SAFETY OF RESERVOIRED HYDRAULIC UNITS OF GEORGIA

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Breakthrough wave or flood developed in the tail water from water-retaining construction sites (dams, dykes, locks, etc.) take one of the most important places with their negative outcome in the list of anthropogenic disaster. Naturally the society is interested in the provision of safety to the system - "water-retaining construction of the reservoir" which requires complex conduct of legal, administration and engineering and technical measures. Engineering and technical aspects of the safety of the dams of hydraulic units of Georgia are reviewed in the paper. Classification of water-retaining constructions and reservoirs by sizes and potential of possible dangers is elaborated. Grading of main reservoired hydraulic units of Georgia according to this feature is run. Classification considering the quantity of the population that might be subject to the effect of possible accidents at the location of Georgian hydraulic units is provided. Terms of the inspection of technical conditions of the reservoired hydraulic units of Georgia depending on the potential of containing danger are suggested.

Today there are many hydraulic structures in the world (dam, dyke, locks, canals, tunnels, etc.) safe operation of which is socially and economically and ecologically very important. Accident at such structures may cause extremely negative outcome sometimes similar to national disaster, especially when they are associated with mass mortality (for instance 2500 persons died and five populated points were destroyed in Italy, in Longarone, Piraggio, Rivalta, Villanova and Fae during the accident at Vajont dam on October 9, 1963) [1].

Breakthrough wave or flood extending in the tail water from water supply sites take important place in the list of technogeneous disasters with their negative outcome (dams, dikes, locks). First one occurs structural integrity of the water-retaining constructions is broken and large amount of water overflows through the water-retaining constructions and the second – in case of the failure to exploit catastrophic discharges by the reservoir in their compulsory outflow into the tail water or during uncontrolled outflows.

Obviously, provision of safety of the system "water-retaining construction" needs complex fulfillment of legal, administrative and engineering activities. Legal and administrative activities are worked out and are effective in many countries of the world [2], [3]. It is necessary either to adapt them to Georgian conditions or to develop the new ones. From new goals of engineering and technical activities the following should be noted: development of classification of water-retaining constructions and reservoirs by dimensions, potential of possible dangers for determining the terms of their inspection and for the development of technical security criteria in order to avoid any losses among population and losses to peoples property in the tail water in case of possible accidents.

Determination of technical safety criteria for dams depend on many factors: topographic, geological, hydrogeological, seismic conditions in their location, unit dimensions, population density in the tail water, importance of the plants and infrastructures located there, degree of the development of the latter and, what is the most important for each particular unit, on the combination of these factors. That is why, the technical safety criteria should be determined for each country individually.

It is obvious that for land-poor Georgia with 38 reservoired hydraulic units the issue of their safety is of primary importance. Grading the dams by reservoir volumes is provided in table 1 and their division in dam heights – in table 2.

Classification of the reservoired hydraulic units was made based on the characteristics provided in table 3.

The practice accepted in the world is to determine the class of the reservoired hydraulic units by danger potential, according to possible victims among population or possible material loss in case of complete or partial dam failure [4].

Table 1

Reservoir volume V, m^3	**Quantity of reservoired hydraulic units**
1	2
$V > 100X10^6$	6
$80X10^6 < V < 100X10^6$	2
$60X10^6 < V < 80X10^6$	1
$40X10^6 < V < 60X10^6$	2
$20X10^6 < V < 40X10^6$	2
$V < 20X10^6$	25

Table 2

Dam height, H, m	**Dam quantity**		
	Concrete	**From local materials**	**Rock embankment**
1	**2**	**3**	**4**
H>100	1	1	-
80 < H < 100	-	2	1
60 < H < 80	1	-	-
50 < H < 60	1	1	-
40 < H < 50	-	-	1
30 < H < 40	-	6	-
20 < H < 30	1	1	-
10 < H < 20	5	8	-
0 < H < 10	6	4	-

Table 3

Category	**Class**	**Reservoir volume, V, m^3**	**Dam height, H, m**
1	**2**	3	4
Non-departmental	**IV**	**No more than 10^6, regardless from height**	**No more than 5 m, regardless from reservoir volume**
Small	III	$10^6 < V < 5X10^6$	$5 < H < 15$
Medium	II	$5X10^6 < V < 50X10^6$	$15 < H < 50$
Large	I	$V > 50X10^6$	$H > 50$

At preliminary design stage, when it is necessary to evaluate possible loss during the accident at the unit to be designed, it would be logical to identify power capacity of water mass causing the accident. The power can be represented in form of potential water mass accumulated in the reservoir (with some reserve):

$$E = \gamma g H W, \text{ joule}$$

where γ – specific gravity of water, γ=1000 kg/m^3, g – acceleration of free fall, m/c^2, H – dam height, m, W – water volume accumulated in the reservoir, m^3.
Grading major reservoired hydraulic units of Georgia by this feature is provided in table 4. It is seen from the data given this table that the power capacity of potential accident of the reservoired hydraulic units of Georgia changes a lot. At the same time, 75% of the hydraulic units presented in the table have energetic function which underlines high responsibility for the safety provision.

Table 4

N	Name of hydraulic unit	Dam height, m	Volume of water accumulated in the reservoir, million m^3	potential energy 10^{13} joule	Function of hydraulic unit
1	2	3	4	5	6
1	Energy HHP	271,5	1100	298,65	Power engineering
2	Zhinvali complex hydraulic unit	102,0	520,0	53,0	Water supply Power engineering
3	Sioni HHP	86,0	325,0	27,95	Irrigation Power engineering
4	Khrami HHP-1	33,0	313,0	12,21	Power engineering
5	Perepadnaya HHP-1	55,0	146,0	8,03	Power engineering
6	Hydraulic unit «Dalis Mta»	38,0	180,0	6,84	Irrigation
7	Algeti hydraulic unit	86,0	65,0	5,59	Irrigation
8	Tbilisi reservoir	15,0	308,0	4,62	Irrigation Water supply
9	Zonkari hydraulic unit	81,0	43,5	3,52	Irrigation
10	Zervula HHP	36,0	82,0	2,95	Power engineering
11	Gumati HHP-1	52,0	39,0	2,03	Power engineering
12	Lajanuri HHP	69,0	25,0	1,73	Power engineering

The power capacity of the water mass accumulated in the reservoir first of all should be considered with regard to the quantity of population in the tail water of the hydraulic unit.

Classification considering the quantity of the population subjected to the effect of possible accident at the locations of the hydraulic units of Georgia is given in table 5. Limiting values of the amount of individuals provided in the table are taken in compliance with their total population.

Table 5

Class of hydraulic unit	Quantity of population in the tail water, m, individuals
I	$M > 100000$
II	$20000 < M < 100000$
III	$1000 < M < 20000$
IV	$M < 1000$

Class assignment for particular unit should be done according to the preliminary identification of the space of flooded area and the quantity of individuals subject to danger in case of possible accident at this unit.

In order to control the maintenance of technical criteria within the admitted limits, the frequency of periodic inspection of the units carrying potential danger is given in table 6.

Table 6

Danger potential	Inspection frequency
Low	Seven years
Considerable	Five years
High	Three years

R E F E R E N C E S

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