



INTERNATIONAL SCIENTIFIC CONFERENCE

CIBv 2010

12 – 13 November 2010, Braşov

THE SAFETY OF THE DAMS IN BRASOV COUNTY

Nicolae DASCALESCU*, Dumitru BOBOCU**

* University Transilvania of Braşov, Faculty of Building Engineering, Installations Department

** Olt Basin Administration, Operation Department-U.C.C. and Dam Safety

.....
Corresponding author: Nicolae DASCALESCU, E-mail: nicolae_dascalescu@unitbv.ro

Abstract: The right of performance and safely operation of dams is enacted in Romania according to the stipulations of the Law 466/2001.

Currently, in Brasov County there are 27 dams in operation. They are classified into several importance categories based on the risk index by the use of a system of criteria, indices and annotations.

On the basis of the risk index, in Brasov County there is one dam of an exceptional importance (Sacele), three of a significant importance (Dopca, Vistea and Voila) and twenty-three of a normal or reduced importance. All these dams are carefully monitored and do not present special situations about the safety in operation.

Key words: dams, dams safety, risk index..

1. THE ROMANIAN LEGISLATION IN THE FIELD OF DAMS

The right of performance and safely operation of dams, as well as the corresponding obligations resulting from the normative laws referring to the environment protection are enacted according to the stipulations of the Law 466/2001, as well as to the stipulations of the international conventions Romania is part of [1].

Dam safety law was elaborated for the first time in Romania and it is the result of the collaboration between the Romanian National Committee on Large Dams (ROCOLD/CROMB) and the National Committee for Dam Safety and Hydraulic Works (CONSIB) [2].

The observance of the demands concerning the safety of dams is compulsory for all the stages in their performance (projecting, accomplishment) and operation (during accomplishment time, current operation, after-use period or decommissioning).

In the sense of the above mentioned law, by dam is meant any hydraulic work having an existent or proposed structure which is capable of ensuring the accumulation, permanent or non-permanent, of water, underwater deposited liquid or solid industrial refuse whose breaking could

cause the uncontrolled leaking of the accumulated content with negative effects especially on the social, economic and/ or natural environment. [1].

The observance of the demands regarding dam safety is equally compulsory for their appurtenant works and installations (power stations and locks in retention front, embankment diversion, lake outline dikes, etc.).

Dams are classified into several importance categories based on the risk index by the use of a system of criteria, indices and annotations according to the technology of framing into importance categories NTLH-021.

Depending on the value of the dam associated risk index, it can fall into one of the following importance categories: A (exceptional important dam); B (significant important dam); C (normal dam) and D (reduced importance dam).

The framing of dams into importance categories represents a legal obligation of dam owners and administrators with a view to establishing the type of surveillance in time and of the attributions of their checking and control, as well as to establishing the obligations of the dam owners.

On establishing the importance category of a dam, the following are taken into consideration: its technical characteristic; the way it was projected, accomplished and operated; the size of potential damage or damages that an accident of a particular dam can cause and the social-economic impact in case of dam break.

For the already operating dams or for provisional operating dams, the dam owner is obliged to obtain a license for safe operating issued by the Ministry of Environment and Forestry based on a documentation referring to the safety state approved by an expert certified by the Ministry. At the recommendation of the National Committee for Dam Safety and Hydraulic Works (CONSIB), for the works from the categories of importance C and D, the license for safe operating can be issued, on the basis of the documentation previously mentioned, by the territorial units belonging to the Ministry of Environment and Forestry.

The license for safe operating certifies the meeting of the performance exigencies during operation time and it is compulsory for getting the license for water management and environment protection [1].

The dam owners are forced to supervise the dams based on some specialized projects: special surveillance project for the dams in the importance categories A, B, respectively, instructions of current surveillance for the dams in the importance categories C, D.

2. TECHNICAL CHARACTERISTICS OF THE DAMS IN BRASOV COUNTY

Currently, in Brasov County there are 27 dams in operation, with heights between 2,0 m and 45 m, which create water accumulations with volumes that vary between 30 thousands m³ and 15 millions m³. Equally, Hoghiz (Fagaras) dam is under construction on the Olt River and Ruia dam in Poiana Brasov.

If we refer to the total number of existent dams in Romania, of 2617 which resulted after the census done by the Ministry of Environment in 2007 [3], Brasov County is one of the counties with the lowest number of dams in the country.

According to the definition provided by the International Committee of Large Dams (ICOLD/CIGB) the condition for a dam to be considered large is that its height is higher than 15 m. They are equally considered large dams the ones whose height ranges between 5 and 15 m, on condition that their accumulations have volumes bigger than 3 millions m³ [4]. By taking into consideration these criteria, there are 7 large dams in Brasov County. From among these, 4 dams (Dopca, Sacele, Vistea and Voila) appear in the World Register of Dams [4].

Sacele dam is the only dam of exceptional importance in the county of Brasov, as it is the highest dam in the county with an initial height of 45 m.

