



Large Dams and New Rules on Seismic Hazard for dams in Albania

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Abstract. Albania have almost 650 dams, among them 350 are recognized as “large dams”. In Albania quite all the dams at the time when they were designed, the pseudo-static method of analysis with a seismic coefficient of 0.1, was used, which is considered as absolute today. We do not have experienced emergencies related to the loss of lives in their downstream section. However, according to the today’s concepts, large dams should be able to resist the effects of the strongest ground shaking to be expected at the dam site, and in this regard, we are conscious of the importance of the modern design and safety concepts promoted by ICOLD. Taken into account the recommendations of ICOLD, and the new probabilistic maps describing the seismic hazard in Albania in terms of PGA and spectral parameters as intensity measures are taken into account for the new dams design and the maintenance of old ones, both for energy, irrigation, water supply and other purposes. Following the new developments in dam design practice, ALBCOLD has approved the decision Nr. 15, date 15/02/2021 “Dam classification depending on the consequences on the downstream area as result of seismic action”. This classification divides dams in three categories: (i) Small risk dams, (ii) Moderate risk dams and (iii) High potential risk dams. Taken into account this classification, the above-mentioned decision of ALBCOLD establishes some “Important Factors” do be applied for the repair of large dams. In this article, the Authors will present new Rules in the Decisions of ALBCOLD on seismic Hazard for large dams in Albania.

Keyword: Large dam, Seismic Intensity, PGA, Potential risk dam, Seismic hazard, Downstream area, IGEO, DCM, ALBCOLD.

1 INTRODUCTION

1.1 Information on large dams and design Codes for the seismic effects in Albania

In Albania have almost 650 dams, among them 350 are recognized as “large dams”. Almost all the types of large dams in Albania are “embankment dams”. Only 4 large dams are concrete dams. Most of dams have the height till 30 m (558 dams) and some of them have the height between 30-60m (77 large dams). The height of 10 large dams is more than 60 m; Considering their use, dams in Albania can be classified different purposes: (i) irrigation, (ii) hydro energy and solar energy production, (iii) water supply, (iv) transport and tourism and (v) fishing and urban attractions. Most of them have been built for multipurpose.

As in other countries world-wide, in Albania quite all the dams at the time when they were designed, the pseudo-static method of analysis with a seismic coefficient of 0.1, was used, which is considered as absolute today. In Albania up to now we do not have experienced emergencies related to the loss of lives in their downstream section. However, according to the today’s concepts, large dams should be able to resist the effects of the strongest ground shaking to be expected at the dam site, and in this regard, we are conscious of the importance of the modern design and safety concepts promoted by ICOLD during the years.

The old design code which accounts for the seismic effects on the HPP structures in Albania is the KTP-N.2-89.

In the Table 1 the importance factors taken into account in regard to the seismic action for the hydro power plants as a whole area presented.

Table 1. Importance factors of the HPP according KTP-N.2-89 design code

Hydro Power Plants	
Class of the hydropower structure	Importance Factor k_r
I	1.5
II	1.25
III	1.0
IV	0.75
V	Seismic hazard not taken into account

As it can be seen from that table, large dams are not specifically mentioned and it is not clear what are the criteria for the classification of the structures in different classes. According KTP-N.2-89, the classification of table 1 above is valid for all the structures under pressure of classes II, III and IV, while for class I structures, included large dams, special micro zonation studies have to be carried out for the assessment of seismic hazard that threatens the dam location.

2 NEW RULES ON SEISMIC HAZARD FOR LARGE DAMS IN ALBANIA

2.1 New Classifications of large dams referred risks and consequences on downstream areas

Taken into account the recommendations of ICOLD and the new probabilistic maps describing the seismic hazard in Albania based not on the “Seismic Intensity” as intensity measure, but on the PGA and spectral parameters, there is prepared the Decision of Council of Ministers (DCM) No. 1162, date 24/12/2020 “For the determination of procedures and terms to obtain the risk attestation for the subjects which request the construction permission”.

Also, ALBCOLD is planning to undertake the preparation of the National Standards and Guidelines for the Dam design and monitoring where the methodology for the assessment of seismic hazard at the large dams location will be described in detail.

Following the new developments in dam design practice, one of the ALBCOLD decisions was Decision No. 15, date 15/02/2021 “Dam classification depending on the consequences on the downstream area as result of seismic action”.

This classification in principle follows the ICOLD classification and divides dams in three categories:

- (i) **Small risk dams** (in case of break no casualties are observed and damages are small, usually circumscribed on the dam’s owner property).
- (ii) **Moderate risk dams** (in case of break no casualties are observed, but cause economical losses, environmental damage and interruption of infrastructure systems)
- (iii) **High potential risk dams** (in case of break cause even one loss of live).

This classification is listed in ascending order of consequence. The hazard classification for a dam can change over time. Factors that can bring changes are:

- new urban developments in the downstream,
- the increase of the water level in reservoir
- the danger to the plant or animal world,
- The revisions in the various reports of meteorological services.

Based on the above, continuous revision and updating of this classification is needed, in accordance with the frequency of the relevant studies.

2.2. Technical Requirements for the risk of seismic actions

ALBCOLD has decided that for the repair of the existing large dams used for irrigation purposes, the Decision of Council of Ministers (DCM) No. 1162, date 24/12/2020 "For the determination of procedures and terms to obtain the risk attestation for the subjects which request the construction permission" to be applied. This includes the use of PGA as seismic hazard parameter according to the maps prepared by the Institute of Geosciences (IGEO) with 475 years of return period (map below).

