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MONITORING THE EXPLOITATION BEHAVIOR OF THE ”VALEA DE PEȘTI” DAM

Romeo Hriscan [1] Sorin Corici[1] Gabriel Codruț Leucuța[2] Teodor Eugen Man [2]

Abstract: This paper describes the observations in monitoring the exploitation behavior of "Valea de Pești" Dam, a gravitational dam, situated on the rock-fill of "Valea de Pești" river, about 500 m upstream of the confluence with Western Jiu river. The dam was traced with a plan curve radius of 2000 m. The construction of the dam was started in 1967 and was completed in 1973 when the dam was put into operation. The "Valea de Pești" Dam serves all the settlements along Western Jiu. Development of serviced land use imposed supplementation in 1985 by commissioning the capture of the Western Jiu Buta (Q = 1 m3 / s0 and adduction D = 1000 L = 6.7 km) to the outlet conduits in "Valea de Pești" Lake.

Keywords: Valea de Pești" Dam, explotation and monitoring

1. INTRODUCTION

"Valea de Pești" Dam ranks 35th in order of height out of a total of 246 dams nationwide - Romanian Register of Large Dams. It has a height of 56 m, length of 2 km and achieves an accumulation of a volume of 4.5 million m^3 of water. In 1997, a bathymetry was made, resulting in a reduction in volume from 4.20 mil. m^3 to 3.73 mil. m^3. In accordance with STAS 4273/83, the dam is classified as Class II of important structures (it has a high importance) and it was calculated for maximum flows with probability of occurrence of 1%. According to NTLH - 021, the owner calculated for the dam, an associated risk index equal to 0.46, according to which the dam is framed in the importance category B (special importance), which requires a special behavior tracking. "Valea de Pești" Dam is managed by National Autonomous Administration “Romanian Waters" - Jiu Basin Water Administration - The Independent Hydrotechnic System of Petrosani.

2. CONSTRUCTION SPECIFICATIONS

"Valea de Pești" Arrangement is made up of:

1. *The frontal dam* - upstream rock-fill covered in an asphaltic concrete mask in upstream.
2. *The bottom drain* - with input at 783.50 mdMB.
3. *The overflow drain* - is a front spillway with a curved threshold.
4. *The water intake* - with input at 792.50 mdMB.
5. *The transportation pipeline* - from the intake tower to valves house, located downstream.

The upstream face has a slope of 1:1.7 and the downstream face has a slope of 1:1.3, with three berms with a width of 1.50 m at 813.00 mdMB, 796.00 mdMB and 782.00 mdMB altitude.

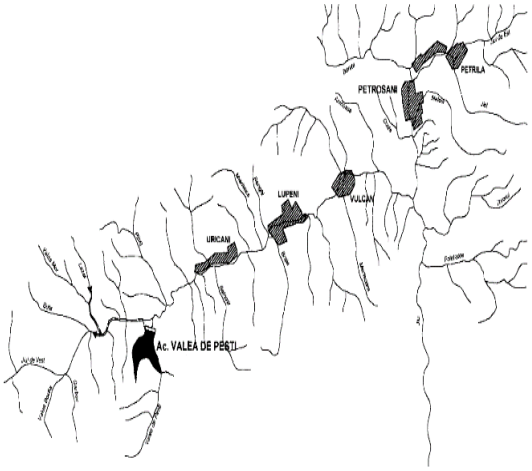

Figure 1. Plan view. Location of "Valea de Pești" Valley

[1]Romanian Waters Authority, Water Basin Administration Jiu Petrosani
[2]Politehnica University of Timişoara, Department of Hydrotechnical Engineering, George Enescu Street, no.1A, Zip code 300022, Timişoara, Romania

Photo 1. Upstream view - "Valea de Peşti" Dam

Photo 2. Downstream view - "Valea de Peşti" Dam

Characteristics:

- dam height:	56.00 m
- crest length	237.50 m
- crest width	6.35 m
- crest height	830.00 mdMB
- normal retention level, NRL	826.50 mdMB
- empty bottom height	783.50 mdMB
- thalweg height	776.00 mdMB
- dam foundation altitude	774.00 mdMB
- upstream face slope	1:1.7
- downstream face slope	1:1.3
- mask surface	15,000 m^2
- crest height	830.00 mdMB
- 1% maximum flood level (check)	829.12 mdMB
- minimum operating level	794.00 mdMB
- gross volume	4.50 hm^3
- useful volume	3.70 hm^3
- dead volume	0.10 hm^3
- protection volume	0.80 hm^3
- lake length	2.00 km

With a pool of 32 km^2 (Fig. 1) and a length of 11km, Western Jiu River (cadastral code VII-1.5) is the most important affluent of Western Jiu. The average altitude of the basin is 1349 mdMB .