The water accumulation created by the Sacele dam, having a useful initial volume of 15 millions m^3 , was created for supplying industrial and drinking water to the city of Brasov, for flood mitigation and electricity production in two micro power stations (Tarlung I and II).

Sacele dam, having a length of 709 m and a upper edge width of 7,5 m, made of earth with a clay core, is placed on the Tarlung river, upstream Sacele. It was projected with a view to its ulterior heightening by earth layers on the downstream gradient. After the heightening of the dam, made while operating it, the height of the dam will reach 50 m and the length at the upper edge will be of 766 and the useful volume of the lake will reach 25 millions m^3 [5].

The sealing of the dam's foundation was done by a concrete cut off wall by using different technologies (Bioge, Else) and the sealing of the foundation rock was made by cement grouting through drilling (two or three rows with a maximum depth of 40 m in the area of the river bed, 5 m in the area of the terrace, respectively) [6].

The spillway is designed to have four bays equipped with drum gates (2 pieces $B \times H = 10,35 \times 1,5$ m, 2 pieces $B \times H = 10,50 \times 1,5$ m) and opening/ closing mechanisms.

Sacele dam is designed with a bottom outlet made in a concrete-cast gallery, placed on the right mountainside.

The water intake for the uses the accumulation was made for is of a tower-type with a height of 46 m, and it was made of reinforced concrete. It has a hexagonal section with an exterior side of 8 m.



Fig.1. Water intake from the Sacele accumulation

The dam is planned to have instrumentation in order to monitoring the possible movements of the right mountainside, the dam deformations and the piezo-metric level in the body of the dam.

All the dams in Brasov County are situated on water streams within the hydrographic basin of the Olt River and were build between 1960 – 1997, about 70% being older than 25 years. The purposes for which these dams were built were: production of electricity, water supply, protection against flooding, fishing and recreation as well as industrial purposes.

Of the total of 27 dams from Brasov County, two are built with hydropower purposes, namely Voila and Vistea. They have 21 m height and three bays equipped with flap radial gates.

The power stations, belonging to the dams, have each an installed power of 14,20 MW [7].

The storage reservoirs created by the dam and the outline dike have a total length of 12 km at the Voila accumulation, respectively 6,7 km at the Vistea accumulation and they are made of earth and sealed by concrete slope protection. The created accumulations have relatively important water volumes: 4,85 millions m^3 - Voila accumulation, respectively 12,25 millions m^3 - Vistea accumulation.



Fig. 2 Voila dam

The dams Voila and Vistea fall into the category of importance B - significant. They were designed to have instrumentation necessary for the surveillance of the dams, mainly for the monitoring of the uplift, the evolution of the hydro-dynamic levels, the deformation of the founding rock and absolute movements (geodetic) or relative (inverted pendulum).

As far as the types of dams are concerned, in Brasov County there are nineteen dams of earth sealed or not with clay or concrete slope protection and two dams of concrete. For the rest of six, the water streams were blocked by gates.



Fig. 3. Weir and gates Turcu

3. THE EVALUATION OF THE DAMS' SAFETY IN BRASOV COUNTY

As it was mentioned before, the dams fall into one of the four categories of importance concerning their safety on the basis of the risk index associated to them (RB). Thus, if $RB > 0,5$, the dam is an exceptional important dam, if $0,5 \geq RB > 0,25$, the dam is a significant important dam, if $0,25 \geq RB > 0,1$, the dam is a normal dam and if RB is lower or equal to 0,1, the dam is of a reduced importance [8].

The value of this index varies in direct proportion to the sum of points awarded to the following criteria which express the consequences of the dam's damage; the density of the population

downstream the dam, the inexistence of the alert system, the purpose of the storage reservoir, the number and importance of the economic objectives downstream the dam, the use of the downstream land, the effects on the environment in case of dam damaging, the position of the dam within the basin's arrangement.

It is thus understood that a dam where upstream there is a locality with a population higher than 20.000 inhabitants, important economic objectives, and productive lands and whose accumulation represents the only water source for the population and which as a consequence of a possible damage would cause an ecologic disaster, will fall into the categories A or B, even if the dam is in a good state, has a small height and creates a water accumulation with a small volume.

Simultaneously, the degree of the risk index depends in a reverse proportion on the sum of the points awarded to the criteria which express the characteristics of the dam and of its location (height of dam, dam and spillway type, type of founding land, earthquake zone and the class of importance according to STAS 4273-83 [9]) and the criteria which characterize the state of the dam (the existence of a surveillance system, the functioning of the mechanic equipment, the maintenance of the dam, its age, the infiltrations, the deformations, the silting of the accumulation, the state of the energy dissipator and the existence of an up-to-date earthquake calculus).

Taking into account the already mentioned criteria, on the basis of the risk index, in Brasov county there is one dam of an exceptional importance (Sacele), three of a significant importance (Dopca, Vistea and Voila) and twenty-three of a normal or reduced importance.

The owners of hydraulic works have the obligation to evaluate periodically their safety state irrespective of their size or use.

The evaluation of the safety state in operation of dams and accumulation lakes, and of the appurtenant constructions and installations is a technical examination, having a special character, which is done according to the methodology NTLH-022 [10].

