

Dam safety monitoring of Qyrsaq dam in Vau Dejës HPP, Albania

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Introduction

Qyrsaq Dam is located in the northwest of Albania and, along with three other dams, creates the lowest HPP reservoir of the Drin River cascade. There are some specific things that make this dam more special in the cascade. The most significant difference is its dam body, consisting of 1/3 gravity concrete dam and 2/3 embankment rockfill dam with a clay core. Qyrsaq Dam is the first dam in Albania on which a photovoltaic panel is installed on its downstream slope of the embankment part of the dam.

Main parameters

Qyrsaq Dam has been operating since 1971. This dam is 54 m high and the dam body volume is about 1.8 million m³. The maximum volume of water in the reservoir is 580 million m³. There are three spillway gates, each measuring 12x12.3 m, with a discharging capacity of 3,900 m³/sec. Two bottom outlet gates, each measuring 4.0x6.5 m, have never been opened during more than 50 years of operation.

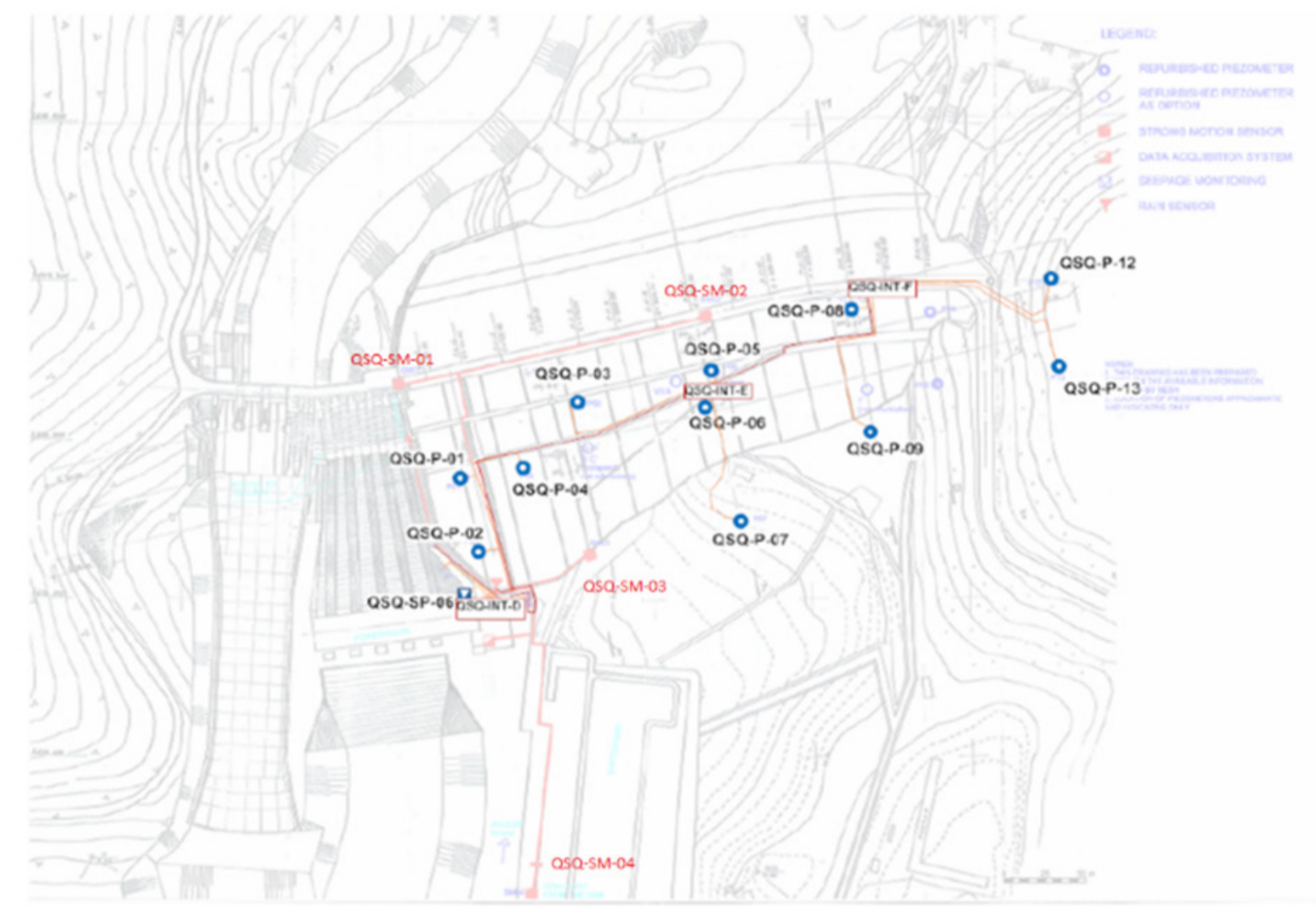


The actual number of people at risk (PAR) is about 196,218 inhabitants. Considering the number of PAR, the height of the dam, the reservoir volume, and the economic impact, Qyrsaq Dam is qualified as a 1st class dam by the Albanian Committee of Large Dams (ALBCOLD).

