

**Joint Statement of the Technical Advisory Panel**

# **Inspection and Reevaluation Protocols—Proposed Amendments**

**California Department of Water Resources  
Division of Safety of Dams**



**U.S. Department of the Interior  
Bureau of Reclamation  
Denver, Colorado**

**October 2018**

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**California Department of Water Resources  
Division of Safety of Dams**

*prepared by*

**U.S. Department of the Interior  
Bureau of Reclamation**

**U.S. Army Corps of Engineers**

**Association of State Dam Safety Officials**

**United States Society on Dams**

*for*

**California Natural Resources Agency  
Department of Water Resources  
Division of Safety of Dams**



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## Acronyms and Abbreviations

ANCOLD	Australian National Committee on Large Dams, Inc.
ASDSO	Association of State Dam Safety Officials
DSDO	Division of Safety of Dams
PFMA	Potential Failure Mode Analysis
Reclamation	Bureau of Reclamation
RIDM	risk-informed decision making
TAP	Technical Advisory Panel
USACE	U.S. Army Corps of Engineers
USSD	United States Society on Dams

## Background and Proposed Amendments

The California Department of Water Resources, Division of Safety of Dams (DSOD) provides regulatory oversight of approximately 1,250 dams with millions of people downstream. In May 2016, the Association of State Dam Safety Officials (ASDSO) conducted a peer review of DSOD’s Dam Safety Program (Bingham et al., 2016), naming it “the leading dam safety program in the Nation.” The program is much larger than other State dam safety programs given California’s complex geology and seismic regime and high population at risk if a dam failure were to occur. Consequences of a dam failure may be extreme with respect to life loss, economic loss in the billions of dollars, and extreme environmental damage. The DSOD program is also the only State regulatory dam safety program in the Nation funded solely by dam owners.

With dams being integral to California’s water management system, investment into the advancement of dam safety and the rehabilitation of aging dam systems is essential to strengthen California’s water future. For any enhancements to the DSOD Dam Safety Program, consideration should be given to providing additional alternate funding mechanisms for the greater protection of the citizens within California. The regulatory oversight provided for dam safety of jurisdictional dams statewide is at the core of public safety.

The Technical Advisory Panel (TAP) believes that there is a prime opportunity to enhance the program by advancing it over time through the adoption of additional dam safety best practices developed at the Federal level with respect to risk. Risk-informed decision making (RIDM) within Federal dam safety programs have taken up to 20 years to mature with dedicated staffing and funding resources. The TAP believes that the State of California should consider the incorporation of formalized risk processes within the DSOD Inspection and Reevaluation Protocols to enhance the protection of the public downstream from California dams. DSOD can benefit from the lessons learned from Federal Agencies experience with implementation of RIDM.

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California Legislative Assembly Bill No. 1270 requires DSOD, in consultation with independent, national dam safety risk management organizations, to propose amendments to its dam safety Inspection and Reevaluation Protocols. DSOD had longstanding protocols for inspections and reevaluations that were well known by its experienced staff members. However, in order to comply with the legislative directive, DSOD formally documented those protocols and then assembled a TAP (with members from the Bureau of Reclamation [Reclamation], U.S. Army Corps of Engineers [USACE], United States Society on Dams [USSD], and the Association of State Dam Safety Officials [ASDSO]) to propose amendments to the protocols.

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The TAP commends DSOD for its commitment to dam safety. The technical staff the TAP interacted with during this process are dedicated to dam safety and highly experienced in dam engineering. In particular, their seismic technical capabilities are excellent and are consistent with the seismic concerns for the State. Although the DSOD program has served the State of California well in the past, the recent Oroville Dam spillway incident reminds us that dam safety is evolving and each incident is an opportunity to review dam safety protocols—not just in California but across the Nation—and incorporate lessons learned and current best practices of the industry.

The TAP offers the following suggested amendments to DSOD’s current protocols to meet the ever-increasing risks from a broad range of dam types, size, ages, and conditions throughout the State. The TAP also recognizes the diversity of dam owners throughout the State, from individual owners with limited means of improving their dams to sophisticated utilities with a large portfolio of dams, and the difficulty of consistently regulating these owners to ensure public safety.

The overarching recommendation of the TAP is for DSOD to develop, implement and fully integrate a RIDM program generally consistent with the Federal standards as is appropriate for a large State regulatory program. RIDM be incorporated into to all aspects of the DSOD program. Risk management has become the standard of practice in many dam safety organizations and within major dam owner organizations throughout the United States and the world. Dam safety risk is defined as the product of the likelihood of an event and the consequences of that event. Risk analysis methodologies provide a tool to further comprehend the interactions of performance observations, loading probabilities, and engineering analyses to better understand the risk of failure. Risk analysis methodologies are also used to evaluate the potential for a sequence of unusual events and decisions that can lead to a system failure.

