Improving the reliability of operation of the complex of structures of the kuiganyar hydraulic unit

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Abstract. The article is devoted to the issues of assessing the reliability and safety of the hydraulic system located on the Karadarya River in the Andijan region of the Republic of Uzbekistan. The results of actual measurements and their comparisons with the requirements for hydropower facilities according to the technical design and current standards building codes and rules (BCR) are presented such key indicators as: maximum and minimum costs, marks of water horizons, marks of the bottom of the inlet and outlet riverbeds; stock of the top of dams and structures over forced water horizons; stability of slopes and the integrity of their fastening in normal and forced operating conditions; siltation of the supply channel and erosion of the bottom of the river behind the shield dam; filtration strength of the soil of the base of structures; vertical precipitation and horizontal displacement of parts of structures; the integrity of concrete elements (bulls, foundations, apron walls, ponuros, etc.); condition of shutters, lifting mechanisms, gate position sensors (DPZ-500) and water levels (WL); conducting routine tests of electric motors, transformers, power and lighting wires for compliance with POC and PTS. Recommendations are given for the safe operation of the Kuyganyar hydroelectric complex.

1 Introduction

Water is a necessary part in all technological processes in all territories of the globe [1-2]. In Central Asia, including Uzbekistan, where agriculture, irrigation and the construction of hydraulic structures are a long-standing occupation of the population, the invaluable experience of scientists and thinkers in this direction has served as a solid foundation for the prosperity of this industry [3-5].

The main sources of runoff in Central Asia are glaciers and snowfields, which guarantee 25-30% of annual runoff. During the growing season, their share in annual runoff is up to 50%.

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The Central Asian region is one of the most intense, demographically growing regions of the world. There is no doubt that with population growth, water consumption will increase. Experts predict that by 2030, increased water demand in Central Asia will reach 15-20% [6]. Kuyganyar waterworks is located in the Andijan district of Andijan region on the river. Karadarya, 200 meters below "the Green Bridge" automobile road in the territory of the Kuiganyar village, is designed to ensure guaranteed water intake into the channels of the Big Ferghana Canal (BFC) and Siza, with a total suspended area of 233.92 thousand hectares [7-11].

The reliability and safety of the complex of facilities of the Kuyganyar hydroelectric complex (KSU) was assessed by comparing the actual data with the requirements laid down in the design in accordance with regulatory documents [12-13].

These include:

-maximum and minimum costs, marks of water horizons, marks of the bottom of the inlet and outlet riverbeds;

-stock of the top of dams and structures over forced water horizons;

-stability of slopes and the integrity of their fastening in normal and

-forced operating conditions;

-siltation of the supply channel and erosion of the bottom of the river behind the shield dam;

-filtration strength of the soil of the base of structures;

-vertical precipitation and horizontal displacement of parts of structures;

-the integrity of concrete elements (bulls, foundations, apron walls, ponurs, etc.);

-condition of gates, lifting mechanisms, gate position sensors (GPS-500) and water levels (WL);

-conducting routine tests of electric motors, transformers, power and lighting wires for compliance with POC and PTS.

For operating hydraulic structures, it is necessary to distinguish the following operational situations [14]:

- normal situation;
- potentially dangerous situation;
- pre-emergency condition.

Hotel researchers [15-17] for the safety indicators of hydraulic structures take the index M1 and M2. Their digital values are determined on the basis of diagnostics and calculated indicators.

We have resolved this issue by comparing indicators and requirements for hydroelectric facilities according to the technical design and current standards (TDCS)

2 Methods

Control of the position of the gates at all culvert holes of the shield dam and the head regulators of the BFC and Siza channels was carried out by sensors of the DPS-500 type, water levels in the inlet river. Karadarya, in the sedimentation tanks of the BFC and the lower downstream of the Siza channel regulator with sensors of the UDU type, the state of the equipment with signal sensors Over the past period of time, 77 years have passed from the start of operation of the facility (1939). During this time, GOSTs and SNiPs appeared, which changed several times, and in the period 1997-1998 the State Committee of the Republic of Uzbekistan for Construction and Architecture approved the Republican norms to replace the existing SNiPs under the acronym KMK (building norms and rules) [18-19].

3 Results and discussions

Comparison of indicators and requirements for waterworks facilities according to the technical design and current standards (TDCS) are given in table No. 2-1.
As can be seen from the above table, the requirements of BR either remained unchanged (clauses 1, 2, 4, 5), or were specified (clause 6), or decreased (clause 3). This suggests that KHC was built according to the standards, the requirements of which do not contradict existing standards.[20-21]

The main water sources of the Kuyganyar hydroelectric complex are the Naryn and Karadarya rivers. Water r. Naryn enter the Big Ferghana.

Canal (BFC) through the head regulator only in the quantity that is needed at the moment.

