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RECONSTRUCTION OF THE SHARKHI HYDROELECTRIC COMPLEX WITH WATER AND ENERGY SAVING IN MIND

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Abstract: This article considers options for the reconstruction of the Sharkhi hydroelectric complex, taking into account waterand energy saving, based on the results of a technical and economic comparison of which the most economical option for the reconstruction of the Sharkhi hydroelectric complex is proposed, which consists in rebuilding the shield part of the dam in order to equip its openings and spillway structures with automatic hydraulic water level gates, and the openings of water intake structures water flow stabilizers, which will ensure waterand energy saving when water is withdrawn from the river.

Keywords: Hydroelectric complex, water, the reconstruction, river, the regulator, automatic hydraulic, hydrosystem, waterand energy.

Introduction. The Sharkhi Hydroelectric complex was built in 1973 on the Akhangaran River in the form of a water intake hydroelectric complex. The hydroelectric complex is located in the floodplain of the river 48 km below the Akhangaran reservoir on the approach to the city of Akhangaran and is intended for water intake to the Шархияleft-bank Sharkhia canal, the right – bank Khoja-Balyand canal and for technical water supply to enterprises of the Almalyk-Akhangaran complex.

The layout of an existing hydroelectric facility does not correspond to any engineering type of water intakes.

As a result of the reconstruction of 1994-1995, the Sharkhia hydroelectric complex today consists of the following structures: a concrete dam, straight in plan, which is like a continuation of the right-bank struvidirectional dam and consists of two-blind spillway and shield parts: the supply and discharge channels; the regulator of the left-bank Sharkhia cannel Шархия, which has a flow rate of 25 m3^3/ s, and a separate spillway structure combined on the right side with a water intake into the Khoja Baliand canal, which has a flow$^{\text{rate of 12 m3}}$/s.

The spillway part of the vacuum profile dam has a discharge front width of 80 m and consists of four holes separated from each other by 1.0 m thick gobies. The shield part of the dam consists of two spans with a width of 6 m each, blocked by flat gates.

Currently, the structures and mechanical equipmentof the Sharkhi hydroelectric complex have not changed or been reconstructed. Today, the shield part of the concrete dam and the regulator to the Sharkhia Canal are equipped with gates installed back in 1973, the openings of the free-standing spillway structure and the regulator to the Khoja Balyand Canal are equipped with gates installed in 1995. The gates of the shield part of the concrete dam and the regulator to the Sharkhia Canal are severely damaged, their skin has dents, holes, rust, and when closed, water leaks constantly through the gates. The gates are mainly controlled manually, because of the frequent lack of electricity, the gates are not automated, so the water supply Sharkhito the Sharkhia and Khoja Balyand channels is carried out with a control error of +20 ... 30%, which

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does not meet modern requirements for water supply and water saving. The old, non-working water intake to the Khoja Balyand Canal, remaining part of the spillway dam front, narrows the spillway dam front, worsening the hydraulic conditions of the hydroelectric complex.

General Design Data and Brief Description of the Structures

The Sharkhiin Hydrosystem is located in the middle part of the Akhangaran River valley, within the flood plain to the east of the city of Akhangaran. Upstream of the hydrosystem, along the Akhangaran River, lies the Akhangaran Reservoir, while the Tashkent Reservoir is situated downstream. The Akhangaran River is formed by small streams flowing down the gentle slopes of the Chatkal and Kuramin mountain ranges. The total catchment area of the river is 7,710 km², and its length is 236 km. Observations of the river's flow regime have been carried out since 1927 by the Turk Hydrological Station. The runoff of the Akhangaran River is mainly formed by the melting of seasonal snow, although rainfall also contributes noticeably to the river's flow.

Average annual discharge: 22.7 m^3/s

Runoff modulus: 17.6 l/s per 1 km^2

Spring floods begin in March, with the highest discharges observed in May, during which approximately 30% of the annual runoff occurs. The discharge varies from 1.05 m^3/s (November 14–16, 1933) to 460 m^3/s (April 8, 1959) According to observations by the Turk Station, the average multi-year turbidity of the river is 0.16 kg/m^3. The annual suspended sediment load amounts to 115 thousand tons, which represents about 0.02% of the total water discharge. Within the Akhangaran River basin, there are 50 small tributary streams These streams are mainly fed by snowmelt and rainfall, with a noticeable contribution from groundwater, resulting in a perennial flow in many of them. The area where the hydrosystem is located has ground elevations ranging from 300 to 500 meters, with slopes of 0.02–0.05. The average annual air temperature is +13.3°C, with recorded maximums up to +44°C and minimums down to –30°C. The average annual wind speed generally does not exceed 3–4 m/s. The hydrosystem is situated within the river floodplain, which is characterized by low and gently sloping banks. The width of the floodplain varies from 400 to 600 meters, and the river channel consists of multiple branches.

