



DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS
441 G STREET, NW
WASHINGTON, DC 20314-1000

REPLY TO
ATTENTION OF

SEP 12 2014

CECW-CE

MEMORANDUM FOR FILE

SUBJECT: Response to 2013 Independent External Peer Review of the U.S. Army Corps of Engineers Dam Safety Program

1. An Independent External Peer Review (IEPR) was conducted for the U.S. Army Corps of Engineers (USACE) Dam Safety program in accordance with Civil Works Review policy EC 1165-2-214, and the Office of Management and Budget's Final Information Quality Bulletin for Peer Review. This program review was at USACE discretion and is not related to any statutory mandate.
2. USACE contracted with Schnabel Engineering Consultants (Schnabel) to perform an IEPR of the USACE Dam Safety Program. The IEPR Team selected by Schnabel consisted of a project manager and a four member panel of reviewers with expertise in dam safety, dam engineering, and management of a dam safety program.
3. I approve the final written responses to the IEPR in the enclosed document. The IEPR Report and USACE responses will be posted on the internet to share lessons learned with other dam owners.
4. The point of contact for this review is Barbara Schuelke, HQ Dam Safety Program Manager, at (202) 761-4643.

STEVEN L. STOCKTON, P.E.
Director of Civil Works

Encl



DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS
441 G STREET, NW
WASHINGTON, DC 20314-1000

REPLY TO
ATTENTION OF

CECW-EC

SEP 9 2014

MEMORANDUM FOR DIRECTOR OF CIVIL WORKS

SUBJECT: Response to 2013 Independent External Peer Review of the U.S. Army Corps of Engineers Dam Safety Program

1. References:

- a. EC 1165-2-214, Civil Works Review, 15 Dec 2012
- b. Office of Management and Budget, Final Information Quality Bulletin for Peer Review, 2004
- c. Federal Emergency Management Agency, 1979 (Jul), "Federal Guidelines for Dam Safety," FEMA 93, Washington, DC

2. An Independent External Peer Review (IEPR) was conducted for the U.S. Army Corps of Engineers (USACE) Dam Safety program in accordance with Civil Works Review policy EC 1165-2-214, and the Office of Management and Budget's Final Information Quality Bulletin for Peer Review. This program review was at USACE discretion and is not related to any statutory mandate. USACE contracted with Schnabel Engineering Consultants (Schnabel) to perform an IEPR of the USACE Dam Safety Program. The objective of the IEPR was to examine how well the USACE is implementing the Federal Guidelines for Dam Safety and executing its stated mission. The review provided an external view of the policies, procedures, and performance of the USACE Dam Safety Program.

3. The USACE Dam Safety Program uses a risk-informed approach to manage its portfolio of 707 dams, with public safety as the highest priority. This risk-informed approach was adopted to improve our understanding of the safety of our dams, better communicate the risks and benefits of the dams, and to enhance dam safety decisions. The Dam Safety Program seeks to ensure that USACE owned and operated dams do not present unacceptable risks to people, property, or the environment.

4. An IEPR team was selected by Schnabel and approved by USACE, consisting of a project manager and a four member panel of reviewers with expertise in dam safety, dam engineering, and management of a dam safety program. Selection of expert reviewers for IEPR efforts was in accordance with the National Academy of Science (NAS) Policy on Committee Composition and Balance and Conflicts of Interest.

5. The Panel conducted its review of the Dam Safety Program between May and October 2013. The review encompassed routine and non-routine dam safety activities being performed by Headquarters (HQ), the Dam Senior Oversight Group (DSOG), Risk

CECW-EC

SUBJECT: Response to 2013 Independent External Peer Review of the U.S. Army Corps of Engineers Dam Safety Program

Management Center (RMC), Dam Safety Production Centers (DSPC), Modeling, Mapping, and Consequence Center (MMCC), Divisions (MSCs), and Districts.

6. Schnabel issued the final IEPR report on November 22, 2013 with twenty-six (26) Comments. The IEPR team rated the comments as either Category A – Critical, Category B – Urgent, Category C – Important, or Category D – Other.

a. Critical: The issue has the potential to significantly degrade or undermine the Dam Safety Program, or otherwise can lead to dramatic negative consequences. Includes “must do” recommendations.

b. Urgent: The finding is of significant importance to the program and can provide substantial dam safety benefits.

c. Important: The recommendation is worthy of implementation and would likely provide a definitive return on investment. Timeline for implementation could be long.

d. Other: Observations, considerations and perspectives worthy of USACE review regarding its Dam Safety Program.

7. The USACE responses to individual IEPR comments are enclosed. Recommend adopting seventeen (17) of the panel recommendations, partially adopting seven (7), not adopting one (1), and one (1) had no action required. Additional explanations of the partially adopted are included in the responses. Actions have been prioritized in consideration of the above categories and are being implemented within current priorities as funding permits. Many actions will be phased such as updating guidance first, then revising associated procedures, followed by training to aid the field with implementation.

8. The agency responses were coordinated with the panel. Request your approval of the IEPR report and our agency responses to the panel findings and recommendations.

9. The point of contact for this review is Barbara Schuelke, HQ Dam Safety Program Manager, at (202) 761-4643.

Encl



JAMES C. DALTON, P.E., SES
Corps Dam Safety Officer
Directorate of Civil Works

USACE Responses to the 26 Independent External Peer Review
Comments on the Dam Safety Program.

Note: The USACE action lead organization or entity includes the following:
Headquarters (HQ), Dam Safety Steering Committee (DSSC), Dam Senior Oversight
Group (DSOG), Institute of Water Resources (IWR), Risk Management Center (RMC).

1. IEPR Comment – Category B - Urgent: The leadership and management of a Dam Safety Program of the size and nationwide breadth of the USACE requires a full time Dam Safety Officer (DSO) with dam safety knowledge, expertise and experience. The Chief, Engineering and Construction has too many other responsibilities to be able to serve as the DSO.

The panel experts recommended the following actions to resolve this comment:

The Dam Safety Officer of the USACE Dam Safety Program should be a full time senior level position staffed by a professional engineer with knowledge, expertise and experience in dam safety, and a clear commitment to the program's mission.

USACE Lead Organization or Entity: Headquarters (HQ)

USACE Response: **Partially Adopted.** USACE assignment of the Dam Safety Officers, including at the agency headquarters, exceeds the letter and the spirit of the Federal Guidelines for Dam Safety and the subject IEPR comment. No further action is required. The Federal Guidelines are quoted below with summary of USACE dam safety governance:

- (1) "The head of each Federal agency having responsibility for design, construction, operation, or regulation of dams should establish a dam safety office (officer) which reports directly to the head of the agency or his designated representative". USACE is compliant with this requirement via the assignment of the agency Dam Safety Officer (DSO) to a Senior Executive Service Member that reports to the agency head. The DSO is supplemented with three full-time senior staff positions (GS-15) at the headquarters to aid administration of dam and also levee safety programs:
 - a. Special Assistant for Dam and Levee Safety that reports directly to the HQ DSO,
 - b. Dam Safety Program Manager (DSPM) that supports the Special Assistant
 - c. Levee Safety Program Manager that supports the Special Assistant.

These offices are further informed and supported by DSOs and DSPMs at the District and Division level, that have similar roles but at the local and regional levels. All positions are selected based on qualifications, requiring relevant experience, education, and professional registration.

Enclosure – IEPR Responses

- (2) “The functions of the office should be advisory to the agency head, and through the agency head to the agency administrative and technical units. The staffing and detailed duties of the office should be commensurate with the agency mission.” The USACE program and DSOs function in the manners specified, with supporting staff that are commensurate with the mission including three robust national technical centers and six regional production centers. USACE views dams and levees as a portfolio of infrastructure with similar challenges and needs that demand an integrated management and leadership approach. Also, the USACE approach to leading, managing, and staffing the program leverages a broad host of competencies provided from other, complimentary mission areas.

2. IEPR Comment – Category B - Urgent: In conjunction with the finding that the USACE have a full time Dam Safety Officer (DSO), it is equally important for there to be active, informed oversight of the Dam Safety Program. This oversight can best be provided by the Chief, Engineering and Construction, whose responsibility should include the review of the overall Dam Safety Program, and the review and contribution to the program’s mission, strategic plan, and overall fiscal planning.

The panel experts recommended the following actions to resolve this comment:

The DSO shall report to the Chief, Engineering and Construction, who should have dam safety knowledge and provide program implementation and strategic planning oversight.

USACE Lead Organization or Entity: Headquarters (HQ)

USACE Response: **Not Adopted**. USACE concurs with the need for having full-time, active and informed oversight of the program and believes our current governance structure meets and exceeds the Federal Guideline DSO requirements as described in comment 1 response.

3. IEPR Comment – Category C – Important: Staff has undergone major change over the past five years, which can lead to frustrations and misunderstandings, and, in turn, to mistrust. Communications are strained by new demands and organizational changes. There exists a common thread of subdued, but hopeful, optimism. The door is open for coalescing team community and commitment. HQ leadership is generally viewed positively, which is a powerful message. However, Divisions and Districts sense that HQ is not giving adequate credibility to their concerns and does not communicate with sufficient candor or frequency.

The panel experts recommended the following actions to resolve this comment:

There is a need to recognize staff at HQ, Divisions, Districts and Centers as mutually critical. Full time leadership is needed to develop a strategy that will build unity and common purpose, and better instill common passions and values to all levels. Key HQ dam safety personnel need to make more visits to Divisions

Enclosure – IEPR Responses

and Districts. This will provide a significant morale lift, providing closer connectedness with the mission. Candid, regular communications are needed to build trust and unity. The IEPR Team applauds the HQ leadership for the exceptional job it is doing and for the passion, dedication and focus it provides. Because HQ is asking staff to do more – HQ efforts and actions need to be more visible and more accessible, so that HQ is seen as doing more than is currently visible to staff.

USACE Lead Organization or Entity: Headquarters (HQ)

USACE Response: **Adopted**

Action to be Taken:

HQ recognizes the need expressed in the comment. In order to foster a clear understanding of the mutually critical roles and responsibilities of team members at all levels of the organization and to build team unity the USACE will continue to conduct a biennial dam safety workshop that includes HQ, Risk Management Center (RMC), Modeling Mapping Consequence Center (MMCC), Dam Safety Production Centers (DSPC), Division, and District management and staff.

Division Dam Safety Committee meetings are conducted at least annually and are attended by district dam safety and DSPC representatives from the respective region. Division Dam Safety Program Manager will assure appropriate representatives from HQ, RMC, and MMC are included either in person or virtually, as appropriate, in the meeting agenda to share current information and also to foster internal communication and relationships.