Flood discharge (0.1% coverage) p. Karadarya is - 1664 m^3/s. The maximum capacity of the discharge openings of the Andijan reservoir is 1700 m^3/s. With the passage of such costs below the dam due to the spreading of the wave, transformation and accumulation of the flow along with the lateral flow in the river. At a rate of 320 m^3/s, in the KHE site there will be a flow rate of 1425 m^3/s, with Qi% -1402 m^3/s, which is close to the estimated maximum KHE flow rate of 1431.5 m^3 s.

Comparison of indicators and requirements for the facilities of the Hydroelectric Complex according to technical documentation and current standards (TDCS), shown in table No. 1, shows that the Kuyganyar hydroelectric complex was built according to the standards, the requirements of which do not contradict the existing standards. As for the maximum flow rate (1425 m^3/s), it is close to * the flow rate of 0.1% of security (1402 m/s) and both of these flows cannot create an emergency at KGU, designed to pass the maximum flow rate of 1431.5 m^3/s.

The decrease in the throughput capacity of the dam unit can only be due to sediment deposits in the supply channel, which, as necessary, is cleaned during the low-water period and transported by the operation outside the supply channel and, therefore, the throughput capacity of the shield dam at the beginning of the growing season is calculated value.

Table 1. Comparison of indicators and requirements for waterworks facilities according to the technical design and current standards (TDCS)

№	Indicators	According to working drawings		According to current	
		Value	Base	Value	Base
1	2	3	4	5	6
1.	Capital class of river facilities	II	"Norms and TU of designing hydraulic structures of	II	BR 2.06.01- 97 Hydrotechnical buildings.
2.	Estimated seismicity of the area in points.	9	According to current standards	9 1 time in 500 years	BR 2.01.03-96 Construction in seismic regions.
3.	Standard safety factor:		"Norms and TU of designing hydraulic structures of hydroelectric power stations." Collection No. 4		BR 2.06.01-97 Hydrotechnical buildings.
	a) The main combination	1,40		1,20	
	b) Special combination	1,10		1.0.8	

4.	Stock at the height of dams	1,0	-«-	1,0	-«-
5.	Estimated probability of exceeding the maximum costs,%		By current standards.		BR 2.06.01- 97. Hydrotechnical buildings . Design Fundamentals.
	-normal	1,0		1,0	
	-emergency	from		from	
6.	Estimated maximum costs				BR 2.01.14-98. Definition of settlement.
	-1,0%	1200		1170	
	-0,1%	1400		1402	

In the present, the right bank of the upper pool is silted with sediment thick
2.0 m, sometimes up to 3.0 m. It reduces the throughput of the openings of the shield dam.

Due to violations of the operating mode and maneuvering with gates, silt of the upper pool is deposited with sediments and the lower pool is washed out behind the spillway. The following activities aimed at ensuring the safety of KSU for the current period have not been completed:

-study of the current state of soils and their comparison with the requirements of RSTU 20522-96 and KMK 2.02.02-98 [22].

- verification by calculations of the stability of structures against the effects of earthquakes by a probabilistic method;

-development of a safety criterion, maximum permissible indicators in the prescribed manner and their approval in the inspection "Govwatercontrol"

4 Conclusion

The main reasons for reducing the safety of the KHE complex are:

1. The assumption of rising water horizons in the upper pool of the shield dam above the calculated values.
2. Sediment sowing during the flood period in the supply channel interferes with the even flow approach to the shield dam during low-water periods and, thereby, contribute to increased concrete wear on separate sections of the spillway of the dam.
3. Evaluation of the state of the facilities of KSU is given on the basis of visual observations of employees of the 4th hydro plots of the 3rd department of the NKUG, they lack geodetic control and measuring equipment (KIA) and data from instrumental observations of the opening of expansion joints, sediment values of various structural elements of structures.
4. In the upper pool of the shield dam near the right bank there are sediment deposits along the coast at a distance of about 100 meters. The thickness is 1.5-2.0 meters, and when adjoining the shore it reaches 3.0 meters.
5. In the lower pool of the intake dam, the bottom erodes to a depth of 1.0 m, especially at the left bank, where the erosion depth reaches
meters.
6. The left bank of the lower pool of the dam is blurred at a length of 40 meters.

To ensure the safety of the complex of structures of the Kuyganyar hydroelectric complex of KSU, it is necessary:

The operation of the complex of Hydroelectric facilities shall be carried out without violating the requirements of the "Operating Instructions".

Timely remove sediment deposits in the riverbed. Karadarya and in the sedimentation canals of the BFK.

Protect the downstream from erosion by the construction of a diversion structure (barrage).

The health content of all gates and technical devices of the hydraulic system.

For the safe operation of the Kuyganyar hydroelectric complex, it is necessary:

-to maintain in working condition the whole complex of Hydroelectric facilities by strictly observing the Operating Rules, to carry out, as necessary, ongoing repair and restoration work in places of damage;

-timely remove sediment deposits in the riverbed. Karadarya and in the BFK sedimentation channels;

-build in the downstream diversion structure to protect the downstream from erosion;

-to develop new rules for the operation of the hydraulic system, taking into account the accumulated experience and modern requirements. The authors of the article are very grateful to the organizers of this International Conference**.**

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