In terms of seismicity, "Valea de Peşti" Dam is located approx. 320 km away of Vrancea epicentral area, the most important seismic zone of Romania and about 90 km from the Fagaras-Campulung, which takes the second place in seismic activity in Romania.

The dam was executed with limestone rock-fills that came from Pribeagu and Paroasa quarries.

3. BEHAVIOR MONITORING

3.1. SURVEILLANCE SYSTEMS OBJECTIVES

The type of dam, the sealing system (with asphaltic mask) and the characteristics of the bedrock, have made the number of phenomena tracking and the performance monitoring devices to be relatively low (Table 1). However, the tracking system designed and put in work can be framed, under the current legislation, in the "special prosecution" category.

Table. 1. Existing measuring instruments for monitoring the behavior of "Valea de Peşti" dam

Phenomenon watched	**Devices used**
1. External loads	
a. The level of the lake (mdMB)	- mira
b. Air temperature (°C)	- thermometer
c. Precipitation (mm / day)	- rain gauge
2. Flow draining or infiltration (l/s)	- collection points of total flow
3. Absolute displacement (mm)	- geodetic equipment

Phenomena, considered necessary to be tracked, are:

a) *Exterior Load:* initially low, only at water levels in reservoirs, then filled with air temperature and precipitation.

b) *Infiltrated and drained flows*: generally tracked as total debts collected by the existing four drains.

c) *Deformations and displacements of the dam-foundation assembly*: monitored through topographic measurements.

Visual observations have a special role, through which the following are monitored:

- Water circulation through the dam, foundation, slopes (occurrence of soaks, drip, changes in already evident infiltrations)
- The behavior of the asphalt mask (state of fissures, deformations)
- The state of the concrete elements
- The state of the filler material
- The operating mode of the hydro mechanical equipment
- The state the adjoining slopes
- Changes occured after exceptional (floods, earthquakes) or regular events (freeze-thaw), transit flows through dischargers, floaters, occurrence of an ice sheet, etc.
- Changes in the downstream area of the dam.

3.2. MEASURING SYSTEMS AND DEVICES FOR EXTERNAL LOADS

"Valea de Pești" there is a hydrometric station on the lake end and posts on the Western Jiu upstream and downstream of the confluence with Valea de Pești.

Photo. 3. Mira "Valea de Pești" Dam

Buta water capture provides important information on the adjacent water basins. "Valea de Pești" Dam has for the external load measurement:
- mira (Photo 2) - for measuring the level of the lake
- thermometer - for measuring air temperature
- rain gauge - for measuring precipitations
- Evaporation raft /cork on the surface of the lake

3.3. MEASURING SYSTEMS AND DEVICES FOR TRACKING DAMMING WORK AND THEIR FOUNDATION

For assessing and monitoring the dam, the measuring devices from Tabel.1 are installed.
The table shows that the monitored parameters are: the debits of the four drains or infiltrates (e. g . in the well from the house of the valves) and absolute displacements determined topographically.
Evaluation is done using a geodetic network comprising: pilasters, orientation landmarks, fundamental level landmarks, space study landmarks, level study landmarks, level transport landmarks.
Surveying series of measurements have been taken, usually, once a year, in 2015 reaching series no. 42-2015.
Regarding the drained discharge, it is important to mention that the projected drain system, volumetric flow was recommended (with beakers) for the drains located at 782 mdMB, 796 mdMB and 813 mdM, for the bottom drain (776 mdMB), and for the measurement of the volume stored in C2 manhole / tank, during pumps interruption.
The tracking system includes other measurements and observations that relate to the operation of the unloader (hours of operation, flow). These elements are a part of the exploitation records and are important in tracking the behavior of the hydro mechanical equipment.
Direct observations are made on:

