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JUSTIFICATION FOR THE CREATION OF A PUMPED STORAGE POWER PLANT ON THE BASIS OF THE CASCADE OF THE URTA-CHIRCHIK HPPS

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Abstract: *The article deals with the creation of a pumped storage power plant. PSPP is the most efficient option for generating electricity in the conditions of Uzbekistan, especially at the Urta-Chirchik cascade. We have discovered a pumped storage power plant in Bustanlik region, Bulaksu-Khojikent PSPP, Kizilsui-Khojikent PSP, Charvak HPP-PSPP and Pskem PSPP, and were convinced that they would justify all the money spent. In the pumped storage power plant in Bustanlik region the necessary infrastructure is available in full, and the production base of the Tashkent region and Bostanlyk district of the Republic is subject to use, taking into account the renewal and appropriate development. A methodology and program for determining the economic indicators of a pumped storage power plant has been developed, and for each considered option for creating a pumped storage power plant based on the Cascade of the Urta-Chirchik HPPs , technical and economic parameters have been determined, i.e. capital investments, generated and consumed electricity in turbine and pumping mode, annual savings of fuel resources, annual cost, annual economic efficiency, payback period of capital investments, profitability ratio of capital investments.*

Keywords: *pumped storage power plant, Urta-Chirchik cascade, the upper basin, the lower basin, hydropower, electricity, the installed capacity*

INTRODUCTION. The energy system of Uzbekistan is the largest in Central Asia. The total installed capacity of the power plants is about 14,140.6 MW. About 85% of electricity generation comes from thermal power plants, mainly powered by natural gas, the rest from hydroelectric power plants. According to the State Statistics Committee of Uzbekistan, Uzbekistan's power plants generated more than 60 billion kWh of electricity per year, which is 3% more than in the previous year. Consumption averaged over 59 billion kWh per year. The maximum load during peak hours of electricity consumption in the winter period of 2019 amounted to 10.4 thousand MW, the difference between the minimum and maximum load was

2.3 thousand MW. At the same time, in the summer period of 2019, the peak figure reached 9.4 thousand MW with a difference between the minimum load of 2.6 thousand MW.

In order to generate peak power, ensure the quality of the output electricity and maintain the energy independence of Uzbekistan, it is necessary to create its own highly efficient sources of power control [1].

MATERIAL AND METHODS. At present, daily regulation in the energy system is carried out at the expense of three stations of the Urta-Chirchik cascade (Charvak HPP, Khodjikent HPP and Gazalkent HPP) in the range of their total installed capacity of 905 MW; as well as changes in the power of blocks of thermal stations from the maximum value to the technological minimum, start-stop of blocks from 150 to 300 MW [1].

The state of water resources in the country affects the development of hydropower. It is the most important sphere of the economy, affecting both the livelihood of the population and agriculture of the republic, and the development of industry. More than 80% of the country's electricity complex runs on gas, while hydropower accounts for just over 20%. The potential of Uzbekistan's hydropower resources is estimated at 27.5 billion kWh per year, but the country uses only about 30% of the potential. There are 37 hydroelectric power stations in the country, which provide about 10% of electricity generation. Hydroelectric power plants with a total capacity of 1854 MW generate about 6.5 billion kWh of electricity, depending on the water content of the year [1]. The authorities of the republic are actively working on the development and modernization of the hydropower industry of the republic. This will allow, according to the state program for the development of hydropower, to increase its share in the country's energy balance from 12.7% to 15.8% [1].

The use of equipment of thermal power plants to cover the peaks of the load schedule of the power system, designed to operate in a uniform, base part of the load schedule, leads to fuel burnout, reducing the time and reliability of the equipment. The Uzbek energy system is increasingly in need of redundant generating capacity; it needs to be replenished with highly maneuverable hydroelectric power plants or pumped storage power plants capable of operating in the peak zones of the daily load schedule [1,2,3].