Although DSOD has historically used risk concepts in its reevaluations to inform its decision making, the processes were performed on a case-by-case basis in a subjective and informal manner utilizing the expertise within its division. Since DSOD’s objectives were to understand the performance of its structures from a standards-based approach, probability of failure and downstream consequences were considered qualitatively rather than quantitatively, as is the level that is now standard practice in many Federal dam safety organizations.

Risk management will allow DSOD to screen for and prioritize reevaluation studies given its limited resources and provide a rational basis for identifying dam system components requiring risk reduction measures. Risk analysis complexity should be commensurate to the level of risk posed by the dam systems and should include, as appropriate, Potential Failure Mode Analysis (PFMA), probabilistic

approached to dam safety analyses, dam break analysis, inundation mapping, life loss estimates, and economic damages estimates.

Recognizing that it has taken Federal agencies decades to establish an RIDM program, the TAP recommends that DSOD undertake a phased approach toward development of a RIDM program that would include:

1. **Establishing a Cadre as soon as possible, but, no later than the first quarter of the calendar year 2020** – Establish a cadre of senior-level, multidiscipline technical staff with the interest and commitment to develop and integrate a RIDM program. The cadre would have the following responsibilities:
  - Review the protocols of other dam safety programs such as Reclamation, ANCOLD, Federal Energy Regulatory Commission, Tennessee Valley Authority, National Park Service, USACE, and smaller programs. (See “References.”)
  - Develop an overall framework for the RIDM program that enhances the existing program.
  - Develop RIDM policies, guidelines, governance, and methodologies.
  - Conduct risk training for staff.
  - Perform dam owner outreach to educate and build support for RIDM.
  - The state's regulatory role is to provide the critically important oversight and technical assessments/reviews to assure the citizens of California that the dams do not present unacceptable risks. California DSOD should evaluate the role of dam owners and DSOD in the RIDM process. It may be more appropriate to require the owner to perform detailed risk analysis with DSOD providing guidance and oversight since dam owners carry the primary responsibility for the safety of their dams. Direct involvement of the dam owners in this process will educate the dam owners of their liability and strengthen their support for needed dam repairs and other dam safety actions. Involvement of DSOD will help ensure consistency across the portfolio of regulated dams.
2. **Developing and Implementing a Risk Screening** – Develop and implement a risk screening of all high- and extremely high-hazard potential dams in the program using available information.

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3. **Identifying a Set of Dams** – From the risk screening, identify a set of dams to complete more in-depth risk studies.
4. **Building the Capacity of the Program** – Each year, build the capacity of the program to accomplish formal risk studies with the goal of completing the studies for all high- and extremely high-hazard potential dams.

The following amendments are integral to RIDM and need to be concurrently implemented:

5. **Creating an Electronic File System** – Given DSOD’s vast file system of data and information originating back to the construction of many of the dams within its inventory, DSOD should consider electronically scanning all official records. Having an electronic file system will provide DSOD an efficient means in researching information on a dam for the purpose of its inspections and reevaluation studies. If information is not in DSOD’s possession, it should be obtained from all sources possible.
6. **Using Multidiscipline Teams** – Instead of single inspectors, DSOD should consider using multidiscipline teams that are appropriate to evaluate the components of a given dam for comprehensive inspections of high- and extremely high-hazard dams on a periodic basis. This may include geologists along with geotechnical, structural, hydraulic and hydrologists, mechanical, and electrical engineers. Inspectors should all be trained on potential failure modes, and inspections should be focused on looking for indicators that could lead to initiation of failure modes.
7. **Develop and use a Checklist Type Inspection Form** – DSOD should develop and implement a checklist type inspection form where data can be tracked in a database.
8. **Using Outside Expertise** – DSOD should consider using outside expertise as the program is developed and implemented.

While no timeframes for the phased approach have been established, the TAP recommends that DSOD begin adopting a more formalized risk program into the reevaluation component of its Dam Safety Program.

Incorporating risk management into a dam safety program can be a significant effort. The DSOD will require additional staffing and funding for the recommended activities.



## Funding Recommendations

Currently, DSOD is funded solely by dam owners, and recent enhancements to the program have caused considerable increases in the annual fees they pay. Additional costs have also been imposed on dam owners due to the new legislative requirements and mandates for inundation maps, emergency action plans, inspections, and spillway reevaluations. These requirements have resulted in financial hardship to many dam owners, particularly private entities, small utilities, districts, and municipalities. The dams in California provide great benefit to the State as a whole, such as power production, water supply, flood control, environmental, irrigation, and recreation. Given the critical role that dams play in California's economy and in the interest of public safety, the TAP believes that the costs to implement these enhancements should be supported by legislation that will provide appropriated funding.

The TAP also observed that there are limited State funding opportunities for underfunded dam owners to make the necessary repairs and modifications to their dams. Typically, smaller private and public dam owners do not have a mechanism to pass the increasing costs associated with dam ownership to ratepayers like large municipalities and power utilities. In the interest of public safety and to ensure dams in California are safe, the TAP recommends that the State establish low-interest revolving loan programs for underfunded dam owners, as established in other States across the Nation.

## **References (for RIDM Adoption)**

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