Some of the more complex and expensive dam safety projects in design and construction will be managed with mega-projects requirements, ECB 2013-11. HQ Senior Leaders and Engineering and Construction staff as well as Division, RMC and DSPC senior engineers will serve in an oversight and advisory role to the project teams, providing a framework for structured and regularly scheduled vertical team interaction with the field.

USACE will continue to provide technical dam safety focused webinars to build capability and unity in the program. This virtual training, necessitated by travel and budget constraints, has the advantage of recordings which can be referred to by a larger number of employees on an as needed basis. USACE will continue to provide quarterly DSO Updates (Dam Community of Practice internal newsletter).

4. IEPR Comment – Category C - Important: The USACE Dam Safety Program has gone through considerable change; however, there remains more to be done. The evolution that has taken place to date has been extremely positive. There is considerable need to assimilate the new tools and processes. This is a long-term proposition, so a long view is needed. Building a focus on training and building confidence in working with new tools requires collaboration, communication and trust

Enclosure – IEPR Responses

(Finding 2013-C-03). This positions USACE to accomplish more with available resources.

The panel experts recommended the following actions to resolve this comment:

USACE HQ and RMC should focus on advancing staff experience and expertise related to the recent changes in processes and procedures. This could be accomplished through both training and providing opportunities for staff to work on projects led by the experts that developed the new processes. USACE should prioritize ongoing changes to streamline and advance their objectives, and regulate changes to avoid overwhelming USACE staff.

USACE Lead Organization or Entity: Dam Safety Steering Committee (DSSC)

USACE Response: **Adopted**

Action to be Taken:

USACE will update the Dam Safety Career Paths and Developmental Plan, including continuing the appropriate training, webinars and other communication avenues to broadly share information about changes in dam safety related policies and procedures across the organization and beyond the traditional target audiences of Engineering Division / Dam Safety offices. The documents will be reviewed annually by the DSSC, updated as necessary, and made available to all personnel who may have a current or future interest in the program.

The existing Development Plan maps recommended career development for the USACE District DSO, DSPM, DS Modification Lead Engineer and DS Project Manager and will be evaluated for inclusion of others. Developmental assignments and training have been structured and scheduled to provide opportunities for field staff to learn from and work directly with experts that were involved in developing the process and tools, to the extent practicable. Additionally, USACE will continue to provide quarterly DSO Updates (Dam Community of Practice internal newsletter) and quarterly webinars on hot topics or new policies.

USACE will continue to align on-going training with policy changes as needed.

5. IEPR Comment – Category B - Urgent: Whereas ER 1110-2-1156 is key to the USACE Dam Safety Program, a peer review of the current document has not been performed and is warranted.

The panel experts recommended the following actions to resolve this comment:

The USACE should conduct a comprehensive external peer review of ER 1110-2-1156 and in particular its risk-informed elements (methodology, training, etc.) and how risk analysis concepts and risk-informed management are being

Enclosure – IEPR Responses

implemented. The review should be carried out in a manner that takes full advantage of the longer and more extensive experience in other areas of civil engineering and the sciences where risk analysis and risk-informed decision making have been implemented.

USACE Lead Organization or Entity: Headquarters (HQ)

USACE Response: **Adopted**

Action to be Taken:

USACE plans to conduct the next Independent External Peer Reviews (IEPR) of its Dam Safety Program in 2016. In response to this recommendation, a focus of the next Dam Safety Program IEPR will be on ER 1110-2-1156, and how its risk informed elements, risk analysis concepts, and risk-informed management are being implemented.

6. IEPR Comment – Category B - Urgent: There are a number of USACE ERs and EMs that are out-of-date and/or whose basis and approach are likely inconsistent with a risk-informed/performance-based approach to engineering analysis and design.

The panel experts recommended the following actions to resolve this comment:

It is recommended the USACE review the status of their ERs and EMs that are important to dam safety and develop a plan to systematically revise them in a manner that is consistent with risk-informed and performance-based methods. Once developed, independent external peer review of these documents should be carried out to review their technical adequacy and consistency with state-of-practice methods.

USACE Lead Organization or Entity: Headquarters (HQ)

USACE Response: **Adopted**

Action to be Taken:

A prioritized engineering guidance update plan has been developed and is implemented within budget constraints. As these products are developed, they will be evaluated on a case by case basis for external peer review.

7. IEPR Comment – Category D - Other: In the last seven years, the USACE has made risk-informed management the foundation of the dam safety program. This is a positive step for the agency, for staff, for use of the nation's resources, and the management of a major part of the nation's infrastructure. Re-direction from a standards-based approach to a risk-informed program is a clear measure of the scale and effectiveness of change that has taken place.

The panel experts recommended the following actions to resolve this comment:

Enclosure – IEPR Responses

There is not a specific recommendation to be implemented by USACE regarding this finding. USACE is to be commended for the major positive changes in the program in incorporating risk-informed management.

USACE Lead Organization or Entity: Headquarters (HQ)

USACE Response: **Comment much appreciated, no response necessary**

8. IEPR Comment – Category C - Important: A focus on public safety is clearly appropriate for dams that may have significant consequences in the event of uncontrolled release of the reservoir. However, it is not clear the current focus is consistent with the broad agency responsibility of managing a critical part of the nation's infrastructure. In fact, it appears it is inconsistent with Office of Management and Budget (OMB) principles. Discussions with all levels of USACE/dam safety program staff suggest the program may be too narrowly focused and that OMB principles are not being met.

The panel experts recommended the following actions to resolve this comment:

The USACE should examine the focus and implementation of the dam safety program as it relates to the degree to which its practices are consistent with OMB principles which it says it is following. The USACE should conduct a comprehensive peer review of ER 1110-2-1156 and in particular its risk-informed element (methodology, training, etc.) and how risk analysis concepts and risk-informed decision-making is being implemented.

USACE Lead Organization or Entity: Dam Senior Oversight Group (DSOG)

USACE Response: **Partially Adopted**

Action to be Taken:

USACE will include a review of ER 1110-2-1156 in the next Independent External Peer Review (IEPR).

For the comment regarding narrowness of focus on life safety associated with uncontrolled reservoir release, USACE will re-evaluate policy and procedures for other risk considerations.

In reference to compliance with OMB principles, USACE does not concur with the IEPR comment: "In fact, it appears it is inconsistent with Office of Management and Budget (OMB) principles". Evidence for this position follows:

- Appropriate use of and references to The OMB principles of risk management, (U.S. Office of Management and Budget (OMB) 1995; Memorandum for Regulatory Working Group, Principles for Risk Analysis (1995) and U.S. Office of Management and Budget (OMB)

Enclosure – IEPR Responses

2007 Updated Principles for Risk Analysis, September 19, 2007), exist throughout our Dam Safety policy and our practices. We believe this will be confirmed in the future Independent External Peer Review (IEPR) of ER 1110-2-1156.

- Every risk analysis and risk assessment performed by USACE on dams in its portfolio has calculated, evaluated and considered the economic risks inherent in the system, and where available, the environmental and cultural risks associated with a decision. This practice is consistently reflected in our characterization of risks via DSAC, as evidenced by the number of DSAC 1 and 2 navigation projects for which there are no loss of life risks.
- USACE approach to assessing and managing risks, including the priority of investments, is coordinated with the Assistant Secretary of the Army for Civil Works (ASA CW) and OMB on an annual basis – they have been supportive and complimentary of the current approach.
- Investments in the modification of non-life safety projects, such as navigation, have been substantial in recent years.

9. IEPR Comment – Category B - Urgent: The current practice to estimating extreme inflows appears to be the extrapolation of flood frequency distribution. This approach does not take into account modern methods of statistical analysis, hydrologic and stochastic modeling methods and uncertainty analysis. The current USACE regulation for the development of the inflow design flood for spillways and reservoirs is established in ER 1110-8-2. As described in ER 1110-8-2, the PMF is used for most USACE projects. In the context of a risk-informed dam safety management program, there is no logical basis for the consideration or use of the PMF or related concepts in establishing the design basis for spillways and reservoirs, or as a basis to measure the safety of a dam or the risk to the public.

The panel experts recommended the following actions to resolve this comment:

USACE should develop and implement modern approaches to the assessment of flood frequencies at dams that include the assessment of epistemic uncertainties, which is the standard practice in the analysis of extreme events. The approach should include alternative levels of analysis that reflect the varying project needs of the USACE and the level of risk for dams across its portfolio. In addition, ER 1110-8-2 should be revised to reflect a full-scope probabilistic approach to developing inflow flood frequencies and design floods for spillways and reservoirs.

USACE Lead Organization or Entity: Headquarters (HQ)

USACE Response: **Partially Adopted**

Enclosure – IEPR Responses

Action Taken:

USACE will not adopt the recommendation for a *fully* probabilistic based approach for selecting inflow design floods. However, methods and tools for estimating inflow design floods will be updated and improved to support credible risk informed decisions. Because the USACE dam safety program is risk informed (not risk based), engineering design standards will continue to be used as appropriate in conjunction with risk estimates and other factors to inform dam safety decisions. Note that USACE currently provides technical guidelines and recommendations for several modern approaches in the Best Practices Manual for Dam and Levee Safety Risk Analysis and in a draft Hydraulics and Hydrology (H&H) methodology guideline document.

USACE adopts the panel recommendations to make improvements to methods and tools for stochastic modeling and uncertainty analysis through several ongoing research and development efforts. Additional improvements include the following:

- a. Develop and enhance in-house core competencies in hydrology, meteorology, and risk analysis through additional education, training, and experience opportunities.
- b. Establish a senior level meteorologist position within USACE,
- c. Establish a cadre or center of expertise for hydrologic hazard analysis,
- d. Develop a comprehensive database of historical extreme storm events.
- e. Update the hydrometeorological reports for application at all dams and supplement with site specific studies for dams with hydrologic risk drivers.
- f. Modify existing hydrologic software tools to include capability for developing and evaluating design storms.
- g. Develop GIS based tools for storm analysis,
- h. Update guidance to explicitly include consideration and communication of uncertainties in Probable Maximum Precipitation PMP and Probable Maximum Flood PMF estimates.
- i. Update guidance to utilize expert elicitation to characterize epistemic uncertainties and to explore plausible scenarios that have not been observed in the historic record (the unknown unknowns).
- j. Update guidance to clarify the intent and purpose of PMP and PMF estimates.

Enclosure – IEPR Responses

k. Research emerging methods for use in informing PMP estimates.

10. IEPR Comment – Category C - Important: Observations and discussions during the IEPR suggest unwarranted variations in the consistency and quality of the risk cadres. Part of the consistency and knowledge issues may be due to foundational educational and experience requirements RMC has established for staffing the risk cadres. Coupled with this may be the need to establish risk cadres that are formed around dam safety risk generalists.

