Water security and the tasks of hydraulic construction in Russia

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Abstract. Along with the main challenge – geopolitical risks, from the point of impact there were included social and environmental risks determined by the water factor including scarcity of water resources and problems of adaptation to the climate change. Determination and assessment of water security at the national level are very urgent. The analytical survey and theoretical analysis was based on the generalization of the results of previous studies, the data from official reports of the Rosvodresources and Rostekhnadzor, as well as the information of the Russian register of hydraulic structures. The analysis of security levels of the existing Russian hydraulic structures performed using the official data showed that 47% complexes of their total number have a normal security level and a little more than 3% of the waterworks have a dangerous level. The main tasks of hydraulic engineering construction, the solution of which, along with other measures will ensure the water security of the country, are: construction, reconstruction and repair of engineering protection facilities, hydraulic structures and reservoirs with the creation of additional regulatory capacities and increased water availability in regions with water scarcity; implementation of comprehensive measures to prevent the negative impact of water.

1. Current state of the problem
Water security is the most important challenge of our time. By the middle of XXI century more than 40% of the world's population will have lived under the conditions of a sharp water stress. In the report "Global Risk Report 2015" there was a warning that in the coming years geopolitical, social and environmental risks will become the main risks for the world community. Moreover, along with the main challenge – geopolitical risks, from the point of impact there were included social and environmental risks determined by the water factor including scarcity of water resources and problems of adaptation to the climate change.

For the national security of our country the water factor is associated with the following sources of threats (risks): catastrophic flooding (Lensk, 2001), the river Tom basin (2004), Krymsk (2012), the river Amur basin (2013); water scarcity; unsatisfactory provision of branches of the economy and population with the services rendered by the water economy (primarily, drinking water); technological accidents at hydro-technical objects of the water economic complex (The Sayano-Shushenskaya HPP). All sources of threats become stronger with time indicating to insufficient measures for prevention of the danger caused by them. Therefore, determination and assessment of water security at the national level are very urgent, and setting the tasks of the domestic hydraulic engineering under the conditions of the increasing influence of the water risk on the domestic economy and social sphere has become the primary goal of the work.
Catastrophic floods and other natural disasters caused by abnormal weather phenomena, are obvious sources of water threats to national security. Currently, floods are potentially dangerous for the population and economy of Russia, is subject to 3.0% of its territory. Damage from flooding in Russia makes more than one third of the total damage from all natural disasters, and the death toll from flooding around 65% of the total number of victims of natural disasters. Half of the floods, leading to major socio-economic and environmental impacts, is evolving with the passage of spring floods. The territory of the Russian Federation is characterized by a diversity of hydrological hazards (floods, floods, surge phenomena), the main ones for individual regions are flooding of different nature. For example, floods caused by the formation of ice jams in the river bed with water outlet and ice piles on the floodplain, it may cause not only material damage but also human victims in 10% of cases, these floods have especially severe consequences [1].

The Russian policy of flood protection necessary to significantly change, it does not correspond to the scale of threats that is characteristic for the present time and do not fully take into account the technical and technological condition of the facilities of the domestic water sector.

Present value of fixed assets of water complex, which includes a large part of hydrotechnical constructions on water objects of Russia, estimated today at more than 350 billion rubles. Most of them are hydraulic systems of territorial redistribution of runoff (41%), hydraulic works for river flow regulation (25%), the systems and structures of water supply for irrigated agriculture and agricultural water supply (13%). The value of special engineering constructions for protection against the harmful effects of water is less than 3% [2].

A variety of hydraulic structures for functional purposes and industry affiliation creates some difficulties in solving the problems of their own safety. Given the importance of hydraulic structures for various sectors of the economy, which are part of power plants, water transport systems, water supply systems and irrigation, special attention should be paid to own the security of such facilities, most of which were built 40-50 years ago.

The greatest potential hazard for the economy and population of the regions of the country are dams within the power of hydraulic systems with pressure of more than 15 meters. The vast majority of water retaining hydraulic structures dams are represented by small and medium-sized reservoirs, many of which are operated without repair and reconstruction and are high risk.

In order to ensure the safety of hydraulic structures July 21, 1997, Russia adopted Federal law No. 117-FZ "On safety of hydraulic structures", which regulates legal, economic and social basis of ensuring safe operation of hydraulic structures. The present law regulates relations arising in the implementation of activities on provision of safety of hydraulic structures, the responsibilities of public authorities, owners of hydraulic engineering structures and operating organizations to ensure safety of hydraulic structures. Article 9 of this Federal law the responsibility for the safety of hydraulic structures (HS) assigned to the owners of the HS and operating organizations.

The government of the Russian Federation from May 23, 1998 № 490 "On the procedure of forming and maintaining the Russian registry of hydraulic structures" the procedure of state registration and accounting of hydraulic structures for various purposes, regardless of ownership and departmental affiliation in the form of the Russian register of hydraulic structures.

The register is a unified system of registration, storage and provision of information on HS of the country. From 2016 the Russian register of hydraulic structures, including the service of providing information on hydraulic structures from the Register of the HS carried out by Rostekhnadzor. It also performs the functions of control and supervision in sphere of safety of hydraulic structures (excluding shipping and port HS), and questions on rendering state services and Federal property management in the sphere of water resources is carried out Rosvodresursy.