Monitoring systems applied

As a 1st class dam, KESH has invested in dam safety aspects of Qyrsaq dam, over the years. Visual inspections are one of the most important monitoring processes applied to this dam, as part of our internal regulations, Albanian legislation,

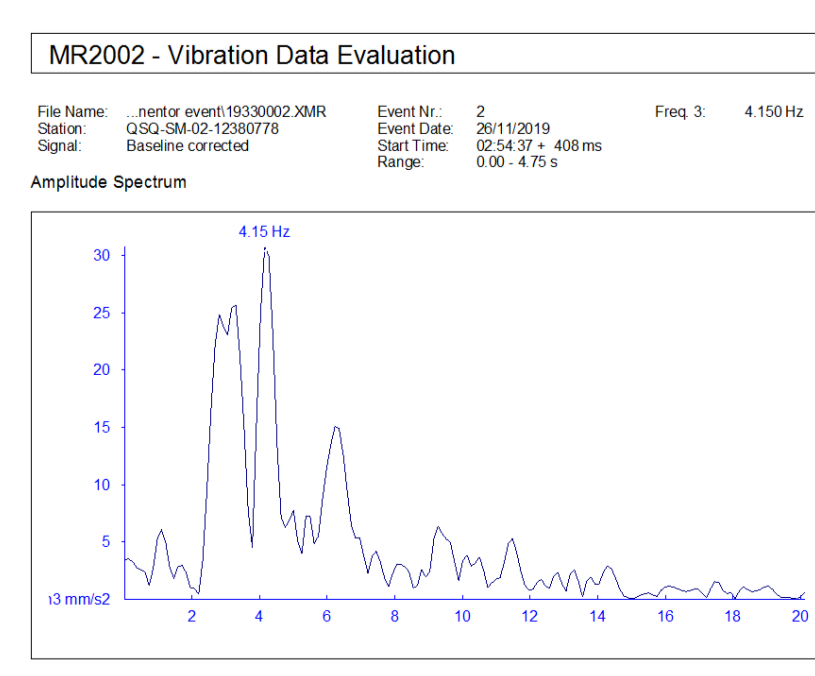
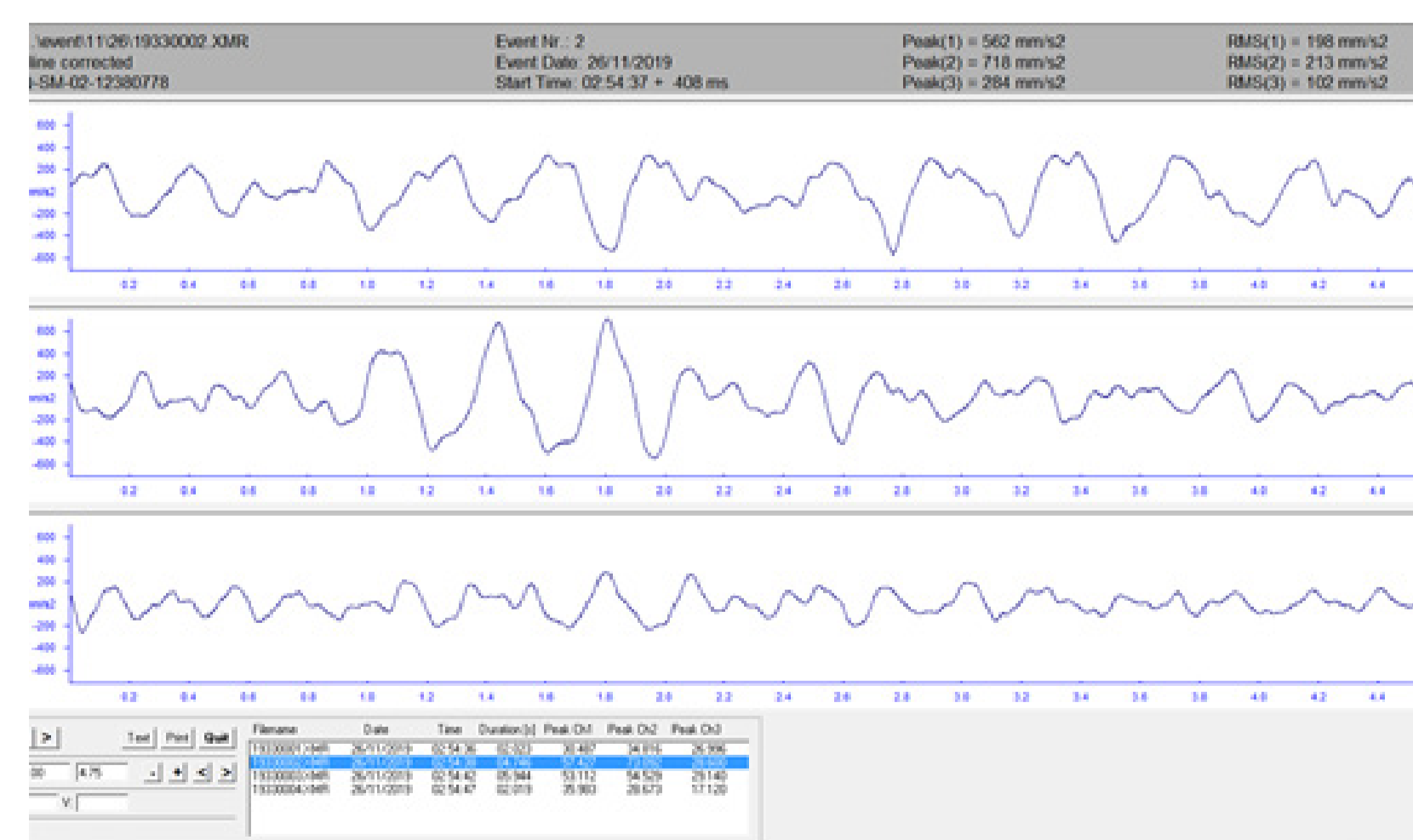
and ICOLD Bulletins recommendations. Also, the monitoring process is done by Dam Safety Monitoring Systems (automatic & manual) installed. There are five modern monitoring systems integrated, which deliver their data in real-time to the dam safety office.