The panel experts recommended the following actions to resolve this comment:

USACE should review and evaluate the performance of the risk cadres, how they are constituted (membership), what their roles and responsibilities are when risk studies are performed, etc. USACE should also establish a dam safety risk generalist position and include individuals in this position in each cadre. This position should have the 'specialty' educational and experience requirements similar to what is required for other dam engineering topical areas (i.e., hydrologists, geotechnical engineers, etc.).

USACE Lead Organization or Entity: Risk Management Center (RMC)

USACE Response: **Adopted**

Action to be Taken:

USACE will develop more formal guidelines to review and evaluate the performance of risk cadres on an annual basis. USACE is also in the process of identifying the educational, training, and experience requirements for the development of dam/levee safety risk analysts.

11. IEPR Comment – Category C - Important: The quality and consistency of PAs is important to the quality of the USACE risk management program. Issues with consistency and quality in applications and documentation have been identified. This included a series of problematic PAs presented at the DSOG meeting attended during the IEPR.

The panel experts recommended the following actions to resolve this comment:

The RMC should assess the root causes of risk analyses that have failed to meet its quality and consistency standards and, as appropriate, provide more and better training, make changes to procedures, modify the role of risk cadres, clarify the role and responsibilities of facilitators, and provide uniform guidance to district staff.

USACE Lead Organization or Entity: Risk Management Center (RMC)

USACE Response: **Adopted**

Enclosure – IEPR Responses

Action to be Taken:

USACE reviewed the root causes of Periodic Assessment (PA) risk analyses that failed to meet quality and consistency standards. USACE developed and implemented appropriate revisions to policies and procedures to ensure quality and consistent PA work products and processes. Training will continue to be conducted following Dam Senior Oversight Group meetings as necessary to share future lessons learned with facilitators and district staff.

12. IEPR Comment – Category B - Urgent: Operations at dams can involve various staff levels, processes, and structure, system and component reliability. Understanding and mitigating operational risks are difficult without the benefit of systems-based risk analyses that look specifically at these aspects of dam operations and performance. The potential for the USACE to fail one of its own dams as a result of misoperation might be a consequence of not understanding how the dam system performs during the full range of operating scenarios.

The panel experts recommended the following actions to resolve this comment:

The USACE Dam Safety Program should include operation risk analysis, which is necessarily a systems-based assessment of dam operations. As appropriate, the results (lessons and insights) of these studies should be integrated into project operating procedures, emergency action plans, training, etc. This recommendation is a natural subset of the recommendations associated with incorporating systems-based methods into the Dam Safety Program (Finding 2013-B-15).

USACE Lead Organization or Entity: Risk Management Center (RMC)

USACE Response: **Adopted**

Action to be Taken:

USACE recognizes that operational risk analysis is an important element to decision making on dams and believe that the current approaches to this risks can be further examined to enhance evaluation. The major component of this risk that current USACE efforts have focused on has to do with the non-breach risks involved in simply following our water control manuals – in some cases, this is substantial. Risks analyses also consider potential failure modes that are operational in nature. To date, such PFMAs have not been major drivers of risk. Lastly, the Asset Management Program in USACE has a mature process to examine operational condition assessments and risks in order to prioritize investments in major maintenance packages – this program was not part of the IEPR scope of work.

The USACE annual budget guidance for the Flood Risk Management business line includes the following “FRM Priority Investment Objectives” along with their

Enclosure – IEPR Responses

respective “Metrics”, which will be reviewed and modified, if required, with Human and Mechanical Reliability in mind.

- a. Efficiently fund operation of USACE FRM projects to maximize investment (OM) and
- b. Maximize investments in maintenance to ensure that these projects will perform as designed (OM).

The Human Reliability (people, process and procedures) should also inform, and refine the required operational Levels of Service (LoS) at each of our project sites. Additionally, to address Mechanical Reliability, the Asset Management program is in the process of developing and implementing a Maintenance Management Improvement Plan (MMIP) and Strategy that aligns specific maintenance activities (preventive, recurring, corrective etc) with Levels of Performance (LoP) desired at each project site.

13. IEPR Comment – Category C - Important: The USACE Dam Safety Program is currently focused on the assessment of public safety risks and their management. This focus is appropriate (in general) and clearly an advantage of a risk-informed approach. There are other opportunities for using risk concepts and the results of risk analyses to support many of the elements of the Dam Safety Program. It appears the development and implementation of risk-informed concepts to all aspects of dam safety and more broadly the management of the USACE dam infrastructure have not occurred. There does not appear to be a clear plan/approach to the implementation of risk analysis insights and lessons to all aspects of the program. As such, the notion of having a risk-informed dam safety program is limited.

The panel experts recommended the following actions to resolve this comment:

The USACE should plan for and evolve to the utilization of risk-informed approaches to support all elements of the Dam Safety Program and Asset Management.

USACE Lead Organization or Entity: Risk Management Center (RMC)

USACE Response: **Adopted**

Action to be Taken:

Although USACE is implementing risk analysis in an increasingly more comprehensive manner (non-breach risks, operational PFMs, targeted instrumentation and monitoring, Interim Risk Reduction Measure plans, asset management, etc...), we concur that there is room for improvement in how it is applied. To be clear, we do not believe risk analysis is the decision tool for all aspects of the program – many routine activities are deterministic in nature and should remain that way. However, ER1110-2-1156, annual budget guidance, and

Enclosure – IEPR Responses

Maintenance Management Improvement Plan will be reviewed, and modified as appropriate to incorporate risk informed approaches more broadly for the maintenance, inspections, and other routine Dam Safety Program activities in coordination with the Asset Management Program.

14. IEPR Comment – Category B - Urgent: The guidance in ER 1110-2-1156 with regard to the evaluation of uncertainties is limited. This leads to inconsistency with respect to how uncertainties are identified, evaluated, and ultimately integrated into a risk analysis and the management of risks. In principle, there is no clear evidence the guidance in ER 1110-2-1156 is followed. While sensitivity calculations are a useful step in understanding the effects of uncertainties, they are not a replacement for a more thorough evaluation and incorporation in a risk analysis.

The panel experts recommended the following actions to resolve this comment with regard to the evaluation of uncertainties:

- a. ER 1110-2-1156 should be expanded to include an in-depth discussion of uncertainties that includes a framework for their assessment, methods for uncertainty evaluation and recommendations for the level of analysis that is required for different applications.
- b. Development of training to describe the evaluation of uncertainties (material in ER 1110-2-1156), with examples, elicitation training, etc.
- c. Development of tools to perform the calculations required in risk quantifications where uncertainty analysis is required.

USACE Lead Organization or Entity: Risk Management Center (RMC)

USACE Response: **Adopted**

Action to be Taken:

- a. USACE will revise policy documents (ER 1110-2-1156) and methodology documents (e.g. Best Practices in Dam and Levee Safety Risk Analysis) to document the use and application of uncertainty in dam and levee safety risk analyses. Policy will define and identify when uncertainty will be included in the risk analysis process and to what level of detail it will be provided. The methodology documents will identify how to elicit uncertainty, how to analyze and evaluate uncertainty, and how to report the results of uncertainty in dam and levee safety risk analyses.
- b. USACE has been actively pursuing revisions to both Dam Safety Risk Analysis Engine (DAMRAE) and @risk software to incorporate uncertainty functions and analysis/output capabilities to evaluate uncertainty in dam and levee risk analyses. These efforts are currently underway.

Enclosure – IEPR Responses

c. Following completion of recommendations a. and b., training of RMC, cadre, and district personnel will be performed to aid implementation of the revised policy and methodology, and provide examples of the use and interpretation of uncertainty in risk analyses.

15. IEPR Comment – Category B – Urgent: While not exclusively the case, it appears that USACE risk analyses do not generally take a systems-based approach. In addition, the notion of systems-based risk analysis did not seem to be part of the experience or mindset of most USACE staff who were interviewed.

The panel experts recommended the following actions to resolve this comment:

USACE should incorporate systems-based approaches to the evaluation of dams. As part of this effort, thought should be given to:

- a. Levels of systems-based analyses that are required for different applications.
- b. The elements of the Dam Safety Program that may be supported by systems-based applications.
- c. Development (or acquisition) of tools to support systems-based analysis.

USACE Lead Organization or Entity: Institute of Water Resources (IWR)

USACE Response: **Partially Adopted**

Action to be Taken:

USACE is somewhat restricted in adopting true, large scale systems approach as Congress generally authorizes and funds by specific project, with an identified specific sponsor and cost sharing entity. Approaches which seek to reallocate risk reduction measures more cost effectively within a larger system require a cost shared sponsor and Congressional authorization. USACE has system wide authorities in limited areas, and that may be the reason why the approach was not as familiar with those interviewed.

USACE methodology documents (e.g. Best Practices in Dam and Levee Safety Risk Analysis) document the use and application of systems-based risk analyses. USACE will continue training efforts to further educate personnel on risk methodology including system-based analyses.

USACE recognizes the benefits of systems based approach in evaluating not only dams, but entire watersheds. As a first step, USACE has initiated the implementation of the Corps Water Management System (CWMS) on a watershed basis across the nation. CWMS allows for analyses of systems including not only dams, but levees and other water control structures. It is an automated information system supporting the USACE Water Management

Enclosure – IEPR Responses

mission. CWMS integrates real-time data acquisition, database storage, flow forecasting of watershed runoff, reservoir operations decision support, river profile modeling, inundation area determination, consequence/damage analysis, and information dissemination into a comprehensive suite of software supporting water management decision processes.

USACE will adopt the recommendation to incorporate system based approaches in analyzing dams by utilizing the implementation of CWMS in its 213 USACE operational basins. The use of CWMS models will help inform USACE dam safety portfolio decisions by better understanding system variables and relationships. CWMS is currently being operated in 30 basins.

16. IEPR Comment – Category B – Urgent: USACE uses the USGS national hazard map to estimate the ground motion hazard at dam sites as part of the risk analysis performed for a PA. The analysis that is the basis for the USGS seismic maps is not adequate to support risk analyses for critical infrastructure facilities. Based on experience in comparing the USGS PSHA results to the results of full-scope PSHAs in the U.S. suggests use of USGS seismic maps may be either conservative or non-conservative. As a consequence, they cannot be considered a reliable basis to estimate the seismic risk of USACE dams.

The panel experts recommended the following actions to resolve this comment:

The USACE should examine and implement an improved approach for estimating earthquake ground motion hazards at project sites. The approach that is developed should be applicable to the various levels of analysis that are required and levels of risk. There are opportunities for doing this in a reasonable, efficient, and technically sound manner that will provide greater consistency across its portfolio. This examination should recognize and be consistent with the current standard-of-practice in PSHA.