Therefore, the development of another area of hydropower in the Republic of Uzbekistan is of increasing interest this is the construction of pumped storage power plants (PSPP). To reduce capital investment in the construction of a pumped storage power plant, you can save on the construction of reservoirs. One of the options is the construction of only one reservoir, and instead of the second, use a large river or canal [2, 3]. Another economical option is the use of existing reservoirs.

The most important issue in the development of water resources has always been the satisfaction of the needs of water management and drinking water supply. Under the conditions of Uzbekistan, the shortage of water resources dictates somewhat different conditions, caused by an increase in water consumption against the backdrop of an increase in the population and environmental protection requirements. Therefore, at the current stage of hydropower development, the development of hydropower resources must be carried out on seasonal inland watercourses, in reservoir systems, and on hydraulic structures without prejudice to the interests of irrigation and water supply. This, as calculations show, greatly reduces capital investments in the development of hydropower resources and makes it possible to more fully use the potential of the accumulated volume of water [2, 3].

As the unevenness of the daily load schedule grows, the wholesale capacity and electricity market develops, the introduction of differentiated tariffs for night and peak electricity and the gap between them widens, an economic basis appears for buying cheaper night electricity and accumulating it at a pumped storage power plant for use during periods of peak daily electricity. load curves [3, 4].

It is expedient to place a pumped storage power plant where there is a concentrated elevation difference, the possibility of creating reservoirs in the upstream and downstream pools, a relatively close location of a water source and the proximity of a large hydroelectric power station [4]. One of the main criteria is the maximum approximation of the hydraulic installation to the center of loads, namely the Tashkent energy system. The options for creating a pumped storage power plant in the Bostanlyk district of the Tashkent region on the basis of the Cascade of the Urta-Chirchik HPPs, which regulates the flow of the Chirchik River with the head Charvak reservoir (Fig. 1), are considered.

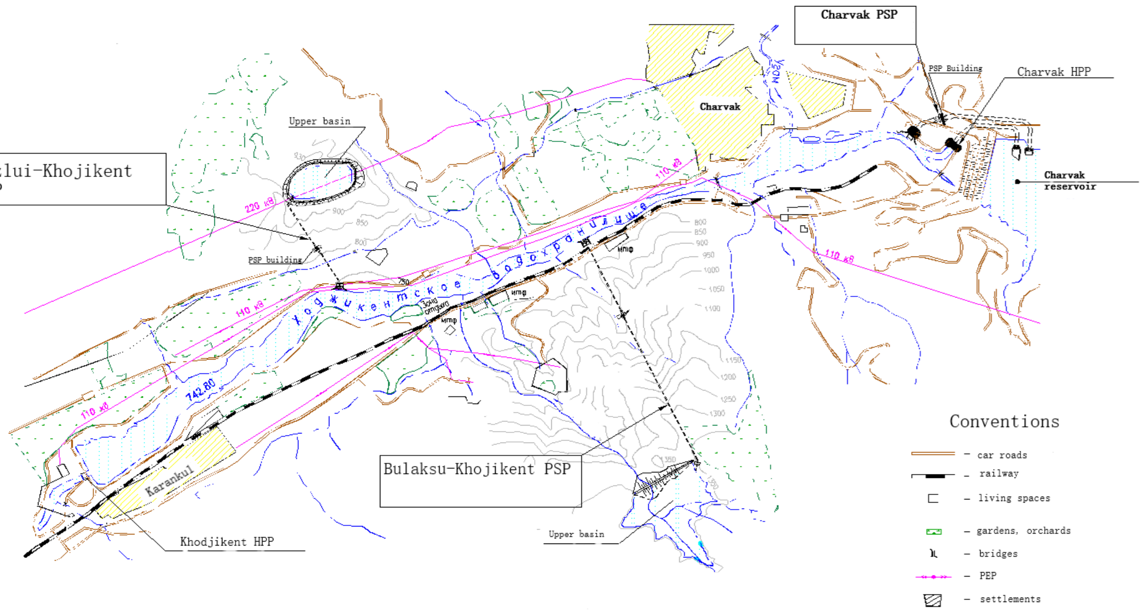

Fig. 1. Scheme of a pumped storage power plant in Bustanlik region

In this case, the necessary infrastructure is available in full, and the production base of the Tashkent region and Bostanlyk district of the Republic is subject to use, taking into account the renewal and appropriate development. On the basis of the Cascade of Urta-Chirchik HPPs, the following options for pumped storage power plants can be considered:

Option 1. Bulaksu-Khojikent PSPP. The upper basin is located on the left bank of the Khodjikent reservoir in the Bulaksu stream. A basin with a capacity of 6.0 million m ^{3} is created by a 43 m high embankment dam blocking the sai (fig.2). The lower basin is the Khodjikent reservoir with a useful volume of 9.0 million m $^{3.}$ The length of water conduits is 2 km. The injection height will be 586 m. The estimated flow rate of the pumped storage power plant in the injection mode is 96 m ^{3}/s, in the drawdown mode 120 m ^{3}/s. The installed capacity of the PSPP is up to 600 MW.

Option 2. Kizilsui-Khojikent PSPP. The upper basin is located on the right bank of the Khodjikent reservoir in the area of the sai Kizilsu. An artificial reservoir of 2.9 million m ^{3} is created in a half-cut-semi-fill on a horizontal section of the relief. The lower basin will be the useful capacity of the Khodjikent reservoir.

The length of the inlet tract is 630 m, the outlet tract is 400 m. The injection height is about 200 m. The estimated flow rate of the pumped storage power plant in the injection mode is 104 m ^{3}/s, in the drawdown mode 130 m ^{3}/s. The installed capacity of the PSPP is about 200 MW.

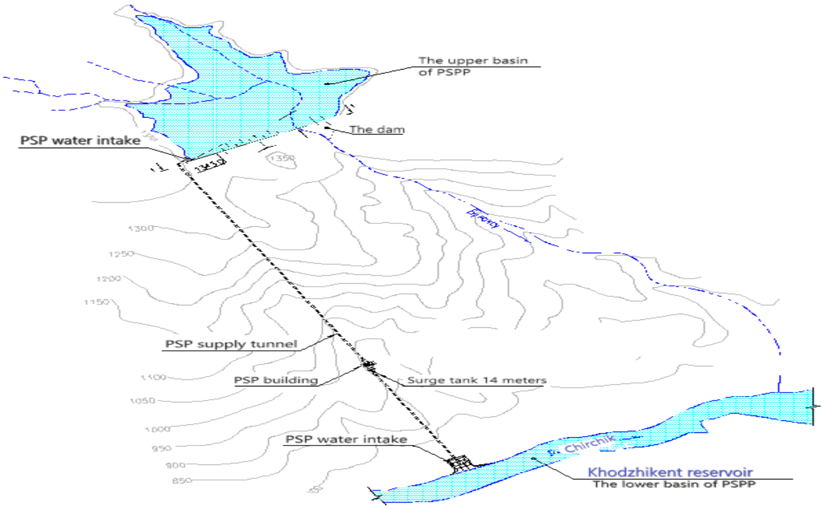

Fig. 2. Scheme of the Bulaksu-Khojikent PSPP

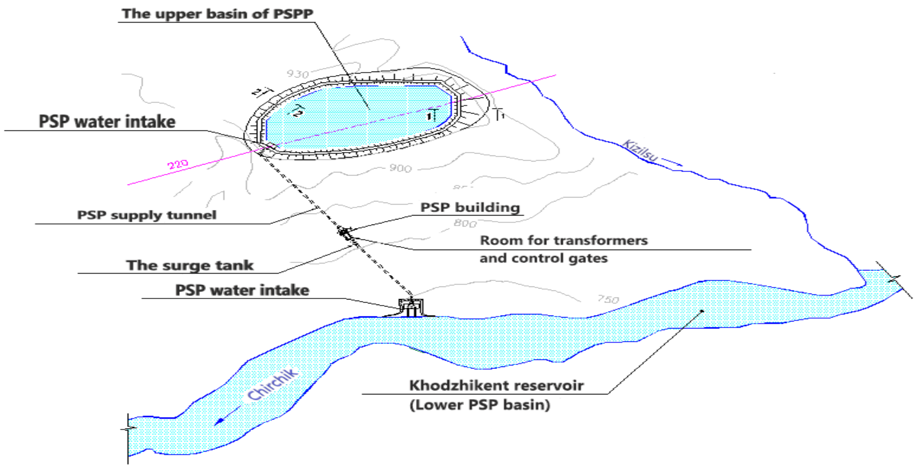

Fig. 3. Kizlui-Khojikent PSPP

Option 3. Charvak HPP-PSPP (Charvak-Khojikent HPP). The creation of the Charvak PSP is based on the use of closed pools of the reservoirs of the Charvak and Khodjikent hydroelectric power stations. The useful storage capacity of the Khodjikent HPP reservoir - 9.0 million m ^{3} is used as a lower basin, which allows Charvak HPSP to operate with an installed capacity of 400 MW in the 4-hour zone of the peak load schedule. The functions of regulating the daily releases of the Charvak HPP will be transferred from the Khodjikent reservoir to the reservoir of the Gazalkent HPP.

The upper basin of the HPSP will be the Charvak reservoir with a useful volume of 1580 million m ^{3} The daily drawdown depth of the reservoir at FSL= 890.0 m will be 22 cm, at ULV=835.0 - 54 cm. The injection height will average 118.0 m. Estimated costs of HPS in the injection mode-360 m ^{3} /s, in the drawdown mode 450 m ^{3} /s. With a range of annual fluctuations of the Charvak reservoir of 55 m from the level of FSL=890.0m to LSL=835.0m, the construction of a pumped storage power plant water intake and the selection of reversible units will be extremely difficult.

According to the conditions of the pumping regime, the axis of the reversible turbine should be buried under the minimum level of the tailwater by 18.5 m (axis mark is about 720.0 m), which determines the underground solution of the station building and the complex of tunnel conduits 1600 m long with their location on the right bank on a sufficiently safe distance from the existing facilities of the station for tunneling drilling and blasting.

