Environmental Safety Conditions and Factors in zones of influence of water facilities

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Abstract. Water problem is one of the most important problems at the present stage of development of the global system “Nature - Society – Man” is practically associated with all types of economic and other activities. The realities of emergency situations (ES) indicate that about 30% of emergencies on the planet Earth are directly related to water resources, which are formed within the spatial limits of basin geosystems interconnected with global water circulation within the Earth’s biosphere. The use of water resources within river basin geosystems by means of intra-basin regulation or inter-basin redistribution of water flow (surface, underground) determines the need for environmental safety (ES), which determines the protection objects’ state under the influence of agent, energy, information flows (AEI) emanating from (Activity Objects (A.O.)), operating as part of the NTE “N.E. - A.O. - P.” for the use of water resources in various technological schemes of economic and other activities. The methodological basis in the issues study on ensuring electronic safety on existing and new “A.O.” is a systematic approach, as a way of creating and describing the interconnection, interaction and interrelations processes (IIR) between the components of the system “Protection Object – Source of Environmental Hazard - Protective Measures” “P.O. – S.E.H - P.M.”, which may include all “P.O.”, the entire set of “P.M.”.

Introduction
The current stage of the global system “Nature - Society – Man” development is characterized by ten interconnected critical problems, of which the first four problems Energy, Water, Food and Ecology are the most important, without the solution of which it is impossible to solve the other six important
problems - Poverty, Terrorism and War, Disease, Education, Democracy and Population. Problem Water is inextricably linked with almost all types of economic and other activities, and the use of water resources in various technological processes of industrial and agricultural production and other areas necessitates environmental safety (ES) in the water facilities’ influence zones that provide intra-basin regulation, redistribution of river flow (surface, underground), selection from a water body and transportation of estimated costs (Q m³/s) to the water consumers and water users. Both the Water problem and the ES provision when using water resources for economic and other activities is determined by a certain feature, which is determined by the processes of the quantitative and qualitative indicators’ formation of the river flow within the spatial limits of the basin geosystem under consideration in conjunction with the global moisture circulation within the Earth’s biosphere.

The basin geosystem within the landscape-geological space in the form of a vertical cylinder, the generatrix of which passes along the watershed line of the catchment area of the river hydrographic network, the upper edge (cover) of which is located at the height of the boundary of the surface layers of the atmosphere (up to 10 km), and the lower edge (bottom) is the depth of the upper layers of the lithosphere (up to 300 m), where underground (ground) waters are formed that exit into the river network (Figure 1).

For the use of water resources, for example, in agricultural production on irrigation and watering systems (IWS), water management facilities have been created and are operating in the form of river reservoirs that regulate the river flows, which make certain changes to the natural processes of water formation in the considered space of the basin geosystem, which actually and creates the features associated with the provision of ES in the water management facility influence zones (reservoir), which occupy almost the entire space of the basin geosystem where water resources are formed.

**Materials and methods**

The study of the processes of interconnection, interaction and the relationship of the water management facility with the natural environment and the living population in the considered space of the basin geosystem is carried out in the natural technical system (NTS) “Environment - Activity Object - Population” (“E. – A.O. - P.”), where under “A.O.” water management facility is understood [1-7]. In the functioning of the NTE “N.E. – A.O. - P.” in the space and time of the basin geosystem the dominant role is played by the technogenic component - “A.O.”, under the influence of which ecological state (ES) is formed, which is the dominant factor in the states dynamics formation in natural, technogenic components, in the life of the living P. The N.E. condition, the objects of economic and other activities and living “P.” in the “A.O.” influence zones of quantitatively and qualitatively determined by the “E.S.” concept [7-15].
Based on the natural features of global moisture circulation within the Earth’s biosphere and, accordingly, at the level of local basin geosystems, the subject of the “E.S.” study is environmental hazard (EH) and its totality, operating in the system “Object of protection - Source of environmental hazard - Protective Measures against danger” (“O.P. - S.E.H. – P.M.”), presented in Figure 2.
Figure 2. Model of interaction of components in the system (“O.P. - S.E.H. – P.M.”)

In the current spatial limits of the basin geosystem NTE “N.E. - A.O. - P.”, the protection objects (“P.O.”) in the zones of influence “A.O.”, as a source of EH, are practically the entire material world and, accordingly, the living “P.” and the surrounding “N.E.” For the emergence and implementation of EH, the conditions associated with the presence of the system itself, the presence of an EH source capable of creating and driving the flows of agent, energy, information (AEI) should be observed; the presence of the normative value of maximum permissible concentrations (MPC), maximum permissible levels (MPL) of energy and information, maximum permissible selectable expenditures (Q m³/s) of water from a water source (MPW), maximum permissible discharge of polluted water (MPD).

In accordance with the law of life preserving by Yu.N. Kruzhakovsky, the entire material world takes part in the continuous exchange of AEI flows, which is the dominant source of influence on everything material and, accordingly, on the human and the environment. If the intensities of these flows exceed the values of MPC, MPL, MPW, MPD in the action zones of the EH source, then “P.O.” under the influence of these flows will experience certain damage and vice versa, when the flows do not exceed the permissible values, then “P.O.” are in the regulatory conditions. Consequently, in the systematic consideration of the “P.O.” concept for NTE “N.E. - A.O. - P.”, can be formulated as follows: Environmental hazard is a negative property of factors arising in the processes of natural, man-made components’ explosives as well as living “P.” as part of NTE “N.E. – A.O. - P.”, capable of causing damage to “N.E.”, “P.” “A.O.” itself.

