expense of their own economic stimulation funds. State regulation of the activities of power enterprises with respect to providing safety of power station structures is necessary. For this purpose it is necessary to develop state standards defining the requirements imposed on the reliability and safety of structures, including on the scientific and technical level of diagnostic check systems of structures and foundations. The scientific basis of these standards can be the investigations conducted in recent years by the research department of Gidroproekt, All-Union Scientific-Research Institute of Hydraulic Engineering, and number of other organizations, investigations in the area of metrological provision and automation of diagnostic checking of structures performed by the research department of Gidroproekt, All-Union Scientific-Research Institute of Hydraulic Engineering, and number of other organizations, investigations in the area of metrological provision and automation of diagnostic checking of structures performed by the research department of Gidroproekt, and the experience of state regulation of works on providing safety of hydrostation buildings in the USA, Canada, France, Switzerland, and a number of other countries. It is expedient to establish the requirements imposed on standardization of indices of the reliability and degree of safety of structures, methods of their quantitative and qualitative determination, standardization of the indices of the scientific and technical level of diagnostic check systems, and regulation of the mutual correspondence of the indicated requirements.

State insurance of dams can have an economic effect on practical intensification of works on providing safety of hydraulic structures. State insurance will make it possible to create a source of covering the cost of eliminating the consequences of failures of structures and to protect workers from material losses related to failures. Differentiated standardization of the amount of insurance payments depending on the state and degree of safety of the structures and on the indices of the scientific and technical level of the diagnostic systems being used makes capital investments in providing safety of structures economically advantageous and amenable to optimization.

LITERATURE CITED


WATER-OPERATED GUARD GATE OF A DEEP INTAKE

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Withdrawal of water from reservoirs with a considerable drawdown storage is possible by means of deep or bottom intakes and pressure conduits. A gate chamber with regulating gates is usually located at the end of the pressure conduit [1, 2]. Owing to the need for periodic inspection and maintenance of the pressure conduit, which is constantly under pressure, the installation of guard gates at the intake inlet is provided for. To close the intake by the guard gate, it is required to construct a special structure in the form, for example, of a reinforced-concrete tower above the inlet opening. However, the tower-type intake requires large capital investments and expenditures of labor, and therefore its construction can hardly be considered expedient for such rarely operating gates, and especially at large heads [3]. The construction of deep intakes with the use of water-operated gates in the form of a float as the guard gates has been realized in world practice. Inflation of the compartments of a toroidal pontoon with compressed air is necessary for lifting the guard gate at one of the pumped-storage stations in Japan [4]. It is known also that at one of the hydro developments in India, special valves are opened by divers before lifting the gate [5].

Water is withdrawn from the Nurek reservoir along the Dangara tunnel for irrigation in a volume of 13-90 m³/sec. The pressure section of the tunnel has a diameter of 4.58 m and length of 330 m and the free-flow section has a diameter of 6.6 m and length of 13,270 m. The entry portal of the pressure tunnel is made in the form of a submerged intake with vertical
entry of water adjoining the tunnel extended into the reservoir. The intake opening is located at a depth of 55 m at a water level in the reservoir at the elevation of the normal pool level (NPL) (Fig. 1). At the end of the pressure section of the tunnel there is a three-barrel gate chamber with 2 x 3-m openings equipped with the service gates regulating the discharge.

A water-operated gate working together with a floating control station secured by cables is used for closing the inlet opening during the maintenance period [6, 7]. The control station is secured by four cables to anchors placed symmetrically relative to the center of the inlet opening. The cables serve as guiding elements when moving the gate vertically. They are parallel to one another and are in tension due to some submergence of the station (Fig. 1).

The guard gate is made in the form of a floating construction having the shape of a float. A part of the volume of the gate is a ballast tank. The gate has a system of valves intended: for admitting water into the ballast tank during submergence of the gate; for emptying the ballast tank during emptying of the tunnel; for delivering water to the tunnel before raising the gate. Figure 2 shows the design of this gate. The gate consists of a hermetically sealed part 1, ballast tank 2, two-way valve 3, water-delivery pipe 4, openings 5 for filling the ballast tank, air-release valve 6, final seating device 7 in the form of a float, seal 8, cable 9 controlling the valve, and lugs 10.

The valve 3 operates in the following way. When the gate is floating, the final seating devices 7 are moved aside, the float 14 due to buoyancy is raised to the extreme position and closes opening 5, and thereby flooding of the ballast tank is precluded. For filling the ballast tank with water, it is necessary to overload stop 13 by final seating device 7. This is the first stage of opening the valve 3. As a result of this, water begins to flow through opening 5 into the ballast tank, displacing the air through valve 6. During the second stage of opening valve 3, the valve pipe 15 is raised to the extreme upper position by means of cable 9. If the gate is on the sill and the tunnel is empty, filling of the tunnel with water through the gate begins.

![Fig. 1. Mechanical equipment of entry portal of tunnel: 1) deep water-operated gate; 2) floating control station with mechanisms.](image-url)