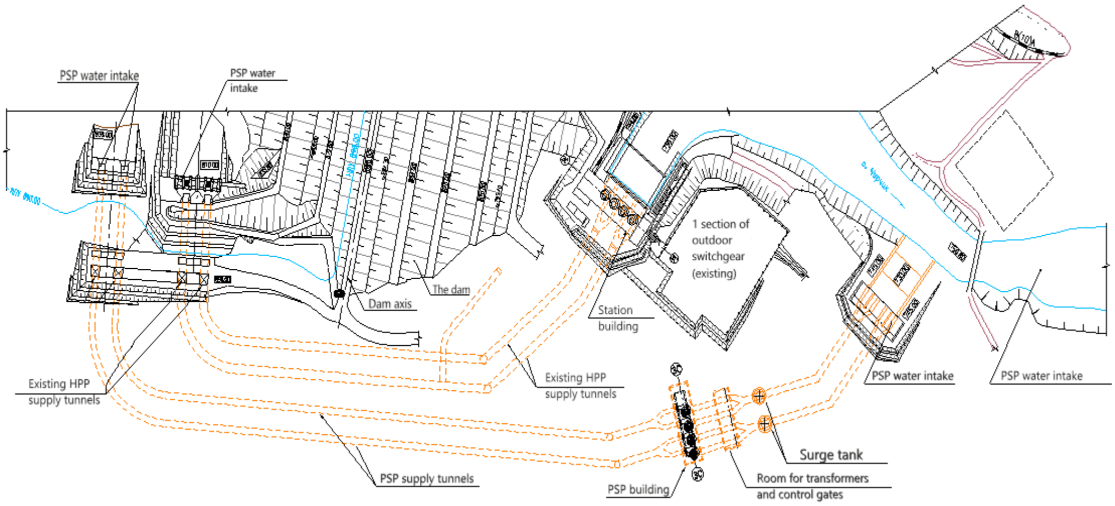

Fig. 4. Scheme of the Charvak PSPP

Option 4. Pskem PSPP. In the Pskem site, subject to the creation of a lower basin with a daily regulation capacity of about 10 million m useful volume of the Pskem reservoir of 486.5 mln. The drawdown of the reservoir at 114 m (from the level of FSL=1166.0 m to the level of energy drawdown of the SER= 1052.0 m) is not quite favorable for the operation of the HPP hydro-turbine equipment. Approximately estimated flow rate of HPS in pumping mode will be 200 m ^{3} /s, in turbine mode 250 m ^{3} /s. The facilities of the pumping station unit of the HPSP can be located on the right bank of the river, including two lines of supply tunnels of 1700 m each with surge shafts and an underground station building.

