Assessment of Natural Hazard Risks
Pöyry has more than 100 years of experience in consulting and engineering services. Around 6,000 specialists and generalists ensure competent advice all over the world. The interdisciplinary cooperation of our experienced specialists provides for short response time. New ideas are immediately taken into account and implemented. You have a professional partner who organises all activities, solves your problems and saves you time and money.

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The assessment of natural hazards is one of our key services. This is the prerequisite for safe design and safety assessment of all kinds of hydropower and infrastructure projects.

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What are the relevant hazards from natural environment affecting your projects.

METHODOLOGY (PAGE 4)
Pöyry’s approach to assess and quantify the natural hazards and the instruments to be applied.

BENEFIT FOR OUR CLIENTS (PAGE 6)
State-of-the-art methodology modularly applied to the needs of our Clients and their projects; efficient and effective analysis of natural hazards by transparent and reproducible procedure.

PÖYRY’S EXPERTISE IN ASSESSMENT OF NATURAL HAZARDS (PAGE 7)
Experienced engineers, geologists, hydrologists and scientists executing successfully projects all over the world, assessing various types of hazards in different environments.
Various types of natural hazards can be distinguished, depending on topographic and climatic conditions in the project area.

HAZARDS
A potentially damaging physical event, that may cause the loss of life or injury, property damage, social and economic disruption or environmental degradation. Hazards can be single, sequential or combined in their origin and effects. Each hazard is characterised by its location, intensity and probability (Ref. [1]).

They represent a serious threat to human life and assets. Therefore a thorough assessment of the prevailing hazards and risks in a specific region is imperative for any kind of development activity. This is particularly important in disaster-prone areas, like floodplains, steep valleys in mountainous regions, areas of high seismicity or areas exposed to storms and high precipitation.

GEOLOGICAL HAZARDS
- Earthquake
- Landslides / Slope Failure
- Block and Rock Fall / Rock Avalanche
- Debris Flow
- Ground Subsidence
- Dissolution of Rock, etc.

METEOROLOGICAL AND HYDROLOGICAL HAZARDS
- Heavy Rain
- Flash Flood
- River Flood
- Strong Wind
- Wild Fire
- Snow Avalanche
- Anomalies of Temperatures, etc.

The time-dependence of the different hazards, which plays an increasing role in connection with climatic change, must be addressed. This requires periodic reassessment of the hazards when new information is available.
Pöyry’s approach in the assessment of natural hazards will mainly follow the methods developed and used successfully in infrastructure projects in Switzerland and abroad, which are located in difficult geological, topographical and climatic environments.

Reduction of risks from natural hazards has a long tradition in Switzerland, starting with the construction of the railways through the Alps and the development of the water resources by run-of-river power plants and large storage schemes, some of them have been in successful operation for more than 100 years. Today, risk-based approaches for particular natural hazards such as flood and earthquakes are gaining importance.

A risk-based approach comprises standardized procedures, clearly defined and logic steps of activities, allowing a flexible application of the methodology depending on the project’s size and complexity, present hazard types and their potential of impact.

**VULNERABILITY**
The conditions determined by physical, social, economic, and environmental factors or processes, which increase the susceptibility of a community to the impact of hazards. The vulnerability is determined by the exposure, the value and the susceptibility to be damaged (“References, page 7”).

**RISK**
The probability of harmful consequences, or expected losses resulting from interactions between natural hazards and vulnerable conditions. Conventionally risk is expressed by the notation Risk = Hazards x Vulnerability (Ref. [1]).

Pöyry’s approach to assess and quantify the natural hazards and the instruments to be applied.

