



Dams risk assessment & portfolio risk assessment

Identifying needs

Throughout history, dams built to store water have occasionally failed with the resulting loss of life, social, economic, financial and environmental losses.

Dam owners have an obligation to ensure that the dams within their portfolio do not impose unacceptable levels of risk to the community or individuals within the area that may be affected by a potential failure of the dam.

This requires an understanding of the potential failure modes and consequences in order to provide methods of dealing with these during all phases of the design, construction and operation of the dam.

Risk assessment is the process of deciding whether existing risks are tolerable and present risk control measures are adequate and if not, whether alternate risk control measures are justified or will be implemented. Risk assessment incorporates risk analysis and risk evaluation. (*Guidelines on Risk Assessment, ANCOLD 2003*)

Solution

GHD offers risk assessment services as a systematic process of estimating and analysing the probability of dam failure and the consequences of that failure, and evaluating the outcome against certain risk decision criteria.

Risk is the measure of the probability and severity of an adverse effect to life, health, property, or the environment' (ANCOLD 2003). This requires an evaluation of the probability of an event occurring and the associated consequences of that event across all failure scenarios for the dam. These must be integrated across all failure initiating events that might affect the dam and associated structures and typically includes normal and flood conditions as well as seismic events. The risk assessment process comprises the following three components:

- **Risk analysis** involves the identification of hazards and failure modes, estimating loading frequencies and conditional failure probabilities, and estimating consequences of failure, to determine the risks associated with the credible failure modes.
- **Risk evaluation** involves the assessment of whether or not a risk is tolerable (including consideration of the ALARP principles), and identifying the need for risk reduction works or further investigations.
- **Risk reduction** involves comparing potential risk reduction options if needed; and establishing a risk reduction strategy.

GHD has extensive experience in risk analysis using **event tree analysis, fault tree analysis and failure modes, effects and criticality analysis** models.

Portfolio risk assessment is the application of risk assessment to a group of dams, and is a decision-support tool for dam safety portfolio risk management.

Portfolio risk management is a risk-informed framework for improved management of dam safety issues for a portfolio of dams in the context of the owners business. This is not an additional activity, but is an improved approach to the entire dam safety management program.

Benefits

Our extensive experience in dams engineering allows us to provide the specific benefits of risk assessment, which vary but generally provide the basis for:

- improved understanding of the current risk profile(s)
- improving the dam safety management program
- implementing short-term risk reduction measures
- developing the dam safety improvement program
- improved integration with the business processes

Our recent experience in risk assessment



Portfolio risk assessment review for State Water Dams, New South Wales

A review of the PRA was undertaken for 18 major dams comprising concrete arch, concrete slab and buttress, concrete gravity, concrete face rockfill, earthfill, and clay core rockfill types of dams up to 114 m height, with 10 classified as extreme consequence category. The study included estimation of the failure probabilities (including failure modes analysis, event trees analysis, and piping risk assessment using the "Piping Toolbox"), risk workshops, risk calculations, risk evaluation and preparation of the portfolio risk assessment report.



Portfolio risk assessment review for Coliban Water Dams, Victoria

A review of the PRA was undertaken for 13 major dams comprising one multiple arch buttress dams and 12 earthen dams. The study included the estimation of the failure probabilities (including failure modes analysis, event trees analysis, and piping risk assessment using the "Piping Toolbox"), risk workshops, risk calculations, risk evaluation, prioritisation of risk reduction works, and preparation of the portfolio risk assessment report.



Baseline portfolio risk assessment for AGL Energy, Victoria

AGL Energy owns 12 dams and weirs in the Kiewa, Rubicon, Dartmouth and Eildon Schemes. The Kiewa and Rubicon Schemes are both cascade systems. The study assessed the seven High consequence category dams, including two rockfill dams (one with a morning glory spillway), two slab and buttress dams, an earthen dam and two concrete gravity dams (one with hydroplus fuse gates and the other with vertical lift gates). A failure modes, effects and criticality analysis model was used for the qualitative assessment.



Ross River Dam - Detailed risk assessment for design validation, NQ Water, Queensland

The Ross River Dam comprises a 40 m long concrete overflow spillway flanked by a central core rockfill embankments and a 7620 m long left bank earth fill embankment, which has no internal filter zones for piping protection. The detailed design for the upgrade works was optimised using risk based design. The process incorporated an assessment of the embankment crest level based on flood risk and wave overtopping, review of 2D and 3D seepage models to assess piping and foundation erosion potential, assessment of fissured soils within the embankment foundation for structural stability and evaluation of spillway model testing for potential spillway failure modes as well as fault tree analysis for evaluating the reliability of the new spillway radial gates.



Perseverance Dam acceptable flood capacity risk assessment for Toowoomba Regional Council, Queensland

Previous work identified that the dam had inadequate spillway capacity as required by the Queensland Acceptable Flood Capacity Guidelines, and upgrade works would be required. GHD proposed to assess the acceptable flood capacity for the dam using a risk assessment approach. This identified that the risk was below the limit of tolerability and also satisfied the ALARP criteria, eliminating the need for a complex dam and spillway upgrade. Remedial works to lower the risk were not justified on the basis of the cost/benefit ratio.



Lake Eildon, Cairn Curran Reservoir and Lake William Hovell Dam improvement projects, Victoria

Goulburn-Murray Water is the largest irrigation water authority in Australia and has 18 water storage dams. GHD undertook the detailed design for these three projects, which included detailed risk assessment of the proposed risk reduction options and evaluation of the risks with respect to the portfolio risk assessment. The risk assessments were used to define the scope of the remedial works to ensure that the ALARP principle was satisfied.

To touch base with the key person in your region, visit

www.ghd.com/dams