Thus, we have geodetic monitoring rate, geological monitoring system, seismic monitoring system, hydraulic monitoring system and hydro-meteorological monitoring stations. A huge number of equipment have been installed, such as piezometers, inclinometers, extensometers, accelerometers, reapers, ultrasonic sensors, water level staff gauges, weather stations, and pendulums.

Special events

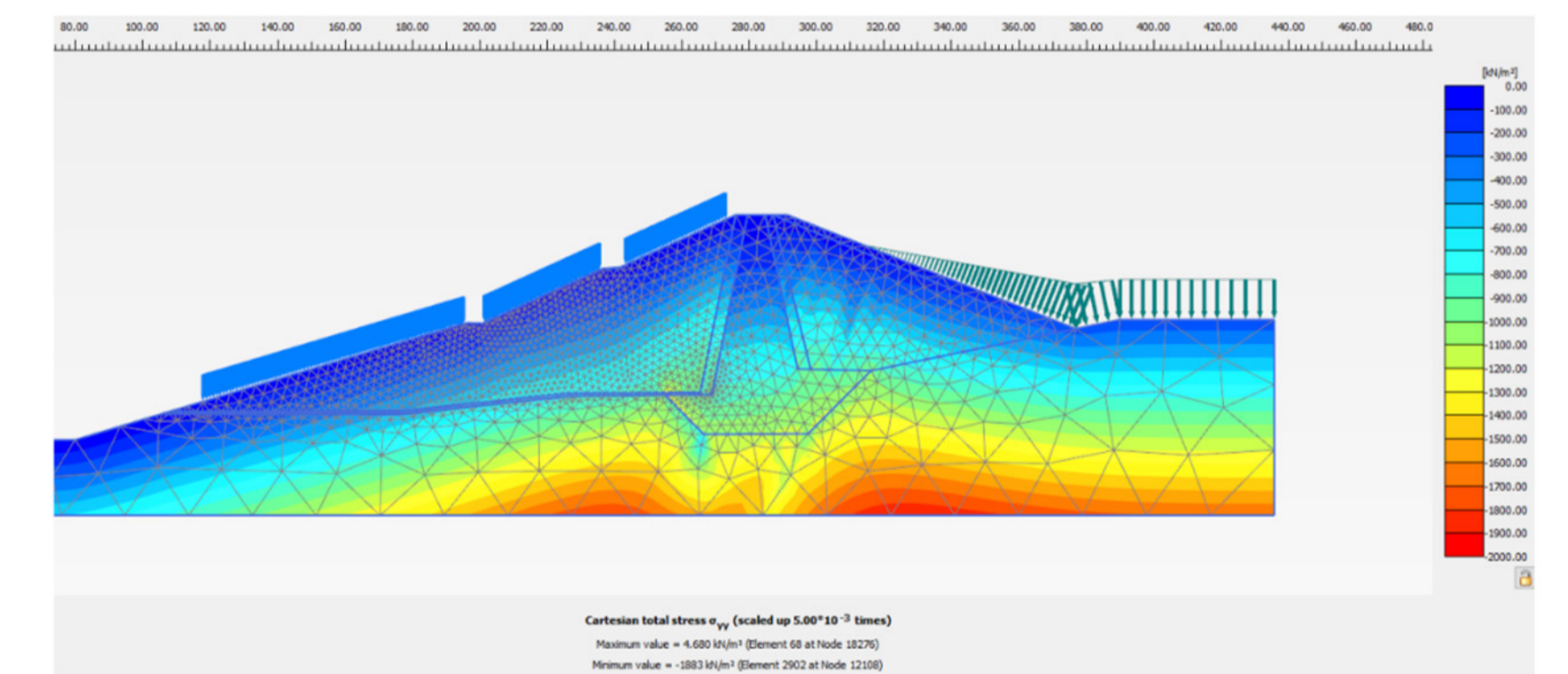
One of the most significant events was the earthquake on November 2019 with a magnitude 6.4, only 60 km far from the dam. Qyrsaq dam is very near the tectonic crack Shkodër (Albania)–Pejë (Kosovo). It is essential to mention that Qyrsaq dam has faced a 6.6 magnitude earthquake on April 1979, about 51 km far away during the operation time. The visual check was done as the first step by the local staff, followed by a brief data check and a site visit was conducted by the dam safety team refer to the checklist of ICOLD Bulletin 166.



Very interesting was the seismic monitoring of the crest of Qyrsaq dam considering the two different parts of this dam. As expected, the largest PGA of 717 mm/sec² occurred on the rockfill part compared to the gravity concrete part with a PGA of 245 mm/sec². The difference in the material of the dam makes the structure react and absorb the dynamic seismic action in a different way.

Monitoring challenging in the future

The new challenge in the monitoring process appeared to us after the installation of photovoltaic panel plants on the dam body. There are more than 10,000 solar panel modules installed producing 5.14 MW-peak. Some geodetic monuments can be reached by at least two of them, and this is enough for monitoring. Even though the weight of panels is low, we insisted on calculating the stress that would be created in the dam body with this new structure on it. It has been revealed that the stress forces in the dam body are as shown in the graph below.



Conclusions and Recommendations for the future

As a conclusion of years of monitoring of this composite dam, we can say that Qyrsaq dam is in optimal parameters in terms of stability, water levels, settlements and deformations. But, considering the factors where the dam is located and circumstances about the impact on the population, our main focus for the future consists in: Urbanization increase in the downstream areas; Climate change coming with new challenges in operation; Sediments monitoring of reservoir; Review of rules on the O&M and discharge by the spillways; Flood problems related with discharges; Building capacity & training of the monitoring team; Comparison analyze of the two main earthquake effects in 2019 and 1979.