USACE Lead Organization or Entity: Risk Management Center (RMC)

USACE Response: **Adopted**

Action to be Taken:

USACE will develop and implement an improved approach for estimating seismic ground motion hazards at project sites where risks warrant more in-depth studies. USACE will investigate and evaluate methods to estimate seismic ground motion hazards for use in dam and levee safety risk analyses including approaches used by the NRC and US Bureau of Reclamation.

17. IEPR Comment – Category A – Critical: The management, implementation and coordination of EAPs continue to exhibit the problems and deficiencies documented in the 2001 ASDSO Peer Review. There appears to be no USACE management or oversight above the District office level to drive consistent, quality implementation of

Enclosure – IEPR Responses

EAPs, including the importance of a strong and collaborative relationship between USACE and the local EMAs, and close emergency management coordination considered the state of practice for dam safety programs.

The panel experts recommended the following actions to resolve this comment with regard to implementation of EAPs:

- a. The management and oversight of the EAP program should be raised to the HQ level, including development of a database tracking system to certify that all USACE dams have an effective, up to-date EAP.
- b. A USACE-wide initiative should be implemented to ensure the effectiveness of the EAP by raising the leadership and staff's awareness of the importance of a strong relationship and close coordination between the dam owner and the downstream local emergency management agencies.
- c. USACE should meet annually, at a minimum, with the local EMAs to ensure understanding of what to expect during a dam-related emergency, and be provided the information they need to plan the appropriate evacuation procedures. During the annual communication with the local EMA, USACE should specifically review the amount of time the detection and confirmation of the emergency will require, and the time it will take to notify the local EMA of the emergency. This should be compared to the amount of time before the nearest affected downstream development is impacted by the flood flows associated with the emergency and the amount of time the local EMA needs to accomplish timely notifications and/or evacuations, if necessary.

USACE Lead Organization or Entity: Dam Safety Steering Committee (DSSC)

USACE Response: **Partially Adopted**

Action to be Taken:

USACE will conduct a comprehensive review of all applicable guidance and regulations and revise and/or provide clarification as necessary to ensure that updates, exercises, and reviews of EAPs are in accordance with the Federal guidelines.

- a. USACE will maintain certification of EAPs at District and Regional level. Effectiveness will be addressed through exercises on systems and/or on individual projects. USACE has a central database that tracks the existence and currency of EAPs. Note USACE is compliant with Federal Guidelines regarding EAPs. District Dam Safety Officers are responsible per ER 1110-2-1156 for development of EAPs as well as keeping the EAPs current, accurate and complete. Division Offices manage implementation and HQ provides oversight. HQ will review EAP metrics and make improvements to better assess EAP effectiveness.

Enclosure – IEPR Responses

b. USACE will implement an agency-wide communication initiative to raise awareness and emphasize the vital importance of USACE, as the dam owner, in developing and maintaining close relationships with downstream local emergency management agencies. HQ s will address the topic directly with Division and District Commanders and senior leadership through a memorandum specifically addressing this issue. Public affairs and emergency management offices at all organizational levels will be tasked to develop effective communication tools to ensure that all staff is fully aware of the USACE’s roles and responsibilities as a dam owner.

c. Exercise guidance will address the information that local EMAs need to plan evacuation procedures. Policy improvements will utilize a scaled approach for annual meetings with local EMAs in consideration of risks: such as meetings not required for low hazard potential dams.

18. IEPR Comment – Category A – Critical: In the course of Division, District and on-site meetings, USACE staff were asked whether the lines of authority and responsibility throughout the Division with regard to the management of dam incidents, as they evolve in real time, were defined, clearly communicated, and understood by all personnel including on-site staff. The findings from these discussions varied from one Division to the next, but there were common observations:

a. Clear lines of authority are not defined within a Division (from the commander down to the project operators).

b. Authorities and responsibilities that are conveyed from commanders to staff are ad hoc and at the discretion of the Division and District commanders.

c. Evaluations (system analyses) have not been carried out to the degree the range of potential incidents that may be experienced and associated incident management challenges have been identified. Coupled with this is the fact project staff have not been trained to manage these events or know what their authorities and responsibilities are.

These findings reflect a gap in the USACE Dam Safety Program with regard to defining clear responsibilities for managing dam incidents.

The panel experts recommended the following actions to resolve this comment:

The USACE should undertake an effort to develop comprehensive incident management authorities and responsibilities. This effort should include the development of incident management training to include project operators.

USACE Lead Organization or Entity: Dam Safety Steering Committee (DSSC)

USACE Response: **Adopted**

Enclosure – IEPR Responses

Action to be Taken:

USACE will undertake an agency wide review of dam safety incident management and make revisions to dam safety training and exercises to ensure emphasis is placed on lines of authority and responsibility for incident management. The lines of communication upward and incident management authorities and responsibilities of personnel on the ground will be evaluated and guidance developed and/or revised as necessary. Reviews of incident management procedures with project staff, and preferably involving local EMAs, will be incorporated into project specific dam safety training that is required on a five year frequency.

19. IEPR Comment – Category A – Critical: Based on survey responses, the Dam Safety Scorecard examples provided, and interviews, current project surveillance programs appear acceptable. On-site and District personnel are trained and understand the critical nature of their work. The data acquisition phase of a project instrumentation program appears adequate, but there are concerns that the data are not always reviewed and evaluated in a timely manner by experienced engineers. Lack of timely data reviews can lead to unacceptable levels of risk. Interviews uncovered a lack of reliable exception reporting, where reading changes beyond predefined limits are not flagged for priority reporting and response. Failure to adequately collect, interpret, and report findings in a timely manner is an urgent shortcoming.

The panel experts recommended the following actions to resolve this comment:

HQ should take a more active role in conjunction with the Divisions to ensure project engineers and project operators fully understand their roles with regard to their project instrumentation program. The panel strongly recommends that a review or audit program be developed and implemented quickly with each District DSO and DSPM for evaluating each project's instrumentation records. Developing a webinar might be useful to set standard file management practices and for training of project engineers and operators on processing and interpreting data. An integral part of a PA is the review of the historical instrumentation data. Prior to the start of a PA, the PA lead engineer should meet with the project engineer to review the instrumentation files and the quality of how the data is reduced and presented prior to the start of the PA panel work.

USACE Lead Organization or Entity: Dam Safety Steering Committee (DSSC)

USACE Response: **Adopted**

Action to be Taken:

USACE will develop a new course on dam instrumentation. Key instrumentation talking points and template slides will be extracted from the new course material to be used by district personnel when providing the required project specific dam safety training that is on a 5-year frequency per project.

Enclosure – IEPR Responses

Each Division Dam Safety Program Manager will annually verify that all dams in the region have been adequately evaluated and documented. USACE will revise the existing routine dam safety program metrics regarding the instrumentation annual report to assure the report includes data evaluation and interpretation. USACE will develop and provide an annual instrumentation webinar. This webinar will cover standard file management practices and proper techniques and procedures for processing and interpreting instrumentation data.

It is USACE's intent that all projects are adequately instrumented and the resulting data collected is properly processed and thoroughly evaluated and interpreted. USACE will update the quality management system process for Periodic Assessments to clarify and strengthen the coordination between the PA team and the District project engineer responsible for the project's instrumentation data.

20. IEPR Comment – Category B – Urgent: Significant concerns were expressed to the IEPR Team related to poor data management of project files. Disorganized and incomplete files are resulting in lost time, budget overruns, and improper or unneeded project recommendations. While the panel cannot identify whether this is a widespread issue, it is of sufficient concern that actions should be taken to address the problem.

The panel experts recommended the following actions to resolve this comment:

HQ should develop quality audit team(s) to perform project file reviews for adherence with basic data management policies and procedures. Each project has an assigned project engineer who should be held accountable for his project file and data management. District DSO and the DSPM need to be engaged with the project engineers to ensure file and data management is receiving proper attention. Division DSO and DSPM should work with Division counterparts to standardize procedures and conduct periodic and routine reviews of project files.

USACE Lead Organization or Entity: Risk Management Center (RMC)

USACE Response: **Adopted**

Action to be Taken:

USACE will oversee development of standards, guidelines and other recommendations for dam project data storage, document and photo storage and the collection of legacy documents with assistance from the Divisions, RMC, and national centers. Additionally, HQ will provide oversight and support, directly and through the national centers, to the Major Subordinate Commands (Division DSO/DSPM) for Quality Assurance activities, including site visits to districts for periodic and routine reviews of project files. Metrics will be developed to provide HQ visibility and ensure accountability.

Enclosure – IEPR Responses

21. IEPR Comment – Category C - Important: The USACE Dam Safety Program has implemented a fiscally responsible program to handle ‘non-routine’ (aka major) dam modifications. Funding for the ‘routine’ O&M of dams is somewhat problematic and competes with the operation and maintenance for all the other assets and programs within a District. District Commanders may not have a thorough knowledge of the project risks. For example, many USACE dams have large gate systems that are aged with known deficiencies. There is a significant degree of uncertainty that gates will operate as designed. Additionally, the use of the terms ‘routine’ and ‘non-routine’ in separating dam safety program activities may lead to diminishing the perceived value of O&M, along with activities such as PIs, PAs, and surveillance and instrumentation.

The panel experts recommended the following actions to resolve this comment:

A separate funding mechanism should be developed for operation and maintenance costs associated with project features that have a significant role in the operation of the project such as gate systems. Possibly a separate priority list can be developed for operating systems based on risk and consequences resulting from gate and other operating system failure, regardless of whether such failure is structural or operational. HQ’s DSO should work closely with District and Division Commanders to facilitate appropriate O&M funding levels for critical dam operation components. Division personnel should quickly review with new District Commanders the need for and the current status of major dam O&M requirements. To better differentiate critical dam safety project activities from the District-funded O&M work, consider replacing the ‘routine’ and ‘non-routine’ terms to better reflect the importance of all critical dam safety program activities.

USACE Lead Organization or Entity: Headquarters (HQ)

USACE Response: **Partially Adopted**

Action to be Taken:

USACE will not adopt a separate funding mechanism for operation and maintenance costs associated with project features such as gate systems. An additional funding mechanism or separate priority list is not consistent with transitioning to a risk-informed budget process. Additionally, such a “fenced” approach to budgeting unnecessarily complicates the dynamic prioritization of investments between projects, regions, and business lines. The highest life safety risk issues have generally not been gates.