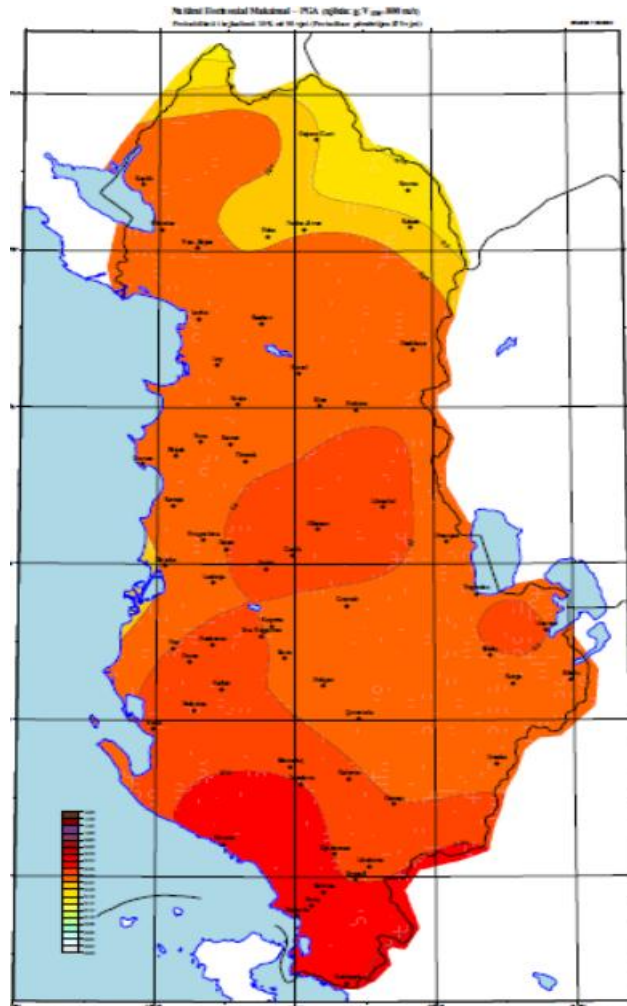


Fig.1 - Map of Peak Ground Acceleration (PGA) for return period of 475 years (source: IGEO)

For this purpose:

- For the existing large dams that are used for irrigation and present a "small risk" according to the above classification, the Safety Coefficient $K_s=1.0$ should be applied.
- For existing large dams that are used for irrigation and present a "moderate risk" according to the above classification, the Safety Coefficient $K_s=1.2$ should be applied.
- For the existing large dams that are used for irrigation and present "high potential risk" according to the above classification, The Safety Coefficient $K_s=1.4$ should be applied.

For the repair of large dams, **that are** part of the energy infrastructure of Albania and their auxiliary structures, the requirements of DCM No. 1162, dated 24.12.2020, Appendix 2, "Advanced requests in implementation of Albanian design standards and the most advanced international standards for seismic risk assessment", as well as the specifications of the above requirements for dams with "high potential risk" ($K_s=1.4$) have to be applied.

In recent years design of high dams for electricity production is reduced in our country, Actually, in the 30 last years, only a few number of high dams have been constructed in our country, and up to now, the appliance of ICOLD standards, based on the Bulletins No.72, 2010 (Revision) and Bulletin No.148, 2016 “Selecting Seismic Parameters for Large Dams, Guidelines” have been recommended and accepted for the design of this kind of structures.

The requirements specified for the design of Large Dams are also applied to structures appurtenant to dams and hydro mechanical and electromechanical components of Hydrotechnical works.

3 RESULTS

Albania is a country with a high level of seismic risks and the results of the recent seismic hazard analysis confirm this evaluation. The actual in force standards for the design of large dams and HPP do not address dams specifically and are based on hazard maps prepared on the early 70s. Accordingly, large dams designed and build in that period are based on those hazard analysis. Taken in account this situation, and in view of the last event in Durres area with with magnitude M 6.4, surrounded by a number of irrigation facilities, fortunately with no consequences, ALBCOLD is trying to upgrade the design standards, not only of dams for energy production, but for all ones, used for various purposes. To this regard, following the efforts to prepare new standards, ALBCOLD has approved some specific requirements in the Decision No. 15, date 15/02/2021 ”Dam classification depending on the consequences on the downstream area as result of seismic action”. Actually, several international workshops and contacts with similar organizations in Europe have been undertaken. The last one was the International Symposium in cooperation with French Committee of Dams and Reservoirs (CFBR) in Tirane with the title “Challenges and Innovations for Better dams”

4 CONCLUSIONS

It is very important and emergency to prepare the new technical standards for the monitoring of large dams and State technical standards for the Seismic -resistant dams that should be used in the design of new dams as well as in the monitoring, safety and rehabilitation projects of existing large dams . ALBCOLD support this process with experts in the field and through cooperation with research institutions with experience in the field of preparation of technical standards.

ALBCOLD has approved the decision Nr. 15, date 15/02/2021 ”Dam classification depending on the consequences on the downstream area as result of seismic action”.

This classification in principe follows the ICOLD classification and divides dams in three categories: (i) Small risk dams, (ii) Moderate risk dams and (iii) High potential risk dams.

Taken into account this classification, the above-mentioned decision of ALBCOLD establishes some “Important Factors” do be applied for the repair of large dams used for irrigation, water supply and hydro energy production which should be applied together with the appliance of the Government Decision No. 1162, date 24/12/2020. These importance parameters have to be applied on the 475 years return period of PGA parameter on rock condition.

5 REFERENCES

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