresponds with the average variations of the water level in the upper part, .

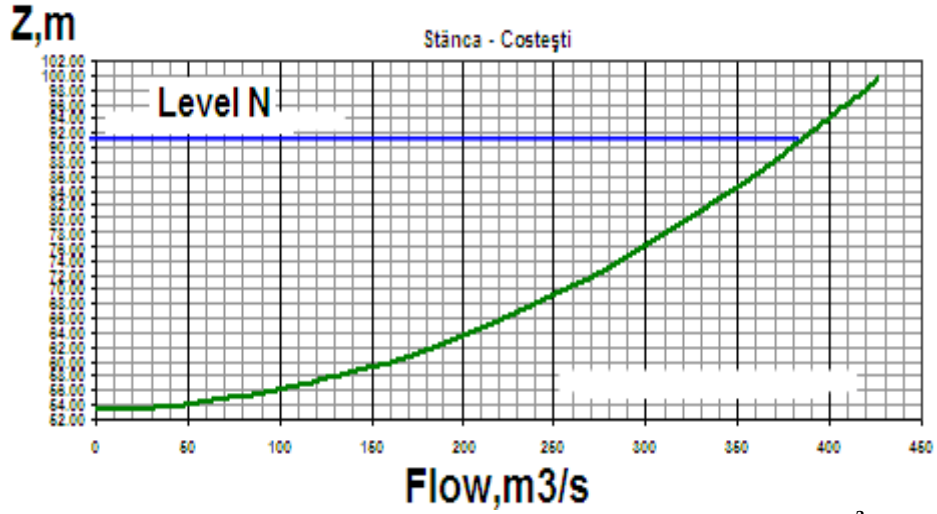

Fig. 4. ***Evacuation galeries water consumption (S = 9 m^2)***

In the Republic of Moldova there are used as potential tehnical energetic sources hydro electric power plants of rivers. Some increase of potential of water resources for increase of development of energy allows use of hydroelectric power station waters, working on drains, which can not pass through turbines and convertible hydromachines move in top basin and then in the intense periods of time on consumption of energy water moves on hydrounits in a mode of the turbine. Such hydrostation was provided at expansion an HES Stânca-Costeşti.

3. THE DEVELOPMENT OF HYDROENERGETICAL POTENTIAL

The turbines which would produse the added energy in summer must ensure with energy these pump stations, which are situated not far from hydrotechnical system in the upper or the down part. For places situated in the down part of the dam, should be watered through gravitation pipes or pumping

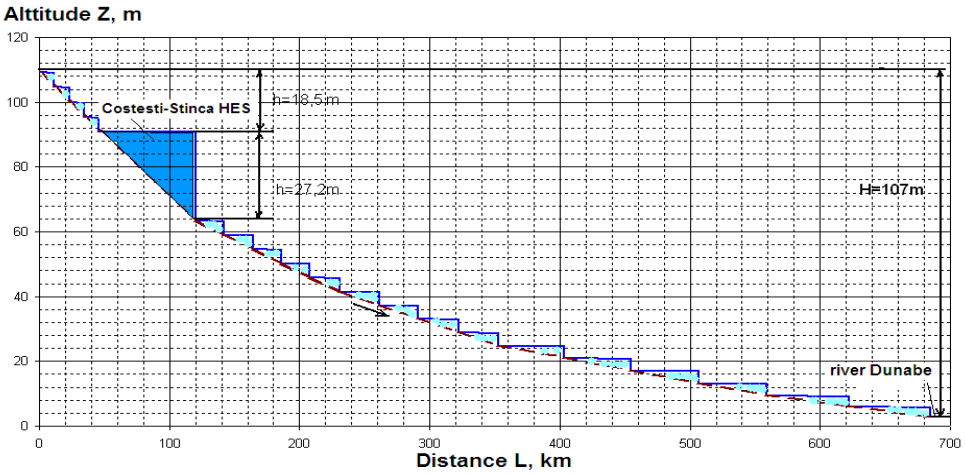

Fig. 5. ***The circuit of development of an energy potential of R.Prut***

above the grounds, then the head of pumping will reduse and the energy consumption would be minimal when the water is raised.