USACE will adopt improvements to better prioritize O&M funding. The USACE Infrastructure Strategy (UIS) Asset Management (AM) team is developing and phasing the implementation of a risk informed prioritization process for all USACE asset investments. This initiative along with the Operational Risk Assessments (ORA) and Maintenance Management Improvement Plan (MMIP) will alleviate the possibility of de-emphasizing “routine” (e.g. preventive

Enclosure – IEPR Responses

maintenance) activities by using a risk-informed approach and improved definitions of maintenance activities as referenced in the Budget EC.

22. IEPR Comment – Category C - Important: Of the new dam and levee safety oriented centers, RMC is most mature and historically most central to the Dam Safety Program. RMC actions and activities have been a focal point of the peer review process. RMC functions as the HQUSACE Dam Safety Program implementation, oversight and support entity. It appears to the panel that RMC is currently providing considerable production oversight and guidance for studies and designs; processes ultimately to be contained within the Dam Safety Modification Mandatory Center of Expertise (DSMMCX) and DSPCs. The RMC has very successfully staffed itself with considerable high-end dam engineering expertise that could significantly benefit a wider range of USACE dam safety needs than are defined in ER 10-1-55. The panel has heard from multiple sources that the stand up of the DSMMCX has been slowed by an inability to attract needed expertise to Huntington, WV.

The Districts hold command and control responsibility for dam projects (“The Commanders at each level of USACE have the ultimate responsibility for dam safety within their commands.”). While Districts rightfully would not choose to surrender that responsibility, in many locations, they appear to be eager to have allies willing to walk the path with them in collaboration and to offer them guidance and counsel along the way.

The panel experts recommended the following actions to resolve this comment:

Promoting service to customers is imperative in developing positive relationships between Centers and Districts, and in rebuilding expertise at Districts and Divisions. Centers will best advance the USACE dam safety mission by providing collaborative support for dam safety demands within the District’s mission. USACE should consider relocating the DSMMCX to Denver or co-locating a portion of the DSMMCX to Denver, where dam engineering expertise can be more readily attracted and where many of the DSMMCX and RMC staff can be readily borrowed and loaned to support both Centers as needed.

USACE Lead Organization or Entity: Dam Safety Steering Committee (DSSC)

USACE Response: **Partially Adopted**

Action to be Taken:

USACE Centers have adopted collaborative support for dam safety demands within the locales and regions for sharing technical resources. The DSMMCX is actively collaborating with the RMC to share resources and transfer knowledge to benefit both organizations. The DSMMCX frequently staffs developmental assignments at the RMC and will continue to seek these opportunities. DSMMCX staff will continue to actively participate in RMC sponsored training and training development to promote knowledge transfer across the Agency.

Enclosure – IEPR Responses

The DSMMCX will continue regular communications, and to facilitate a focused discussion each month, with the RMC and DSPC Directors with the purpose of collaboration, promoting and enhancing knowledge transfer, and coordinating work sharing.

The RMC and the DSMMCX will continue to explore flexible recruitment options combined with the use of virtual resources to attract and retain the highest qualified individuals to the Centers. For example, the Centers are recruiting for positions that will allow interested individuals to select from multiple locations, including Denver, across USACE.

USACE will not adopt relocation of the DSMMCX. The activities described above demonstrate that complete co-location is not required to achieve coordinated efforts. The DSMMCX was located in Huntington, WV largely due to the dam safety talent that already existed there – a testimony to the ability to recruit talented professionals to Huntington, WV. This has enabled the DSMMCX to efficiently and expeditiously standup and staff to approximately 50% level. Therefore, relocation of the DSMMCX to Denver is undesirable due to the projected loss of many of the existing professionals.

23. IEPR Comment – Category B – Urgent: Current review processes entail redundant reviews of questionable value and focus. Review milestones are major stall points for project progress. It is reported that some units do not perform baseline calculation checks. Accountability for quality processes at the Division and District levels, and perhaps at Centers, is lacking. Concerns with quality processes are broad-based and have a common foundation across all reporting entities.

The panel experts recommended the following actions to resolve this comment:

Quality processes need significant attention. Quality reviews need to be improved to reduce schedule and budget impacts, and to focus on issues of importance to production and review personnel. Dam safety quality audit teams should be created to visit Districts and perform project file reviews for adherence with calculation checking, as well as with policies and standards of practice for quality reviews and comment resolution. HQ may want to consider quality compliance ratings that define a range of types and frequencies for future reviews based on audited compliance and process effectiveness.

Quality oriented behaviors should be incentivized, with rewards, including less frequent future audits and transition to “on-board review” opportunities for units with increasing levels of compliance. For units stubbornly out of compliance, formal critiques, and more frequent and intense audits are needed. Accommodation of on-board reviews that don't stall project development are recommended for those commands embracing quality review processes. The panel recommends that the ATR, IEPR Type II and Board of Consultants' concepts be integrated into an updated ATR concept (to the extent allowed by law), with outside experts added to ATR teams to eliminate the need for separate

Enclosure – IEPR Responses

and sometimes overlapping appraisals. This recommendation better integrates independent (outside) perspectives into design guidance and review processes and helps to address the acknowledged shortage of senior dam engineering expertise.

USACE Lead Organization or Entity: Risk Management Center (RMC)

USACE Response: **Adopted**

Action to be Taken:

USACE will review and evaluate the performance of quality control and quality assurance efforts, guidance, procedures and processes with a focus on achieving efficiencies and improving quality, budget, and schedule performance. Opportunities for improving Division quality assurance audits of districts will be investigated. Existing Quality Management System policies will be reevaluated with a focus toward streamlining where possible. Opportunities for integration of ATR, Quality Control and Consistency, IEPR Type II and Board of Consultants' concepts, as well as early engagement of outside experts when necessary and frequent onboard reviews into an updated ATR concept will be thoroughly investigated. USACE has sufficient authority within current statutory requirements and implementation guidance to more effectively and efficiently integrate these processes.

24. IEPR Comment – Category C - Important: There is considerable concern regarding funding and, therefore, staffing levels to meet recognized demands. Based on economic conditions and political stalemates, it should be assumed budgets will continue to shrink. The panel was exposed to dam projects with engineering costs (planning through construction) well above 50% of construction cost. Private sector dam engineering costs for planning through construction are commonly in the range of 20% to 30% of construction cost. The panel was also exposed to project designs that were overly conservative and/or included misdirected design elements and/or approaches. Additional guidance and expert reviews beginning early in the dam safety modification process will provide significant benefits. DSOG deliberations exposed both technical and cost issues that are concerning.

The panel experts recommended the following actions to resolve this comment:

A “doing more with less” attitude needs to be broadly adopted. To the extent possible, USACE should benchmark the costs of dam design activities against other federal agencies and the private sector. The re-maturation of USACE dam safety expertise needs to include a significant focus on economy of design and construction along with the redevelopment of dam safety engineering expertise discussed in Finding 2013-B-26.

Enhancing design effectiveness, cost-effectiveness of construction engineering services and construction contract management will reap great benefits. Many elements fold into one another to compound benefits. More relevant and cost

Enclosure – IEPR Responses

efficient construction measures reduce engineering costs. Better reviews improve direction, trim schedules and reduce costs. Dam safety leadership needs to undertake a thorough review of costs for engineering, effectiveness and judiciousness of designs, and construction cost management.

The Dam Safety Program needs to undertake a thorough review of:

- a. The utility of cost streams for engineering services
- b. The feasibility, effectiveness and judiciousness of design measures
- c. The costs to translate designs into completed remediation projects

Areas of improvement need to be prioritized, action plans developed to enhance performance standards and expectations, and accountability measures put into place to drive actions. The panel believes that the Dam Safety Program has the potential, over time, to improve the effectiveness of its work product delivery.

USACE Lead Organization or Entity: Dam Senior Oversight Group (DSOG)

USACE Response: **Adopted**

Action to be Taken:

USACE will undertake a comprehensive review of the Dam Safety Program processes and procedures and develop meaningful performance metrics designed to improve overall effectiveness of designs, reduce design and construction costs, improve product quality, and deliver risk reduction measures more quickly and efficiently. Some of the more complex and expensive dam safety projects in design and construction will be managed with mega-projects requirements, ECB 2013-11. Mega-project governance includes development of enhanced Project Management Plans (PMP) and cost and schedule control measures utilizing earned value management techniques.

HQ Senior Leaders and Engineering and Construction staff as well as Divisions, RMC and DSPC senior engineers will serve in an oversight and advisory role to the mega-project teams and provide a framework for structured, regularly scheduled vertical team interaction, including cost control and administration of project contingencies and approval of construction reserves.

The Divisions, RMC and Dam Safety Production Centers (DSPC) will work closely with Districts to formulate the enhanced PMPs for each project to implement the appropriate risk reduction measures and utilize appropriate level of resources to execute in the shortest time frame possible. Reviews that are required by law are being coordinated and implemented to reduce redundancies and time required to complete. Each project is required to develop a detailed

Enclosure – IEPR Responses

Review Plan as part of the PMP that meets requirements of USACE quality processes and those required by law.

USACE will continue to interact with other Federal agencies on implementation and execution of dam and levee safety programs from a national perspective. USACE will engage other Federal agencies to review and compare costs. Recognized industry experts will be utilized early in the design and construction processes as part of Agency Technical Review (ATR) teams, as warranted, based on project size and/or complexity.

25. IEPR Comment – Category C - Important: Many IRRMs entail significant reductions in benefits, which can be tied to direct (hydropower) or indirect (flood protection, recreation, etc.) income streams and/or functions that benefit the public. IRRMs are many times used to defer structural measures. Benefits losses present collateral impacts that for some projects are reported to sum to many hundreds of millions of dollars. Risk-informed processes, discussed as separate findings, can equally be applied to characterize economic risks (and rewards). Where IRRM costs significantly reduce upgrading costs (singly and/or as systems), expediting expenditures can provide a net benefit.

The panel experts recommended the following actions to resolve this comment:

For IRRMs that are costly in terms of lost benefits, creative avenues should be considered to turn benefit losses into funding to accelerate structural upgrades. Creative cost sharing measures should be explored to accelerate restoration of full project operations. Accelerated benefits recovery should be central to project funding and scheduling discussions.

USACE Lead Organization or Entity: Institute of Water Resources (IWR)

USACE Response: **Adopted**

Action to be Taken:

USACE has established an Alternative Financing Product Delivery Team (PDT) as part of the overall USACE Infrastructure Strategy initiative. Pilot projects and case studies are being developed, including potential options using both existing authorities and potential new authorities for public-private partnerships that may be enabled by the Water Resources Development Act /Water Resources Reform and Development Act language currently being considered in the Congress. As part of the Alternative Financing PDT, USACE will work to develop a case study or pilot that prescribes opportunities to invest in Interim Risk Reduction Measures as an enabler for broader project development in Fiscal Year 15.