1. **RISK ASSESSMENT**
   - Analysis of all prevailing hazards
   - Analysis of vulnerabilities
   - Use of harmonized and natural hazard-consistent procedures

2. **RISK EVALUATION AND DEFINITION OF PROTECTION GOALS**

3. **DEFINITION OF DESIGN CRITERIA**

4. **PLANNING OF MEASURES ACCORDING TO SUSTAINABILITY PRINCIPLES**
   - Planning of measures, applying an integrated approach by following applicable codes, regulations and recommendations
   - Planning of sustainable solutions
   - Partnership with all project stakeholders and authorities

An integrated approach for reduction of hazards and risks demands well established hazard and risk assessments.
THE PRIMARY GOAL IS TO FIND ANSWERS TO THE FOLLOWING QUESTIONS

1. **What** can happen (slope failure, rock fall, flood, etc.) and **where** will it happen? >> Identification of hazards
2. **How often** and **how intense** will it happen, how big is the expected **damage**? >> Analysis of hazards and vulnerabilities and risk
3. **What are the most efficient ways** to **protect** people and assets? >> Planning of measures

The bases for answering these questions are a series of map types (Ref. [1]):

1. **EVENT MAP AND EVENT REGISTER**
   Record events occurred in the past and provide a first overview.

2. **MAP OF PHENOMENA**
   Documents past events and phenomena/sources indicating future, potential events.

3. **HAZARD INDICATION MAP**
   Shows where a hazardous process can occur; hazards are distinguished according to the type of hazard, source area, flow path and impact area.

4. **DANGER MAP**
   Shows intensity and probability of the process: Primary management tool, justification for structural protection measures, basis for site monitoring and emergency planning, basis for risk assessment.

5. **VULNERABILITY MAP (MAP OF POTENTIAL DAMAGE)**
   Contents economic assets and is used as tool for emergency planning, priority setting and basis for production of risk maps.

6. **RISK MAP**
   Shows either a qualitative classification of risk, an average loss per event or per year, a number of deaths per event or per year. Is the basis for the chronological and financial prioritisation of protection measures and is the most appropriate tool for decision making about structural and non-structural measures.

7. **EARTHQUAKE MAP**
   Shows the probabilistic earthquake hazard of the area.

8. **INTENSITY MAP**
   Provides the spatial extent and the corresponding intensities of a natural event, having a specific return period or probability of occurrence.

The type and complexity of the project defines which map types will be applied for the assessment.
Benefit for the Client

This methodological approach gives the following benefits to the Client:

**STATE-OF-THE ART METHODOLOGY**
The working steps are well defined, standardized and can be successfully applied for different natural hazards and infrastructure projects.

**MODULAR CONCEPT APPLICABLE TO THE NEEDS**
The level of applied instruments and level of assessed details (simplification) can be adjusted to the size and complexity of the situation / project.

**EFFICIENT AND EFFECTIVE TREATMENT OF NATURAL HAZARDS**
Only hazards with real impact on the project will be treated and the mitigation measures can be tailored to the risk. However, all possible hazards will be considered.

**TRANSPARENT AND REPRODUCIBLE PROCEDURE**
The standardisation of the steps and instruments enables transparency and reproducibility of the results for all stakeholders.

**COST**
Our tailored studies to the Clients needs lead to the most cost efficient solutions.
Our Experience & References

The professional assessment of Natural Hazards requires a long experience of observations and mapping in the field. We can provide this important precondition.

WORLD-WIDE FIELD EXPERIENCE
Pöyry with its countless and successfully executed projects has the required experience and knowledge from all different geographical regions in the world.

NATURAL HAZARD EXPERTS
Our experts are familiar with the Swiss approach of natural hazard assessment and many other state-of-the-art methodologies and have long experience from hydropower and other infrastructure projects world-over.

YOUR CONTACTS FOR NATURAL HAZARD ASSESSMENT
GEOLOGICAL HAZARDS:
Dr. Thomas Dietler, geologist, Zurich, Switzerland; 33 years of professional experience in geological fieldwork and natural hazard assessments in Switzerland, Norway, Sri Lanka, India, Papua New Guinea, Iran, Mozambique, etc.
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EARTHQUAKE HAZARDS:
Dr. Martin Wieland, senior dam engineer and earthquake expert, Zurich, Switzerland 45 years of professional experience in the seismic safety evaluation of some of the world’s largest dams and other infrastructure projects. He has been the Chairman of the ICOLD Committee on Seismic Aspects of Dam Design since 1999.
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METEOROLOGICAL HAZARDS:
Dr. Martin Fuchs, hydrologist, Vienna, Austria; 18 years of professional experience in the field of climate change, climate resilience, hydro-meteorology and hydrology in water resources and hydropower systems worldwide.
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