2. Material and methods research
The analytical survey and theoretical analysis was based on the generalization of the results of previous studies (including the author’s), the data from official reports of the Rosvodresources and Rostekhnadzor, as well as the information of the Russian register of hydraulic structures.
Statistics shows that the increase in flood damage due to two reasons:

- change of anthropogenic load on water objects,
- rapid (gain) of the natural hydrological extreme situations, apparently, with global climate change.

We propose the following measures to prevent or reduce flood damage:

- flood forecasting;
- warning and evacuation of the population;
- monitoring the condition of hydraulic engineering constructions on water objects and watersheds;
- control economic use of the catchment areas;
- construction of hydraulic engineering facilities protection.

Besides the above reasons for the significant growth of the damage caused by the flooding, Russia has a dangerous feature associated with the growing number of accidents at hydraulic structures, in particular due to the small capacity of the spillway structures, suffusion and imperfections of the sealing devices and the poor operation of hydraulic structures.

In 2016, and in accordance with the State report "the status and use of water resources of the Russian Federation in 2015", the country has more than 65000 units of the HS, including 29964 hydraulic engineering structures supervised by Rostechnadzor, of which 568 HS fuel and energy complex, 844 complexes to industrial facilities, 28552 structures of water sector, of which 3496 ownerless hydraulic engineering constructions. In the Central Federal district of Russia is concentrated 9136 supervised the HS, including in Moscow – 639, Moscow region – 1940.

Of the 65 000 hydraulic structures built on the territory of Russia, more than 60,000 are in Federal ownership under the jurisdiction of the Ministry of agriculture of the Russian Federation, 313 Federal navigable hydrotechnical facilities within the jurisdiction of the Ministry of transport of the Russian Federation and 138 Federal waterworks, under the authority of the Federal water resources Agency.

The distribution of domestic regulated technical inspection of hydraulic structures in classes depending on their height and type of Foundation soils based on their potential risk:

- class I - 116 complexes (0.4%);
- class II - 332 complex (1.1%);
- class III - 669 complexes (2.2%);
- IV - 28 of 847 systems (96.3%).

In Russia on average by 100 km² area located 17 of potentially dangerous hydrotechnical facilities supervised by Rostekhnadzor, in the territory of the Central Federal district is the highest and is equal to 156 per 100 km².

The vast majority of ownerless hydro refers to the IV class. More than 95% of the complexes HS proprietary, built for solving problems of land reclamation, recreation, fisheries, livestock and other household needs.

Identified a number of weaknesses in the operation of hydraulic structures:

- operation of hydraulic structures is carried out without the project and Executive documentation;
- not provided the estimated capacity of water conveyance structures of hydropower installations, including those not provided drainage systems;
- not met the requirements of the legislation in the field of safety of hydraulic structures with respect to Declaration of safety, development of safety criteria and operation according to the developed instructions and monitoring projects on safety of hydraulic structures;
- staff services operation of hydraulic structures do not have the necessary qualifications, appropriate to the project (if any) and the requirements of the legislation in the field of safety of hydraulic structures;
failure to comply with the requirements of the design documentation in terms of filling the reservoir above the maximum allowable volume, as well as the violation of the geometry of hydraulic structures;

the number of functional test equipment does not correspond to design decisions, current regulations and construction norms and rules.

3. The results of the research

Water security is a condition of the state water objects and water economic system under which the guaranteed (quantitative and qualitative) provision with water resources is achieved for a sustainable socio-economic development of the regions and the country as a whole, preservation and restoration of water bodies to the level that ensures environmentally favorable living conditions of the population and protection of the population and economic facilities from a negative impact of water under changing climatic conditions.

It is established that measures to prevent and reduce damage from harmful water effects – first of all floods, can be grouped into:
1) prediction of extreme water situations;
2) information, technological and property provision of the population and economic objects in the period of the emergence and development of such situations;
3) control of the state of hydraulic structures and water objects in terms of the factors influencing the formation and development of extreme situations;
4) construction, reconstruction, repair and maintenance of protective engineering and hydraulic structures of a special-purpose (e.g., flood control) and complex (hydro storage units) purpose;
5) monitoring and control of the economic usage of the territories subjected to harmful effects of water.

The analysis of security levels of the existing Russian hydraulic structures performed using the official data showed that 47% complexes of their total number have a normal security level and a little more than 3% of the waterworks have a dangerous level. Accidents at hydraulic engineering structures are first of all connected with their unsatisfactory financing and operation, insufficient capacity of culverts, reduced capacity or imperfect antifiltering devices as well as non-designed deformations of structures.

The main tasks of hydraulic engineering construction, the solution of which along with other measures will ensure the water security of the country are as follows:

– construction, reconstruction and repair of engineering protection facilities, hydraulic structures and reservoirs with the creation of additional regulatory capacities and increased water availability in regions with water scarcity;
– implementation of comprehensive measures on prevention of the negative water impact to ensure the operational reliability and safety of hydraulic structures.

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