Discussion Results
According to the many-years research results on water management systems within the basin geosystems of the Kuban, Terek and Lower Don rivers, where there are more than 6,000 “A.O.”, operating as a part of the “N.E. – A.O. - P.”, we can conclude that EH in the use of water resources is a central concept in the study of the issues related to ensuring electronic safety and, accordingly, generalized safety during the construction and subsequent operation of “A.O.”.

In the Federal Law “On Environmental Protection” dated January 10, 2002 in the Article 1 “Ecological safety” is defined as the state of the natural environment and vital human interests’ protection from the possible negative impact of economic and other activities, natural and man-made emergencies and their consequences [3-12]. Providing ES is considered as: the goal of maintaining a favorable environment, natural resources and biological diversity; basis for environmental regulation.

The methodological basis in the study of ES “A.O.” as a part of NTE “N.E. – A.O. - P.” is a systematic approach, as a way of creating, interpreting and using as a description of the IIR processes between “P.O.”, “S.E.H.” and “P.M.” in order to ensure electronic safety, they are considered as a whole in the system “S.E.H. – P.M.” (Fig. 2). System “P.O. – S.E.H. – P.M.” in general terms, it may include all “P.O.”, the whole range of hydraulic structures (HS) as a part of “A.O.” and the entire set
of “P.M.”, but for studying the IIR processes of all components of this system with the continuous exchange of AEI flows in the space and time of the “A.O.” in the basin geosystem under consideration, as reality shows, it causes significant difficulties. Therefore, in the study, it is more expedient to consider the P.O. - S.E.H. – P.M.Z.” with the allocation from the total number of more important and necessary “P.O.”.

In the model of the system “P.O. – S.E.H. – P.M.” (see Fig. 2) with a real “S.E.H.” in the form, for example, of the reservoir, “A.O.” there are the adjacent territories in the water system influence zone in the upper and lower pools, the diversity of ichthyofauna (fish species, etc.) in the water body, settlements in the zone of possible flooding during the water system pressure front destruction, etc. Based on the components’ relationship in the system “P.O. – S.E.H. – P.M.” ES can be considered as a property of the system to exist and develop in the absence of dangerous for “P.” surrounding “N.E.” and the ability of the system to weaken these interactions with “A.O.” to safe the values for MPC, MPL, MPE, etc. ES in the zones of influence of “A.O.” in the composition of the considered NTE “N.E. – A.O. - P.” forms ES in the system “P.O. – S.E.H. – P.M.”, in which “A.O.” is “S.E.H.” [12-15].

In the improvement of existing and the creation of new “A.O.” involved in technological schemes for the water resources use as established by the research, a very important concept is environmental acceptability (EA) constructive solutions. EA technologies for the use of water resources and hydraulic structures in the generalized concept is determined by the resource intensity, in which the dominant resource is energy, interconnected with the main source of Energy on Earth - the Sun. Therefore, we can conclude that EA water use technologies, constructive solutions “A.O.” are determined by the use of renewable and non-renewable energy sources. Based on the energy principle of assessing the technology excellence level, the EA design solutions can be considered as a trend towards the creation of nature-like structural and technological solutions in the water resources use.

Based on the concepts of “E.S.”, “A.O.” and the formed “E.S.” in the space and time of the zones of “A.O.” influence as a part of NTE “N.E. – A.O. - P.” the concept of “Environmental Safety Criteria” (“E.S.C.”) is stipulated, which is quantitatively and qualitatively regulated by MPC, MPL, MPW, MPE and MPD. In the NTE class “N.E. – A.O. - P.” on the water resources use in various technological schemes of economic and other activities of E.S.C. determines quantitative (l_i) and quality (l_j) environmental acceptability indicators of the “A.O.” impact on the natural processes of self-regulation in “N.E.” without causing negative degradation trends in the influence zones.

Based on a systematic analysis of the “A.O.” functioning as the main technogenic component in the composition of the N.T.E. – A.O. - P. ”, which encloses itself within the spatial limits of the basin geosystem a certain catchment area of the hydrographic river network, where a water flow (surface, underground) is formed, located in the IIR with a relief, climate, hydrological and hydrogeological conditions, soil cover, diversity of plant and animal worlds, ichthyofauna (fish species, etc.) and flora in river water, and types of economic and other activities, it was found that ES in the zones of influence of “A.O.” can be expressed as a series of conceptual statements:

1. ES in the zones of “A.O.” influence is inextricably interconnected with the life processes of N.E. and “P.”;
2. ES in the life processes of “P.”, the animal and plant worlds under the “A.O.” influence in the zones of its influence in the energy-entropic understanding is expressed by the energy forms’ transformations;
3. The danger of a decrease in the ES level starts being obvious as a result of the uncontrolled exit of energy and substance flows from the current “A.O.” into the environment, for example, the destruction of the reservoir pressure head;
4. In a causal relationship, the ES violation initiator in the system “P.O. – S.E.H. – P.M.” is “A.O.”.

Summary
1. Using a systematic approach to the description of the processes of interaction between the central “A.O.” technogenic component as a part of NTE “N.E. – A.O. - P.” developed a model of the system “P.O. – S.E.H. – P.M.” to assess the ES level in the zones of “A.O.” influence.

2. To increase the ES level “A.O” the concept of EA “A.O.” is formulated as a part of NTE “N.E. – A.O. - P.”, where ES is considered as a trend towards the creation of nature-like technologies for the water resources and constructive solutions’ use “A.O.”.

3. Based on the results of a systematic analysis of the functioning of “A.O.” as part of NTE “N.E. – A.O. - P.” formulated a number of conceptual statements on the ES assessment in the zones of influence of “A.O.”.

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