

SUMMARY OF USSD WHITE PAPER ON DAM SAFETY RISK ASSESSMENT: WHAT IS IT? WHO'S USING IT AND WHY? WHERE SHOULD WE BE GOING WITH IT?

Prepared by the
Working Group on Risk Assessment
USSD Committee on Dam Safety



This White Paper (USSD 2003) represents the consensus position of a diverse group of US Society on Dams (USSD) members and other dam safety professionals. It was prepared for the dam engineering profession in the US by a Working Group established by the USSD Committee on Dam Safety (CODS) in response to a request from the USSD Board. The request grew out of the growth of interest in and applications of dam safety risk assessment. The White Paper's overall purpose is *"To assess the state-of-the-practice in dam safety risk assessment, and to provide commentary on appropriate types of applications and ways to facilitate and strengthen its use."*

The White Paper is neither a "how to" guide nor a standard of practice. The Working Group did not endorse any specific approaches. References made to applications are illustrative of what some owners and regulators have found to be useful. They should be understood in the context in which they were conducted and in which their outcomes were used. They should not be considered templates to be copied.

The Working Group held several half-day working sessions in addition to three-day workshop in March 2000 with sponsorship from FEMA through the Association of State Dam Safety Officials (ASDSO 2001). The ASDSO/FEMA Specialty Workshop on Risk Assessment for Dams provided the principal opportunity to develop the consensus position presented in the White Paper. The Working Group was assisted at the Workshop by some additional participants, including some from the States and some from Australia and Canada.

The organization of the White Paper flows from the three questions posed in its title, *"Dam Safety Risk Assessment: What is it? Who's using it and why? Where should we be going with it?"* as follows:

- **What is it?** Section 2.0 summarizes some principles and fundamental concepts of dam safety risk assessment. Section 3.0 provides an assessment of the current state-of-the-practice for the four risk assessment application categories, which are listed below.
- **Who's using it and why?** Section 4.0 provides summaries and evaluations of applications in each of the four application categories by the owners or regulators who sponsored them.
- **Where should we be going with it?** Section 5.0 provides commentary on appropriate current practice of risk assessment, including cautions and limitations, which were identified by the Working Group. Section 6.0 summarizes technology

transfer and training (T³) needed to make the state-of-the-practice more broadly available to the profession. Section 7.0 summarizes research and development (R&D) needed to improve the breadth, depth and quality of applications.¹

The Working Group's findings and commentary on appropriate current practice are summarized for each of the four risk assessment application categories as follows:

- **Failure Modes Identification (FMI)**, which is an early step in performing a risk assessment, should also be standard practice for traditional standards-based approaches to dam safety evaluation and design². FMI provides a more comprehensive safety evaluation of a dam and a basis for strengthening many aspects of a dam safety program (e.g. instrumented and visual monitoring, emergency preparedness planning, O&M). Applications guidance is urgently needed for performing FMI. Users must recognize that FMI is a qualitative diagnostic approach and not a decision tool.
- **Index Prioritization (IP)** approaches are valuable and increasingly utilized for prioritizing dam safety issues and investigations, but should be calibrated and must incorporate a risk metric to be considered risk-based. They are generally less costly to use than PRA, but are more limited in the scope of their outcomes.
- **Portfolio Risk Assessment (PRA)** is a valuable and increasingly accepted approach for cost-effectively prioritizing dam safety remedial measures and further investigations for a group of dams. It provides insights that can better inform owners about the business and liability implications of dam ownership. PRA outcomes must be used with regard for the limitations of the approach and should be periodically updated.
- **Quantitative Risk Assessment (QRA)** approaches are valuable for providing insights and understanding of failure modes and associated stakeholder risks (probabilities and consequences). Uncertainties in inputs and outcomes must be taken into account. Improved approaches to the estimation of probabilities and consequences are needed. Acceptable/tolerable risk criteria need development and are yet to gain widespread acceptance. Stakeholders must decide on issues of appropriate use and defensibility.

By separating the category of QRA from the other application categories, the Working Group was able to recognize the applications potential of each category separately. For the case in which a QRA provides justification for a level of safety below that normally associated with the traditional approach, the Working Group considered that stakeholders must decide each case within its particular decision context, including legal and regulatory aspects. Differences in decision contexts and stakeholder information needs for dam safety decision making were given special consideration by the Working Group at the ASDSO/FEMA Workshop and provided the backdrop for the Working Group's evaluation of application categories and other findings.

¹ Recommendations for T³ and R&D are under consideration by the ICODS Research Subcommittee.

² The FERC is developing a Performance Monitoring Program (PMP), which incorporates "Failure Modes Analysis" in reviewing and evaluating the safety and performance of water retaining structures regulated by FERC in the context of the existing Part 12D program of Dam Safety Evaluation.

The Working Group's recommendations for technology transfer and training and for research and development in dam safety risk assessment are many. The Working Group encourages the vigorous pursuit of these recommendations. This should include pilot studies and demonstration projects since, as with other new areas of engineering practice, while seminars and workshops are of value, it is only through hands-on experience that professionals can develop appropriate practice.

The application of risk assessment to dam safety continues to be a heavily discussed topic. Resistance and discomfort often accompany change in any field, especially when a significant paradigm shift is proposed. It is not that the traditional approach does not allow for risk and uncertainty, it does; but the risk-based approach seeks to consider them more explicitly and to empower the decision-maker with an understanding of their implications using the common currency of risk. The dam engineering profession must be confident that change will lead to improvements in dam safety and even more importantly in public safety. The Working Group's commentary on the current practice of risk assessment is considered a cautious approach, which provides for flexibility in recognition of different decision contexts and information needs across the dams business. The commentary emphasizes that limitations must be fully considered and that risk assessment approaches should be used only as a supplement and not as a replacement for the traditional approach. This "risk-enhanced" approach provides a way for the benefits of improved understanding and management of dam safety risks to be realized, while maintaining a reference to established practice. As experience grows, and improved capabilities are developed, a future review of the risk assessment field may be bolder in its findings, but at this time, the Working Group considers that its findings and commentary on current practice are appropriate and justified.

REFERENCES

- ASDSO. 2001. *Report on the ASDSO/FEMA Specialty Workshop on Risk Assessment for Dams*. Submitted to FEMA by ASDSO.
- USSD (United States Society on Dams) (2003). *Dam Safety Risk Assessment: What is it? Who's using it and why? Where should we be going with it?* USSD Emerging Issues White Paper.