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Seismic

The determination of seismic risk in the planning of hydropower schemes.

Issue

Geological uncertainty and the possibility of earthquakes can introduce construction, safety and financial risks for developers of hydro schemes in particularly prone areas.

Some dams are built in areas with known seismic activity, and some are built directly on or in a region of fault lines. In some locations reservoir induced seismicity can result from the weight of water filling a new storage. This triggered seismicity is likely to be low level earthquake activity that occurs in the vicinity of artificial reservoirs as a consequence of impoundment, and is the result of tectonic loading associated with water storage and the depth of the water column.

Most dams are designed to cope with seismic risk and usually seismic activity results in no damage; however if not adequately considered in the project siting and design stage, adverse consequences of an earthquake/seismic event can ensue. At a minimum it may lead to costs to repair dam walls and associated infrastructure, and in a worst case scenario it could lead to dam failure with high cost the community, the environment and power supplies. Clearly, understanding seismic risk is important for siting, design and construction decisions as well as for financial reasons.

Management

Assessment of seismic risk is influenced by geology, tectonic factors, history of seismic activity, and by past experience with underground construction in the region indicating ground stability. Seismic monitoring information should be collected and analysed in the evaluation of potential development sites, this information used to inform decisions with regard to the most appropriate construction techniques that are appropriate to the geodynamics of the area.

In order to conduct such an analysis it is necessary to access reliable geological mapping information supported by topographic data at the dam site, and similar information at a coarser scale for the reservoir area. Aerial photography can also be used to reveal if the location has been subject to previous landslips or similar earthquake disturbance. This information, together with a geological survey of the site, is combined with monitoring records of any seismic activity in the region to determine the probability of a seismic event.

The level of earthquake chosen as a basis of a deterministic (risk) analysis is usually measured in terms of estimated return period. Risk is usually based on an assessment of return periods of 72, 475 and 975 years. These years correspond to 50, 10 and 5 percent probability of a similar event occurring within a 50-year period, which is often the design life of a structure (see ASTM standard E2026-99).

Once a site has been selected, instrumentation can be installed to monitor dam movement and structural integrity following construction. This instrumentation should form part of a robust, strategically located, seismic network coupled to an analysis process that produces prompt reports of seismic activity and informs dam safety emergency plans.