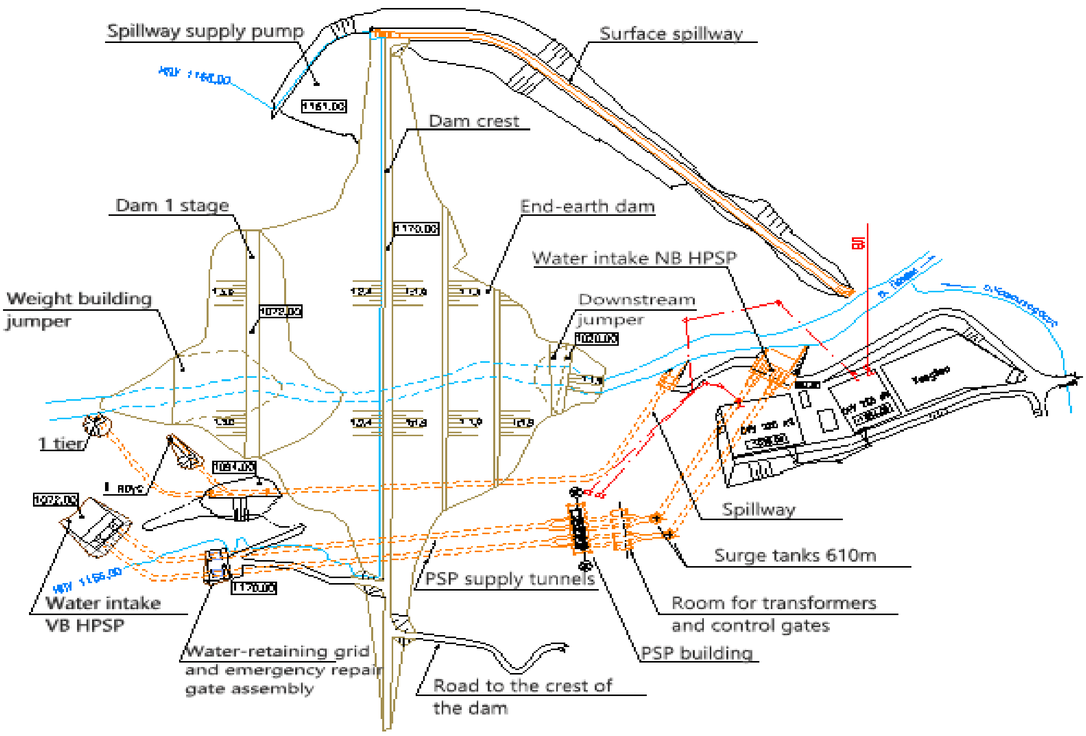

Fig. 5. Scheme of the Pskem PSPP

RESULTS AND DISCUSSION. A methodology and program for determining the economic indicators of a pumped storage power plant has been developed, and for each considered option for creating a pumped storage power plant based on the Cascade of the Urta-Chirchik HPPs , technical and economic parameters have been determined, i.e. capital investments, generated and consumed electricity in turbine and pumping mode, annual savings of fuel resources, annual cost, annual economic efficiency, payback period of capital investments, profitability ratio of capital investments, etc. (Table 1) [5].

