

# 7 Safety Reviews

## 7.1 Introduction

A safety review is a procedure for systematically assessing the safety of a dam after its original construction. It is a fresh engineering assessment of the integrity of all elements of a dam. It usually incorporates a:

- current failure impact assessment
- detailed review of structural, hydraulic, hydrologic and geotechnical design aspects
- review of historical operational performance
- review of surveillance reports
- comprehensive inspection of the dam
- comparison of the standards used for building and upgrading the dam against current design standards.

## 7.2 Steps involved in a Safety Review

The steps involved in a safety review include:

- Collect background information on the dam. This includes all relevant historical investigation, design, construction, remedial, operation and maintenance, monitoring and inspection data.
- Compare the performance of the dam with the standard set by the original design engineers (if known) and the relevant standards and guidelines existing at the time of the review. The review must include a prediction or assessment of the theoretical performance of the dam against current standards and guidelines.
- Where design aspects are based on assumptions or are incomplete, the Safety Review should include basic investigations and detailed analysis to substantiate the design.
- In the case of incomplete documentation, further investigations may be required, particularly in the case of an initial safety review. Where insufficient plans or data exist of critical elements, additional investigation activities should be undertaken to resolve uncertainties. Typical investigation activities include:
  - survey to establish lines and dimensions
  - testing of materials in the dam and its foundation
  - geological drilling and mapping
  - calculation of revised flood estimates
  - updating of earthquake forces.

Particular attention should be given to changes in land use that may have occurred since construction of the dam which may affect design and operation criteria. This includes such activities as mining, urbanisation or clearing of the catchment area both upstream and downstream of the dam.

The design assumptions and standards used should be reviewed and compared with current best practice, eg

- the foundation integrity (bearing, seepage) applied should be reviewed and compared with current best practice
- the spillway adequacy should be reviewed and compared with current accepted engineering standards, ie ANCOLD–Guidelines on Selection of Acceptable Flood Capacity for Dams
- the embankment and outlet structure should be reviewed and checked as to whether it can withstand appropriate loadings (including seismic) in accordance with current engineering practice.

Conclusions should be developed regarding the adequacy of the main elements of the dam (ie foundations, main wall, spillway, outlet works, associated equipment and monitoring system).

Comments should be made regarding adequacy of the dam safety surveillance and inspection program and operation and maintenance procedures. Such comments and conclusions should reflect prevailing knowledge in hydrology, hydraulics, soil mechanics, geology, structural analysis and design criteria relating to dams.

Further guidance in the issue to be addressed when undertaking a Safety Review can be obtained from Appendix 3 - Checklist of Dam Technology Issues.

The level of sophistication of Safety Reviews varies depending on the complexity of the dam. For example, a Safety Review for a large gated structure requires a greater range and depth of studies than for a small grassed bywash earth dam. In addition, Safety Reviews are not necessarily completed when the Safety Review Report is finalised. Subsequent investigations recommended in the Report are often required and may take years to finalise.

### 7.3 Frequency of Safety Review

The frequency of dam safety reviews is generally based on the age of the dam and the appropriateness of the technology used on that dam. Safety reviews are generally conducted on a maximum twenty-year cycle but may also be initiated in response to issues such as:

- an absence of design and construction documentation
- a regulatory requirement
- detection of abnormal behaviour
- changes in acceptable design and construction standards
- proposals to raise or modify a dam
- changes in Standing Operating Procedures.

### 7.4 Safety Review personnel

the Safety Review of a dam can be quite complex and personnel engaged in safety reviews should be experienced in dam technology. Where necessary, the services of suitably experienced geologists, hydrologists and other specialists should be utilised. Consideration should also be given to independent review by engineers other than those who carried out the original design of the dam.

### 7.5 Safety Review Reports

A Safety Review Report should be produced to document the safety review and should include:

- a statement on the safety of the dam indicating whether or not the dam is in a satisfactory condition and capable of meeting current design criteria
- report on comprehensive inspection
- parameters adapted and assumptions made (and their bases) for review analyses)
- methods of review analyses and results (numerical and physical)
- identification of any deficiencies in the dam including criticality ratings for these deficiencies<sup>6</sup>
- recommendations for remedial work, emergency action and/or further studies which should be undertaken and timings for these.

<sup>6</sup> A deficiency may be insufficient knowledge about a particular aspect of a dam.

Whilst dam owners may engage consultant engineers to carry out the Safety Review and prepare the report, the recommendations contained in a Safety Review Report will be considered as originating from the dam owner. The dam owner will be responsible for implementing the recommendations. Comprehensive inspections and ultimately audits undertaken by the Regulator, will evaluate the dam owners response to Safety Review Reports.

When preparing a Safety Review Report the reviewer should consult the checklist of dam technology issues included as Appendix 3—Checklist of Dam Technology Issues.