a) the adjacent slopes:
- general stability (cracks in rock, collapses, occurrence of bumps, slips)
- occurrence and disappearance of springs (location, intensity, water quality - trains or not solid material)

b) the reservoir lake:
- floaters emergence (location, nature, estimating the quantity)
- silt occurrence (from the lake bottom, on tributaries)
- erosion of banks, according to level variation regimes
- occurrence of ice, ice sheets, thickness, duration
- occurrence and duration of floods, their effects

c) the dam body:
- occurrence of springs on the downstream slope (location, intensity, water quality - trains or not solid material)
- visible deformations (bumps, crashes, cracks, splits)

d) the sealing mask:
- occurrence of cracks (location, size, evolution dimensions)
- possible link between the evolution of seepage flow through the drainage system and the development of cracks or springs.

e) the concrete constructions (galleries, wells, trucks, etc.):
- concrete degradations (cracks, peelings etc.)
- occurrence of cracks (location, size, evolution, dimensions)
- occurrence of leaks at the joints on concrete, through cracks in the concrete (location, debits evolution, quality - trains or not solid material)
- occurrence of deformations (bumps, joints that tend to overlap, uncovering of the reinforcement etc.)
- calcite deposits or of other kind

f) the riverbed downstream of the dam:
- change in morphology (configuration, longitudinal profile, transverse profile)
- erosion after the spill, collapses of banks etc.

g) hydromechanical equipment:
- existence of exploitation instructions and of the operating rules (annual inspection; it updates with changes in equipment)

- personnel training status (a check will be performed annually by the management department of exploitation)
- general state of the equipment
- state of corrosion protection
- state of seals
- state of drive installations
- state of signaling installations
- state of the installations for heating the equipment
- the program of maneuvers and operations stipulated in regulation and the observed record

h) equipment and devices for measurement and control:

- when measurements are taken, the equipment will be verified, their corrosion protection, this protection covers
- the state of the leveling landmarks, the fundamental ones, is mandatory to be checked, after the passing of the cold season and before the annual tranche measurements.

No major changes were done to the behavior in exploitation monitoring system. The changes that were made consisted only in a better tracking of flow / discharge of infiltration / drain.

4. CONCLUSION

From the data analysis and from the observations that characterize the exploitation of the ”Valea de Pești” arrangement, it is considered that the ”Valea de Pești” accumulation had a normal behavior in operation and can still safely function without any restrictions, following the procedures laid down in the Exploitation Regulation and the functioning authorization.

It is noteworthy that in 1999 it recorded the biggest flood, of the operating time until now; the flow was 38 m^3/s. Because the lake was at NRL the entire flood was attenuated in the spillway blade. The spillway consists of a curved threshold, with a length of 20 m, maximum flow of 200 m^3 / s.

Flow seepage

The debits collected by the drainage system varied in a narrow range, depending on the level in the lake. Visual observations have revealed no atypical or abnormal phenomena.

The existing degradations on the sealing mask, from the upstream slope, does not affect the safety of the dam.

The degradation phenomena, observed mainly due to the action of freezing and thawing, are minor and inherent in a building in operation for over 40 years.

Seepage is collected by the four drains that are actually gutters that collect water that escapes through the waterproofing of the upstream slope and from the foundation and directs it downstream, where it can be monitored. Maintaining the level in storage around NRL level, with low variations, has made its influence on the draining flow negligible. They were maintained in the normal range, influenced mainly by rainfall.

Displacements, measured geodetically, in 1973-2015, are below 90 mm. The displacement variation in time charts show that fill deformations are generally amortized.

Because of the measurement and observations made by the operating personnel in the surveillance program "Valea de Pești" Dam, we can say that it had a normal operating behavior.

REFERENCES

[1] SC AQUAPROIECT SA, Bucuresti – Study tracking behavior Valley Dam hydro-technical constructions of Pisces during 2013-2014

[2] Prof.univ.dr.ing. Dan Stematiu, - Evaluation of the safety operation of the dam and reservoir Valley of Pisces - September 2013

[3] Study geodetic time performance monitoring of the dam Valley Fish 42- Series 2015