The water intake to the Sharkhia canal Sharkhiis damaged in the waterhole part and apron, in addition, the waterhole part and apron of the shield part of the dam are heavily damaged, which indicates high specific water flow rates observed periodically in the downstream of the spillway dam. It follows that since the concrete dam and regulator to the Sharkhia canal of the Sharkhia hydroelectric complex have been operating for more than 40 years, they are physically and morally outdated and require reconstruction.

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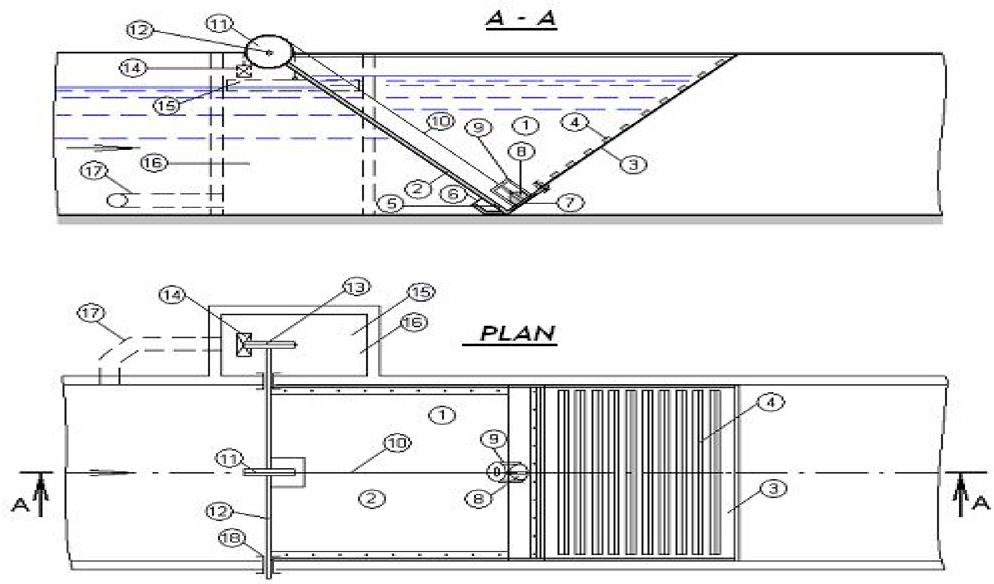

Water level autoregulator with flexible working bodies: 1-valve reservoir, 2-rigid pressure part, 3-soft shell, 4-rigid bar, 5-inlet hole, 6-visor, 7-outlet hole, 8-ball valve, 9-guides, 10-cable, 11 - rigid block, 12-AGC shutter rotation axis, 13-rigid block, 14-counterweight, 15-float, 16 - float chamber, 17-pipe, 18-hinge.

We have considered two reconstruction options:

The first option is the destruction (elimination) of the old non-working entrance part of the water intake to the Khoja Balyand Canal, which has one span of 3 m wide, and the shield part of the spillway dam, which has two spans of 6 m wide each, then the construction of a new shield part of the spillway dam, which has three spans of 5 m wide, on the site of these structures equipment of the dam's shield openings and water intake spans into Sharkhithe Sharkhia and Khoja Balyand channels with new electrically controlled flat wheel gates connected to the telemechanical control system.

Option 2: destruction (elimination) of the old non-functioning entrance part of the water intake to the KhojaBalyand Canal, which has one span of 3 m wide, and the shield part of the spillway dam, which has two spans of 6 m wide each, then construction of a new shield part of the spillway dam, which has three spans of 5 m wide, on the site of these structures equipment of the dam's shield openings with segmental automatic flood gates with a counterweight, operating entirely on renewable hydraulic energy of the water flow, with connection to the telemechanical control system, as well as equipment of the entrance part of the water intakes the Sharkhia and Khoja Balyand channels instead of the existing old flat gates with water working entirely on renewable hydraulic energy of the water flow with connection to the telemechanical control system.

The considered reconstruction options improve the hydraulic working conditions of the lower stream of the spillway dam by increasing the culvert front of the shield part of the dam and, consequently, reducing the specific water consumption at the water trough, and also provideautomatic water distribution through water intakes to Sharkhithe Sharkhia and Khoja Balyand channels..

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Based on a technical and economic comparison of the 2 reconstruction options discussed above, it turned out that the 2nd reconstruction option is more efficient due to the use of hydraulic segment valves – automatic upstream level and water flow stabilizers that save water and electricity, and also differs in lower reconstruction costs. At the same time, the coefficient of economic efficiency of capital investments for reconstruction for option 1 is 25%, and for option 2 it is 37%, the payback period for capital investments for reconstruction for option 1 is 4 years, and for option 2 it is 2.7 years. Therefore, we offer the 2nd reconstruction option as the cheapest and most efficient.

Conclusion. The second version of the reconstruction of the Sharkhi water intake hydroelectric complex is proposed by us for implementation as the most economical, it will improve the operating conditions of the Sharkhi water intake hydroelectric complex, will fully automate the process of water distribution, ensuring waterand energy saving during water intake and reduce the cost of its operation.

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