Table 1

Technical and economic parameters of the pumped storage power plant at the Urta-Chirchik HPP cascade

№	The name of indicators	Unit of measurement	Value			
			Charvak HPP-PSPP	Bulaksu-Khojikent PSP	Kizilsuysko-Khojikent PSP	Pskemskaya PSPP
1	Head in turbine mode (TP)	m	105	578	180	186
2	Head in pumping mode (HP)	m	118	593	194	205
3	K.p.d. _ PSPP	%	73.44	73.28	73.56	73.41
4	Number of units	PCS.	four	2	2	four
5	Pumped storage power plant consumption in TR	m^3 / sec	450	120	130	250
6	Pumped storage power plant consumption in NR	m^3 / sec	360	96	104	200
7	Used volume in pumped storage power plant	million m^3	8.99	2.90	2.90	5.40
8	HPS power in TR	kW	400 020	599 996	199 991	400 057
9	HPS power in HP	kW	489 693	672 038	233 129	480 538
10	Capital investments in PSPP	billion soums	5309.1	8442.0	2839.1	6065.7
11	Annual EE generation in TR	million kWh	810.4	1469.5	452.6	876.2
12	Annual EE consumption in HP	million kWh	1240.0	2057.4	659.5	1315.5
13	The cost of generated EE from a pumped storage power plant during the peak period	billion soums	283.62	514.32	158.41	306.64
14	The cost of consumed EE from a pumped storage power plant in HP	billion soums	217.0	360.0	115.41	230.21
15	Annual savings in fuel resources	thousand tce _	121.55	220.42	67.90	131.42
16	Yearly cost of a pumped storage power plant	billion soums	360.24	572.81	192.65	411.58
17	Benefits from the creation of a pumped storage power plant	billion soums	985.1	1468.28	564.51	1084.18
18	Economic efficiency per year	billion soums	1107.21	1516.0	660.17	1182.1
19	Payback period	years	5.389	5,750	5.029	5.595
20	Return on investment	%	0.186	0.174	0.199	0.179

The shown energy performance of the HPS in Table. 1 are preliminary. The capacities of the projected PSPPs will depend on the possibility of creating sufficient capacities of the upper and lower basins, and the injection and drawdown modes will be determined by the results of optimization feasibility studies according to the requirements of the energy system, taking into account the long-term strategy for its development.

CONCLUSION. The potential and technical possibilities of creating a pumped storage power plant on the cascade of the Urta-Chirchik HPPs have been studied, which allows:

1. Obtain a total peak power of about 1,600 MW and additionally generate more than 3,600.0 million kWh/year of electricity.
2. C saves about 540.0 thousand tons of fuel equivalent. organic fuels.
3. Annual economic efficiency will be more than 4,400 billion soums.

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THE ISSUE OF AUTHENTICATION BASED ON BLOCKCHAIN TECHNOLOGY

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Abstract: *This article provides information on what results can be achieved by using blockchain in electronic voting. Authorities use blockchain technology to implement secure voting procedures without the need for a central authority. Blockchain-based voting systems are also more robust, tamper-proof (no changes to the vote by the voter or other third parties), and cost-effective. There has been extensive research into electronic voting systems that allow voters to vote, which are mostly systems that can be implemented using a mobile phone, computer, or other electronic device. These systems are immune to threats that could affect the integrity of the voting process. The article proposes a secure and robust electronic voting system using blockchain, aimed at ensuring the anonymity of voters and the transparency of the process.*

Keywords: *blockchain, security, anonymity, voter, candidate, electronic vote, TTP, authentication.*

INTRODUCTION. New security software for Internet voting includes firewalls, electronic authentication, and other computer security technologies [1, 2]. All of these technologies usually work to prevent malware, protect the network connection from other attacks when casting votes. If a voter votes remotely, in most cases the computer must be booted from the