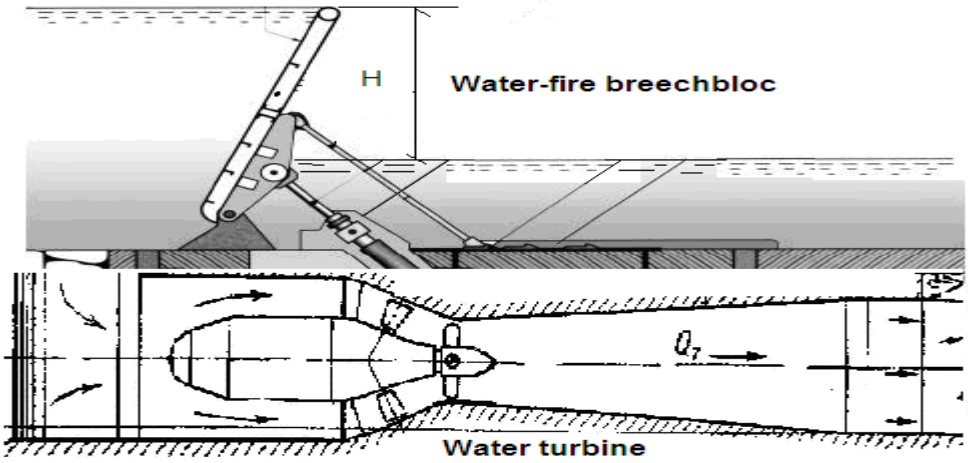

Fig. 6. ***Section of a structure for job of hydrostation with a small pressure with boards under action of water on the small rivers Prut with line hydrounits.***

As a rule, for the calculation of debits that produce energy through the evacuation pipes or through a reserve plug , should be found from this relation:

$$Quzg = Qafl - Quzb - \Delta V / \Delta T; \qquad (2)$$

Where: Quzg - the debit that produce energy through the evacuation pipe;

Quzb - the debit that produce energy through base turbine;

Qafl - the tributary debit;

ΔV - the volume variation in the basin;

ΔT - the interval of time adequate to the variation of volume.

The system that produce energy at some base turbines and those installed on evacuation pipes must be ensured at maximum efficiency, from hydrological and working situation. For the work optimization of the both variants for energy production should be taken in consideration the debit distribution in time, first of those tributaries, should be efficaciously used in work the water volumes accumulated in rainfall and the filling-evacuation system from the upper part, ensuring optime falls to turbines.

Fig. 7. ***Variation volumes and flows from basins HES Costesti-Stinca (computers aspect)***

Might be analyzed other variants that foresee the enlargement of production capacity hydropower plant Stănca-Costeşti by modernization of the hydro unit (generator change, intensification of the cooling system) or the improvement of working conditions of the hydro plant with modern informational techniques by

measuring hydro and electric parameters Lately AQUAPROIECT S.A.[1] has made a study that foresaw the elaboration scheme about the hidrografic basin Prut, in prospect of long standing, which foresaw to place at the basin on river Prut a dam at Rădăuţi with a total volume of 850 million m^3 and that useful 400 million m^3 suggested for irrigation, fishing, for improvement of navigation conditions. The works for the capitalization of hydropower potential refers to the realization of a hydropower plant with a capacity not less then that from Stânca-Costeşti.

A hydropower potential have the tributaries of river prut, in this zone the realization of it might be done by installing hydropower plants with small power at the extant dams on rivers .a possibility of capitalization of the hydropower potential , we hope that this will give a plan of actions in concordance with government decision rm nr.1092 from 31.10 2000 and nr. 1078 from 5.08.2003 for the use of energy regenerative resources. Concerning to river prut these can be realized in collaboration with respective institutions from romania. The hydroelectric power station from stânca-costeşti equipped with one 16 mw turbines with a head of 27,3 m and debit 65 m^3/s. Below in fig.5,6 the circuit of development of potential is given of river prut with variant from19 che by total capacity power plant of 50 mw (head 3,5-4m, qmed=80-90 m3/s).

5. CONCLUSIONS

Presented hydroenergetic of rivers basins and between the river Prut from CHE Costesti-Stinca the inside of Moldova, on seeting materials Prof. D. Pavel, modern condition and perspective development.The partial solving of the energetical crisis in Moldova can be performed by fitting the hidrotechnical structures provided on rivers hidroenergetical purposes. The hydroenergetic technical potential designed by means of well known methods for the mean Moldavian river Prut is comprised between the fllowing values new stations power 24MW.

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