

Natural hazard management for hydropower plants and dams

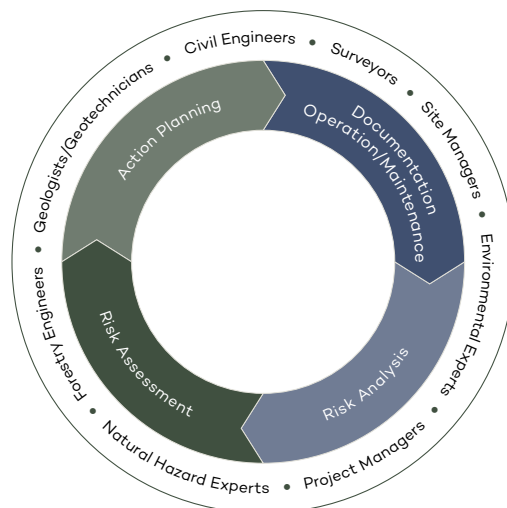
Natural hazards present a potential risk to hydropower plants and water retaining structures. Such events as rockfall, avalanche, or landslides present not only danger to human life but potential damage to important components of hydropower plants and loss of power production.

Protection against natural hazards is conceived in the first instance on the basis of integrated risk and asset management strategies such as those defined by the Swiss guidelines^{1,2}, but can be adapted to any specific local requirements.

This process involves the identification of tangible natural hazards, the definition of the assets and the assessment of risk to them. Physical protective mitigating measures can never be 100% and prioritization is required with a degree of acceptable residual risk, which may be compensated for through operational management systems.

Residual risk of high priority structures, such as large water retaining dams, must be minimized to the greatest economical extent. For low-safety relevant structures a balance between investment cost of installed mitigating measures with repair cost is made. For the case of hydropower plants, cost consideration must also include the potential loss of power production.

An integrated natural hazard and asset management system requires input from a wide field of expertise. To name the essential disciplines: meteorologists, hydrologists, geologists, geotechnical engineers, rock mechanics engineers, environmental engineers, surveyors, as well as dam engineers and specialists for hydropower plants. AFRY has these experts under one roof, both locally positioned and internationally connected, facilitating a multidisciplinary coverage for every project regardless of geographic location for the development of tailor-made and sustainable solutions. AFRY can support all projects in every planning stage for all technical fields with the use the most current and modern methods.



AFRY's experts are in the position to carry out large scale integrated national/regional risk analyses. Evaluation of the various natural hazards and their potential affect can be performed both numerically and analytically to leading edge level.

Possible constructional mitigation measures are considered i.e. rockfall barriers, conventional landslide stabilization, landslide stabilization with biological engineering measures, avalanche barriers and check dams. Alternative or complementary, measures such as land-use management, operational management, monitoring systems or evacuation planning may be implemented.

- 1) National platform natural hazards PLANAT: dealing with risks related to natural hazards, strategy 2018
- 2) Swiss Federal Office of Environment BAFU: dealing with natural hazards, 2020





The requirements – our technical competence

With the involvement of experts of all disciplines and the use of leading-edge methods AFRY offer a personalized and comprehensive evaluation with appropriate mitigation against all kinds of potential natural hazards and support during all project phases.

Selected potential natural hazards

- Rockfall and rockslide
- Landslide and debris flow
- Extreme rainfall and flood
- Avalanche
- Glacial lake outburst flood (GLOF)
- Glacial collapse (impulse wave, ice fall)
- Permafrost melting
- Earthquake

Identification, analysis and reporting

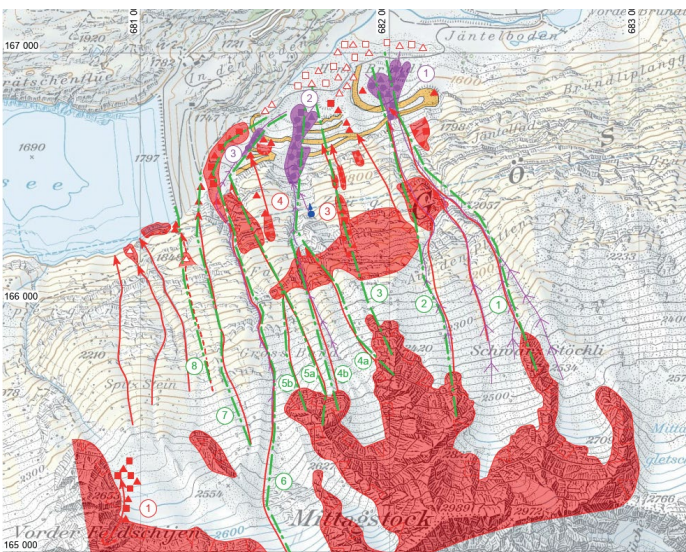
- Risk analysis
- Event mapping
- Instrumentation and monitoring
- Numerical landslide analysis
- Meteorological and hydrological modelling
- Hydraulic analysis and numerical simulation
- Numerical debris flow simulation (e.g. RAMMS)
- Hazard mapping, hazard zone maps incl. flood risk maps
- Seismic stability and deformation analysis and evaluation

Identification and organisational implementation

- Integrated action planning
- Monitoring systems
- Warning systems
- Emergency planning (institutional and specific)
- Training

Selection of mitigation measures

- Stabilisation of large landslides
- Slope stabilisation i.a. with biological engineering
- Rock stabilisation
- Rock fall barriers
- Check dams (rock fall, flood etc.)
- Avalanche barriers
- Avalanche and rockfall galleries
- Spillway adjustments



Contact

Stefan Ehlers
Geotechnics and Dam Safety
stefan.ehlers@afry.com

Dr. Felix Oberrauch
Hydraulics and Water Management
felix.oberrauch@afry.com

AFRY Switzerland Ltd.
Herostrasse 12
8048 Zurich
Switzerland

+41 44 355 55 55
info.ch@afry.com