26. IEPR Comment – Category B – Urgent: Dam engineering has a great need for generalists who have an array of skills and experiences related to dams, their foundations and their ancillary structures. These multidisciplinary dam engineering

Enclosure – IEPR Responses

skills are also an important foundation for Risk Cadres (discussed separately). USACE has depth of engineering expertise, but much of that expertise is focused within sub-disciplines (silos). USACE has a major decades-long backlog of dam remediation projects, and shares a broadly held recognition that its Dam Safety Program lacks sufficient dam engineering experience and expertise.

The panel experts recommended the following actions to resolve this comment:

Expanded development of dedicated dam engineering specialists is recommended to lead the execution of the USACE's major, long-term dam safety upgrading program. It is recommended that Divisions, Districts and applicable Centers be directed to earmark interested and capable engineers for an expanded developmental program for careers focused on dam engineering. The dam engineering consulting community should be better leveraged to provide additional expertise to bridge the shortfall in internal talent.

USACE Lead Organization or Entity: Dam Safety Steering Committee (DSSC)

USACE Response: **Adopted**

Action to be Taken:

USACE will work to expand development of dam engineering specialists throughout the agency. These specialists will focus primarily on dam safety engineering and will be supplemented as needed with private industry dam safety consultants. The DSMMCX will improve coordination among DSPCs and facilitate work sharing using national contract and developmental assignments.

USACE will strategically utilize dam engineering consultants when internal resources and expertise are constrained, or the programs/projects demand specialized expertise that is limited or unavailable in USACE.



**FINAL REPORT
2013 INDEPENDENT EXTERNAL PEER
REVIEW**

**U.S. Army Corps of Engineers Dam Safety Program
Contract No. W912QR-10-D-0031
Task Order C0002**

Schnabel Reference 11615026.08
November 22, 2013





November 22, 2013

Mr. Thomas Bishop
Risk Management Center (RMC)
U.S. Army Corps of Engineers
12596 West Bayaud Avenue, Suite 400
Lakewood, CO 80228

Subject: FINAL REPORT, 2013 Independent External Peer Review of the USACE Dam Safety Program, W912QR-10-D-0031 Task Order C0002, Louisville District (LRL) (Schnabel Reference 11615026.08)

Dear Mr. Bishop:

SCHNABEL ENGINEERING CONSULTANTS, INC. (Schnabel) is pleased to submit this **Final Report** for our 2013 Independent External Peer Review of the USACE Dam Safety Program. This peer review was performed in accordance with our contract dated April 22, 2013, modified on May 20 and June 27, 2013.

Our draft report was submitted on October 14 and a meeting was held on October 22, 2013, to brief USACE senior leaders and various staff involved with the Dam Safety Program. During that meeting, the findings and recommendations were discussed, and this final report includes revisions developed based on those discussions.

We appreciate the opportunity to be of service for this project. Please contact me if you have any questions regarding this report.

Sincerely,

SCHNABEL ENGINEERING CONSULTANTS, INC.

A handwritten signature in blue ink that reads "Greg Paxson".

Gregory S. Paxson, PE
Principal

GSP:DBC:DJM:RPB:MJM:MCC:SAR:hcf

U.S. Army Corps of Engineers
2013 Independent External Peer Review of the USACE Dam Safety Program

Distribution (email only):

USACE RMC

Attn: Mr. Tom Bishop

Attn: Mr. Chris Hogan

USACE LRL

Attn: Mr. Dan Corrigan

**FINAL REPORT: 2013 INDEPENDENT EXTERNAL PEER REVIEW
USACE DAM SAFETY PROGRAM**

TABLE OF CONTENTS

1.0	ACKNOWLEDGEMENTS.....	1
2.0	EXECUTIVE SUMMARY	2
3.0	INTRODUCTION.....	6
3.1	Purpose and Scope of Independent External Peer Review	6
3.2	IEPR Team.....	7
3.3	Federal Guidelines for Dam Safety.....	8
3.4	Risk-Informed Management for Dam Safety	8
4.0	USACE DAM SAFETY PROGRAM	10
4.1	Overview and History.....	10
4.2	Safety of Dams – Policy and Procedures (ER 1110-2-1156)	13
4.3	Organization.....	13
4.4	Processes	17
4.5	2001 Peer Review.....	18
4.6	2013 Survey Questionnaire	18
5.0	FINDINGS AND RECOMMENDATIONS	20
5.1	The Charge	20
5.2	Subject Areas and Categories	21
5.3	Organization and Management.....	21
5.3.1	<i>2013-B-01: Full Time Position in HQUSACE Dedicated to the Dam Safety Program Leadership and Management</i>	<i>22</i>
5.3.2	<i>2013-B-02: HQUSACE Oversight and Strategic Leadership of the Dam Safety Program</i>	<i>23</i>
5.3.3	<i>2013-C-03: Dam Safety Team Unity.....</i>	<i>23</i>
5.3.4	<i>2013-C-04: Adaptation to Change</i>	<i>24</i>
5.4	Dam Safety Policies and Procedures	25
5.4.1	<i>2013-B-05: Peer Review of ER 1110-2-1156.....</i>	<i>25</i>
5.4.2	<i>2013-B-06: USACE Engineering Manuals and Regulations.....</i>	<i>26</i>
5.5	Risk-Informed Management.....	26
5.5.1	<i>2013-D-07: General Direction of Program with Regard to Risk Management</i>	<i>27</i>
5.5.2	<i>2013-C-08: Complying with OMB Guidance.....</i>	<i>28</i>
5.5.3	<i>2013-B-09: Frequency of Flooding and Use of the PMF Standard</i>	<i>29</i>
5.5.4	<i>2013-C-10: Consistency/Quality of Risk Cadres</i>	<i>30</i>
5.5.5	<i>2013-C-11: Risk Analyses Performed as Part of Periodic Assessments</i>	<i>31</i>
5.5.6	<i>2013-B-12: Operational Risks.....</i>	<i>31</i>

U.S. Army Corps of Engineers
2013 Independent External Peer Review of the USACE Dam Safety Program

5.5.7	2013-C-13: Broad Based Application of Risk-Informed Management.....	32
5.5.8	2013-B-14: Evaluation of Uncertainties in Risk Analysis.....	32
5.5.9	2013-B-15: Systems-Based Risk Evaluation.....	34
5.5.10	2013-B-16: Seismic Hazard Analysis.....	34
5.6	Emergency Preparedness.....	35
5.6.1	2013-A-17: Emergency Management Procedures Oversight and Implementation.....	35
5.6.2	2013-A-18: Decision-Making for Time Critical Emergencies.....	37
5.7	Dam Safety Program Implementation.....	38
5.7.1	2013-A-19: Surveillance and Instrumentation.....	38
5.7.2	2013-B-20: Data Management.....	39
5.7.3	2013-C-21: Budgeting for ‘Routine’ Activities.....	40
5.7.4	2013-C-22: Roles of RMC, DSMMCX, and DSPCs.....	41
5.7.5	2013-B-23: Technical Review Processes.....	43
5.7.6	2013-C-24: Project Design and Construction Costs.....	45
5.7.7	2013-C-25: IRRM Financial Impacts.....	47
5.8	Technical Capabilities for Dam Engineering.....	48
5.8.1	2013-B-26: Resources and Expertise.....	49
5.9	Summarizing the State of the USACE Dam Safety Program.....	50
5.10	Independent External Peer Review – Lessons Learned.....	55
5.11	IEPR Panel Consensus.....	57
5.12	Summary and Follow Up.....	57

APPENDICES

- Appendix A: USACE Statement of Work
- Appendix B: List of Documents Provided by USACE
- Appendix C: Information from IEPR Visits
- Appendix D: 2001 ASDSO Peer Review Report – Executive Summary
- Appendix E: 2013 USACE Survey Questionnaire
- Appendix F: IEPR Team Bios

LIST OF ACRONYMS USED IN THIS REPORT

- ASDSO – Association of State Dam Safety Officials
- ATR – Agency Technical Review
- CEATI – Centre for Energy Advancement through Technological Innovation
- CIPR – Critical Infrastructure Protection and Resilience
- COI – Conflicts of Interest
- DDR – Design Document Reports
- DSAC – Dam Safety Action Classifications
- DSM – Dam Safety Modification
- DSMMCX – Dam Safety Modification Mandatory Center of Expertise
- DSMR – Dam Safety Modification Report
- DSO – Dam Safety Officer

U.S. Army Corps of Engineers
2013 Independent External Peer Review of the USACE Dam Safety Program

DSOG – Dam Safety Oversight Group
DSPC – Dam Safety Production Center
DSPCSC – Dam Safety Production Center Steering Committee
DSPM – Dam Safety Program Manager
DSPMT – Dam Safety Project Management Tool
DSSC – Dam Safety Steering Committee
EAP – Emergency Action Plan
EC – Engineering Circular
EMA – Emergency Management Agencies
ER – Engineering Regulation
FCCSET – Federal Coordinating Council for Science, Engineering and Technology
FEMA – Federal Emergency Management Agency
FERC – Federal Energy Regulatory Commission
GAO – Government Accountability Office
H&H – Hydrology and Hydraulics
HQ – Headquarters
HQUSACE – Headquarters United States Army Corps of Engineers
IEPR – Independent External Peer Review
IES – Issue Evaluation Study
IRRM – Interim Risk Reduction Measures
IWR – Institute for Water Resources
LRL – Louisville District
M&I – Municipal and Industrial
MMC – Mapping, Modeling and Consequences Production Center
MSC – Major Subordinate Command
NAS – National Academy of Sciences
NEPA – National Environmental Policy Act
NWD- Northwest Division
NWP – Portland District
O&M – Operation and Maintenance
OMB – Office of Management and Budget
OMRR&R – Operation, Maintenance, Repair, Replacement and Rehabilitation
PA – Project Assessment
PI – Project Inspection
PMF – Probable Maximum Flood
POA – Alaska District
POD – Pacific Ocean Division
PRQCP – Peer Review Quality Control Plan
PSHA - Probabilistic Seismic Hazard Analysis
RMC – Risk Management Center
SOW – Statement of Work
SWD – Southwest Division
SWT – Tulsa District
USACE – United States Army Corps of Engineers
USGS – United States Geological Survey
WRDA – Water Resources Development Act

1.0 ACKNOWLEDGEMENTS

This report provides the results of the 2013 Peer Review of the United States Army Corps of Engineers' (USACE) Dam Safety Program by an Independent External Peer Review (IEPR) Team. The review was performed during the time period of May to October 2013, with the report finalized in November 2013, following a briefing meeting at HQUSACE on October 22, 2013.