The evaluation of the safety state consists of two parts. The first stage represents the analysis of the technical state of the hydraulic work and of the operation conditions, evaluated after a technical inspection and on the basis of the data held by the administrator of the work referring to the natural location conditions, the design, execution, functioning, operation and behavior in time of the hydraulic construction. Similarly, in the first stage of evaluation of the safety state, the program of further investigations necessary for the ending of the final evaluation is established.

In the second stage of the evaluation of the safety state which is based on the result of the further investigations proposed in the first stage, there is the establishment for the works proposals and necessary steps for bringing the building and functional parameters of the dam to the degree of safety in exploitation corresponding to the demands and regulations in force as well as the next operation conditions.

The evaluation of the safety state in operation of the dams in Brasov County highlighted a series of works and actions which need to be done, from case to case, for increasing their degree of safety in operation, from which we mention:

- The filling in of "The technical book of the construction" with topographic plans of the dam's location and of the lake's basin as well as with transversal and longitudinal profiles of the dam;
- Finishing off the dam's endowed instrumentation with water level indicators, thermometers, rain gauge, topographic markers;
- Systematic surveillance of the maintenance and repair works for the dams of category C and D, where they were done only on an irregular basis in the past;
- The increase of the dam's evacuation capacity by accomplishment supplementary spillways when it was noticed that the hydraulic regime changed in time or the existent ones were under-dimensioned;
- The execution of some repair works to the dam and the appurtenant buildings;
- The certification of the operational personnel about the surveillance activity of the dam and appurtenant buildings;

- Organizing thematic inspection for checking the achievement rate of the steps proposed by experts and advised by safety committees as well as the field evaluation of the technical state.

On the basis of the evaluation reports for dams safety done by licensed experts, the territorial committees for advising the evaluation documentations of the safety state in operation of the dams, appointed by the Ministry of Environment and Forestry, establish if the operation of the work can continue to the parameters from the project or with restrictions of operation or conditioned by setting up a rehabilitation and/ or remedy of work programs. Depending on the conclusions of the committees, the license for safe functioning is awarded for a longer or shorter period, when the dams' safety will be again evaluated.

Currently, in Brasov county, two dams are under construction: Fagaras (Hoghiz) and Ruia, and the Sacele dam is operated with level accumulation restrictions due to the works which are done in the gallery of the bottom outlet. Similarly, at the Dopca accumulation, whose main purpose is the water supplying of the Rupea-Homorod area, the technical documentation is made up, and in the following year the beginning of the rehabilitation works is intended. They mainly consist of: the sealing of the sloping upstream face with polyethylene sheet of high density, the drainage of the downstream toe of dam, the rehabilitation of the hydraulic equipment [11].

At the Fantanita Craiești recreation lakes, there are currently rehabilitation works which consist of the division of the main reservoir, heightening of the contour dikes, the rehabilitation of the water-catching system and of the water distribution.

The situation of the license from the point of view of safety in operation is the following: for 15 dams functioning licenses were awarded for periods longer or equal to five years, for 6 dams the already mentioned licenses were awarded for periods shorter than five years, and a number of five dams are under evaluation. For the Dopca dam development for the rehabilitation project was issued referring to the observance of the performance exigencies concerning the dam safety.

From here it could be concluded that the dams in Brasov County are carefully monitored and do not present special situations about the safety in operation.

REFERENCES

1. ***, *Legea nr. 466/2001 privind siguranta barajelor*
2. STEMATIU, D., IONESCU St., MARINESCU, P., *Progress in Romanian dam safety legislation based on risk management*, Proceedings of ICOLD European Symposium "Dams in a European Context", pp 343-348, Geiranger, Mitdtomme et al (eds) 2001
3. ABDULAMIT, A., TANASESCU, M., *Considerații privind Registrul Național al barajelor din România – REBAR*, Revista Hidrotehnica nr. 4 – 5/2009
4. ***, *World Register of Dams*, ICOLD/CIGB Paris 1998
5. ***, *Dams in Romania*, Romanian National Committee on Large Dams, Univers Enciclopedic Publishing House, Bucuresti, 2000
6. ***, *Fisa tehnica a barajului Sacele*, Administratia Bazinala de Apa Olt
7. COJOCAR, M., *Hidroconstructia, vol.1 Constructii hidroenergetice*, Bucuresti 2008
8. ***, *NTLH-021, Metodologie privind stabilirea categoriilor de importanta a barajelor (Ordinul MAPM nr. 115/2002 si MLPTL nr. 288/2002)*
9. ***, *STAS 4273-83, Constructii hidrotehnice – Incadrarea in clase de importanta*
10. ***, *NTLH-022, Metodologie privind evaluarea starii de siguranta in exploatare a barajelor si lacurilor de acumulare (Ordinul MAPM nr. 116/2002 si MLPTL nr. 289/2002)*
11. ***, *Fisa tehnica a barajului Dopca*, Administratia Bazinala de Apa Olt

Received October 20, 2010