The IEPR Team acknowledges the significant amount of time, effort and support provided by USACE personnel that went into making this review meaningful. The candid participation of representatives from HQUSACE, the DSSC, the DSOG, and staff from RMC, NWD, NWP, POD, POA, RMC, SWD and SWT is gratefully acknowledged, along with the efforts of individuals from across USACE that supported this effort with thoughtful and incisive survey responses. The IEPR Team appreciates the effort expended by staff at all levels in following up on requests, preparation of materials for review, candor in answering questions, courtesies extended, and the general cooperation and assistance throughout the IEPR process. In particular, the IEPR Team acknowledges the support of Tom Bishop (RMC) in managing the IEPR for USACE. In addition to responding promptly to requests for additional information, he provided valuable information regarding the organization and workings of USACE.

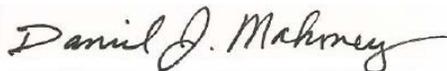
Respectfully submitted,



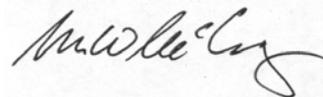
Randall Bass, PE, Principal, Schnabel Engineering



David Campbell, PE, Senior Consultant, Schnabel Engineering



Daniel Mahoney, Director, FERC Dam Safety and Inspection (retired)



Martin W. McCann, Jr. PhD, President, Jack R. Benjamin & Associates



Gregory Paxson, PE, Principal, Schnabel Engineering

2.0 EXECUTIVE SUMMARY

The U.S. Army Corps of Engineers (USACE) contracted with Schnabel Engineering Consultants, Inc. (Schnabel) to perform an Independent External Peer Review (IEPR) of the USACE Dam Safety Program. This report summarizes the results of the IEPR, performed between May and October, 2013.

As described in the Statement of Work (SOW), an objective of the IEPR is to “examine how well the USACE is implementing the federal guidelines for dam safety and executing it’s stated mission.” The SOW included the following general “charge” questions to be answered as part of the IEPR:

- Is the direction of the program appropriate?
- Has USACE overlooked any critical items?
- Does the panel have any other observations to add?

An IEPR Team was selected by Schnabel and approved by USACE, consisting of a project manager and a four member panel of reviewers with expertise in dam safety, dam engineering, and management of a dam safety program.

USACE provided numerous documents to the IEPR Team as part of the review, and several additional documents were provided upon request from the IEPR Team. In addition, the IEPR Team performed visits to Headquarters (HQ), the Risk Management Center (RMC), and several USACE Districts/Divisions.

The USACE Dam Safety Program is the largest in the United States, and USACE owns and regulates hundreds of high and significant hazard dams, with the majority constructed between 1930 and 1980. This period of construction was followed by the current period of dam safety modifications to address deficiencies at existing dams.

In 2001, the Association of Dam Safety Officials (ASDSO) conducted a peer review of the USACE Dam Safety Program, with the following major finding:

[USACE] “is currently considered to have a minimally acceptable Dam Safety Program and any further reductions in their Program will endanger their dams and the lives and property they protect.”

This finding, coupled with other events such as the levee failures resulting from Hurricane Katrina, motivated a series of significant changes in the USACE Dam Safety Program, most notably the adoption of a risk-informed approach for dam safety portfolio management and decision making. The changes in the program since 2001 have been dramatic and are continuing. As preface to summarizing the IEPR findings, it is worth noting the progress and positive steps of the program in the past decade:

- The USACE has made a commitment to risk-informed management in the dam safety program that less than a decade ago would have been considered inconceivable. This includes the establishment of the RMC.
- Staff has been established (through new hires and education) and a new programmatic structure created to implement the risk-informed management program.
- The RMC has recognized the value and importance of education and training of the USACE staff, resulting in the ongoing development of a strong training program in risk analysis methods,

facilitator training and certification, etc. The IEPR Team observed that this training has provided benefits across USACE.

- The dam safety program has established and is implementing an effective programmatic structure for managing its portfolio of dams.

The change in direction of the dam safety program to the use of risk-informed management has been extremely positive. While the IEPR findings note that this evolution is not complete, the changes in the program have been highly successful and should continue with the full support of USACE leadership.

The IEPR Team has developed findings and recommendations with regard to the USACE Dam Safety Program. With regard to the objectives identified in the SOW, the IEPR Team offers the following:

- The USACE Dam Safety Program is being implemented in general accordance with the federal guidelines for dam safety. In many areas, USACE exceeds the requirements of the federal guidelines. Updating of EAPs appears to fall short of the federal guidelines.

With regard to the “charge” questions listed in the SOW:

- *Is the direction of the program appropriate?* The answer to this question is clearly “yes.” The implementation of a risk-informed approach for dam safety portfolio management and decision making is a great improvement in the program and the program continues to mature. USACE should be commended for the positive changes made in the past decade.
- *Has USACE overlooked any critical items?* The IEPR Team has identified three findings as “critical”; however, it may not be correct to state that USACE has “overlooked” a given item. One of the findings could be considered to have been overlooked by USACE (2013-A-18: Decision-Making for Time Critical Emergencies). In addition, there are elements of the program that warrant improvement and change.
- *Does the panel have any other observations to add?* Many of the findings and recommendations presented in this report are considered to fall into this category.

The IEPR Team identified 26 findings, with a recommendation for each. The findings and recommendations are summarized as follows (grouped into six subject areas):

Organization and Management: The overall organizational structure of USACE is complex and creates obstacles in organizing its dam safety program. In addition, given the amount of activity and attention required to safely operate and maintain hundreds of large high and significant hazard dams, the USACE Dam Safety Program demands full-time leadership dedicated to its dam infrastructure (excluding levees). The IEPR Team holds the people leading the dam safety program in very high regard. However, we believe the demands of such a large, complex and risk-sensitive infrastructure require the full attention of the Dam Safety Officer. Additionally, the stresses deriving from the major transformation of the dam safety program in the past decade demand leadership attention to critical USACE staff resources. There exists a reservoir of good will towards the changes that have been driven to advance the program. Issues related to communication and trust are stressed, but they are not broken, so the door is open for coalescing the team’s sense of community and commitment. The pace of change has been intense, so a continuing focus on training and development to build expertise in using the new tools and processes that form the foundation of the dam safety program is essential.

Dam Safety Policies and Procedures: The policies and procedures of the USACE Dam Safety Program are detailed in "Safety of Dams" (ER 1110-2-1156), which has gone through significant transformation as the dam safety program has changed. The significant changes warrant an external peer review of this regulation, with a focus on the risk-informed procedures, methodology, etc. Most engineering manuals and regulations are still framed in deterministic terms and do not relate to risk-informed processes. It is recommended the USACE review the status of their ERs and EMs that are important to dam safety, and develop a plan to systematically revise them in a manner that is consistent with risk-informed and performance-based methods.

Risk-Informed Management: The introduction and implementation of risk-informed approaches to dam safety management is the area where the greatest change is taking place. The changes that have taken place are significant and positive. At the same time they are ongoing. A number of findings and associated recommendations have been made relative to risk-informed aspects of the dam safety program. A number of the findings are based on the observation that current practices do not seem to implement the dam safety regulations, ER 1110-2-1156. For example, this seems to be the case with regard to meeting OMB guidelines with regard to risk management and uncertainty analysis. In other cases there appear to be areas that are not being addressed. Examples include systems-based risk analysis, analysis of operational risks, and the utilization of risk concepts to support areas of the dam safety program such as emergency action plan development, operator training, etc.

Risk concepts and performing risk analysis studies are new to much of the USACE Dam Safety Program staff. While the dam safety program has placed a considerable emphasis on training, there are consistency and quality issues that need to be addressed. There are elements of risk analysis that are counter-intuitive for engineers who are accustomed to standards-based practices. The issues of consistency and quality are in part the evolutionary transition that is taking place. It is also a function of the number of qualified staff who have the educational and experience background that are needed to carry out a job on the scale of the USACE Dam Safety Program.

Emergency Preparedness: Effective Emergency Action Plans (EAP) are a major program feature for preventing life loss downstream of USACE dams. The USACE EAP program, however, continues to be a significant risk to the dam safety program. While substantial improvements have been realized in improving inundation mapping and providing it to the local Emergency Management Agencies (EMA), the problems and deficiencies identified in the 2001 Peer Review remain.

There appears to be limited USACE management or oversight above the District office level with regard to implementation of EAPs. For a dam safety program as geographically diverse and multi-leveled as USACE, consistency and effectiveness cannot be maintained without nationwide oversight. The panel found insufficient evidence that the guidance and requirements regarding the importance of a strong relationship and close coordination with local EMAs in ER 1110-2-1156 and the Federal Guidelines are broadly understood or uniformly implemented across the USACE nationwide program.

Another issue identified by the panel related to emergency preparedness involved clear lines of the authority across the Division, District and projects with regard to the management of dam incidents, as they evolve in real time. This appears to be a subject that has been overlooked.

Dam Safety Program Implementation: Findings indicate that the substantial changes to the overall USACE Dam Safety Program have required significant redefinition of both activities and staff. While

these extensive changes have been executed to bring major benefits to the dam safety program for the long term, the retooling and retraining efforts are, understandably, a work in progress. Centers are being stood up and, in some cases, are getting down to business. Given their newness, they are still developing, maturing and defining their missions. Quality processes are inadequate and not effectively audited. Therefore, the range in quality of work products is broad. Consistency of performance and diligence in dam safety monitoring and documentation are goals that have not been broadly or consistently achieved, with the quality and consistency of instrumentation monitoring a critical concern. There are loose ends to be tied and processes to be updated and upgraded to allow effective and efficient implementation of the full menu of dam safety activities.

Technical Capabilities for Dam Engineering: The quantity and quality of technical resources are fundamental to the success of the USACE Dam Safety Program. USACE has some of the world's leading experts on dam safety, particularly at the HQ and Centers (RMC, MMC, DSMMCX). However, USACE also has a massive backlog of dam evaluations, studies, and designs, and the overall complement of trained and experienced staff to complete this work is limited. Therefore, the upper echelon of expertise is mature and leading the way, while much of the dam engineering staff attending to the day to day needs related to the full array of activities from construction through operation and maintenance are still maturing into critical roles and responsibilities. Additionally, much of the USACE expertise is aging, so serious consideration needs to be directed towards replacement of retiring senior engineers.

As a means of summarizing the state of the USACE Dam Safety Program, the IEPR Team applied the Maturity Matrix approach to provide an aggregate assessment of the state of each subject area noted above. The Maturity Matrix is presented in Section 5.9 of the report.

In addition to the findings and recommendations, the IEPR Team developed several "lessons learned" through the IEPR process that will likely benefit future peer reviews.

To maximize the benefit of this peer review, the IEPR Team recommends that USACE develop and provide to USACE Leadership a response to the findings and recommendations included in this report, which include:

- Proposed approach to implementing the recommendation.
- Proposed schedule for implementing the recommendation.
- A summary of and response to the Survey Questionnaire of the Districts, Divisions, RMC, etc. which was performed as part of the Peer Review.

Based on discussions at the October 22, 2013, meeting, we understand that USACE is initiating their response to this report.

3.0 INTRODUCTION

3.1 Purpose and Scope of Independent External Peer Review

As described in the SOW for this project (included in Appendix A), the objective of this IEPR is to “examine how well the USACE is implementing the federal guidelines for dam safety and executing its stated mission.” The IEPR “shall provide an external review of the policies and procedures, and performance of the [USACE] Dam Safety Program” with the intent of providing USACE “with an external examination of its internal workings, with external ideas to improve performance, and a level of comfort that [USACE] is leading industry dam safety practices.” The IEPR “should also provide a level of transparency for USACE and the public that will determine if USACE is effectively and efficiently managing risks for its inventory of high and significant hazard dams.”

According to the SOW, the IEPR should answer the following general questions (referred to as the “Charge”) regarding the overall USACE Dam Safety Program:

- Is the direction of the program appropriate?
- Has USACE overlooked any critical items?
- Does the panel have any other observations to add?

The SOW included a list of several documents to be reviewed as part of the IEPR. During the course of the review, numerous additional documents were identified as relevant to the IEPR. A list of documents provided by USACE is included in Appendix B.

The objective of the IEPR was to perform a review of the USACE Dam Safety Program, with a focus to address the questions noted above. The IEPR is considered a programmatic review, as opposed to a detailed technical review of the methods, procedures, and processes. The non-technical nature of the IEPR is reflected in specific assumptions by the IEPR Team during contract negotiations, including the assumption that the panel would become generally familiar with the USACE dam safety regulation (ER 1110-2-1156). In this context, the IEPR did not include a detailed review of ER 1110-2-1156, the technical methodology it describes or references, or the policy content. The IEPR also excluded detailed review of how technical evaluations and analyses are completed.

In this context, the IEPR addresses programmatic elements of the dam safety program and is not and should not be interpreted as a technical endorsement of the methodologies, procedures, and policies of the program. In fact, the IEPR includes a recommendation for a review of these aspects of the program.

The general inclusions and limitations of the IEPR described above are intended to conceptually define the bounds or limits of the panel's review. In spite of the limitations, it goes without saying the panel was exposed directly or indirectly to various technical elements of the USACE Dam Safety Program and its implementation. Within this context if a technical issue came to the panel's attention, an observation and recommendation were made. These technical observations (as limited as they are) should not be interpreted to be a result of a thorough technical review.

In addition to review of selected documents provided by USACE, the IEPR Team visited the following USACE offices and facilities:

U.S. Army Corps of Engineers
2013 Independent External Peer Review of the USACE Dam Safety Program

- Headquarters (HQ), Orientation Briefing, May 30-31, 2013
- Northwest Division (NWD), Portland District (NWP), and Lookout Point Dam, June 18-20, 2013
- Alaska District (POA), including Pacific Ocean Division (POD) staff, and Moose Creek Dam, July 9-10, 2013
- Risk Management Center (RMC), Western Division, July 23-25, 2013 (included attendance at portions of DSOG meeting)
- Southwest Division (SWD), Tulsa District (SWT), and Pine Creek Dam, July 30 – August 1, 2013

The IEPR Team interpreted the purpose of the visits to Divisions, Districts, and the RMC as a means to obtain a general understanding of the organization and operations of the entire USACE Dam Safety Program, and obtain a sampling of observations and opinions of USACE staff regarding the program and its processes and procedures. The visits were not considered to be an evaluation of the individual Districts or Divisions with regard to implementation of the program. Appendix C includes information regarding each visit, including the agenda, attendee list, and a memorandum with discussion topics prepared by the IEPR Team in advance of the visits. In addition to these visits, the IEPR Team interviewed Mr. James Dalton, HQUSACE Dam Safety Officer, on September 18, 2013.

This Final Report summarizes the IEPR of the USACE Dam Safety Program. The only other deliverables for this project are the Peer Review Quality Control Plan (PRQCP) (dated May 22, 2013) and a draft version of this report (dated October 14, 2013), which were submitted according to the schedule. The schedule for the project is included in the SOW in Appendix A.

3.2 IEPR Team

The IEPR Team includes a project manager and review panel, selected by Schnabel's Project Management and Technical Review Team for this contract. In accordance with the SOW, the panel includes four Level 3 reviewers (15 or more years of specialized experience) with expertise in dam safety, dam engineering, and management of a dam safety program, and with recent and relevant experience on multi-million dollar projects. Credentials for the IEPR Team were provided to USACE for approval. The IEPR Team includes:

Project Manager:

- Mr. Gregory (Greg) S. Paxson, PE, Schnabel Engineering, West Chester, PA

Panel:

- Mr. Randall (Randy) P. Bass, PE, Schnabel Engineering, Alpharetta, GA
- Mr. David (Dave) B. Campbell, PE, Schnabel Engineering, West Chester, PA
- Mr. Daniel (Dan) J. Mahoney, FERC (retired), Glen Burnie, MD
- Mr. Martin (Marty) W. McCann, Jr., PhD, Jack R. Benjamin & Associates, Menlo Park, CA

Summaries of the IEPR Team members' experience and qualifications are included in Appendix F. The IEPR panel was selected in accordance with the National Academy of Sciences (NAS) Policy on Committee Composition and Balance and Conflicts of Interest (COI). Full resumes, along with signed NAS COI forms, were included in our PRQCP dated May 22, 2013.

3.3 Federal Guidelines for Dam Safety

As noted in Section 3.1, an objective of the IEPR is to evaluate how USACE is implementing the federal guidelines for dam safety. These guidelines were developed by the Interagency Committee on Dam Safety and are documented in the Federal Emergency Management Agency (FEMA) document “Federal Guidelines for Dam Safety” (April 2004). The guidelines, originally published in 1979, are summarized as follows (FEMA, 2004):

“These guidelines apply to management practices for dam safety of all Federal agencies responsible for the planning, design, construction, operation, or regulation of dams. They are not intended as guidelines or standards for the technology of dams. The basic principles of the guidelines apply to all dams. However, reasonable judgments need to be made in their application commensurate with each dam’s size, complexity, and hazard.”

The Federal agencies have a good record and generally sound practices on dam safety. These guidelines are intended to promote management control of dam safety and a common approach to dam safety practices by all the agencies. Although the guidelines are intended for and applicable to all agencies, it is recognized that the methods of the degree of application will vary depending on the agency mission and functions.”

As part of the IEPR, the federal guidelines were considered and found to generally be a limited metric for evaluating the USACE Dam Safety Program. While they have been updated over the years, the federal guidelines, originally prepared in the late 1970s, are considered to be somewhat outdated; and based on discussions with USACE, the guidelines are currently undergoing significant revisions. In addition, a number of elements of the guidelines do not provide reasonable guidance or standard for evaluating and measuring the adequacy of a dam safety program. As such, the IEPR Team found the federal guidelines to be of limited practical value in conducting the peer review.

3.4 Risk-Informed Management for Dam Safety

Risk has been used in the management and decision making in various industries for some time; however, the application of risk management is relatively new to the dam safety industry. The “Federal Guidelines for Dam Safety” (FEMA, 2004) discuss the incorporation of risk approaches, stating:

“Risk-based analytical techniques and methodologies are a relatively recent addition to the tools available for assessing dam safety. With further refinement and improvement, risk-based analyses will probably gain wider acceptance in the engineering profession and realize potential as a major aid to decision-making in the interest of public safety. However, even when fully developed, risk analyses cannot be used as a substitute for sound professional judgment of engineers, contractors, or review boards. In view of the dual problems of uncertainty in analysis and possibility of misinterpretation by the public, but in recognition of the high potential these techniques have, agencies should be encouraged to conduct research to refine and improve the techniques and to develop the methodologies and base of expertise necessary to apply them to dam safety evaluations. Specifically, agencies should strive to perfect techniques for evaluating the probability of possible deficiencies causing dam failure and estimating the potential losses due to such a failure. Meanwhile, the agencies should evaluate the potential consequences of failure of the dams under their jurisdiction. Although the value of potential property losses can

be estimated, it is recognized that potential loss of lives can only be quantified, but not evaluated. On new dams, potential losses can be used in study of project alternatives and in assessment of additional safety incorporated into the dam facilities. On existing dams, a risk-based analysis should be considered in establishing priorities for examining and rehabilitating the dams, or for improving their safety.”

The IEPR Team has observed a high level of commitment toward the use of risk by federal agencies in the past few years. For example, federal agencies, including USACE, have contributed to a draft document entitled “Federal Guidelines for Dam Safety Risk Management,” (2012) and appear to have embraced the use of risk in dam safety management, as implied by the following statement.

“In particular, the United States, the United Kingdom, the Netherlands, and Australia have integrated risk into safety decisions in various ways since the 1950’s. Those entities that analyze, evaluate, and manage risks have found that risk provides a rigorous, systematic, and thorough process that improves the quality of and support for safety decisions.”

USACE ER 1110-2-1156, “Safety of Dams – Policy and Procedures” (May 2013 draft) includes the following statement (Section 1.10), which demonstrates USACE commitment to the application of risk for dam safety management:

“USACE has moved from a solely standards-based approach for its dam safety program to a dam safety portfolio risk management approach. The standards-based or essential guidelines approach is included in the risk-informed approach to the dam safety program and dam safety program decisions will now be risk informed.”

4.0 USACE DAM SAFETY PROGRAM

4.1 Overview and History

The dam safety program is part of the USACE Civil Works program, which has the following stated mission and vision (<http://www.usace.army.mil/Missions/CivilWorks.aspx>):

“Dedicated to providing quality, responsive service to the nation in peace and war. The Directorate of Civil Works is a major component of the U.S. Army Corps of Engineers. The Civil Works programs include water resource development activities including flood risk management, navigation, recreation, and infrastructure and environmental stewardship. Our mission also includes emergency response.”

While not publically available, a document was provided to the IEPR Team with the heading “Dam & Levee Safety: Measures of Success,” which included the following Vision and Mission:

Vision:

A future where dam and levee infrastructure (are successfully managed to) provide authorized benefits to the Nation commensurate to the risks to life, property and the environment.

Mission:

The mission of the Dam and Levee Safety Program is to assess, communicate and manage risks to life, property and the environment within the broader context of flood risk and asset management.”

As part of the IEPR, USACE provided dam inventory data indicating that USACE owns 557 dams across the United States, with 398 of these structures classified as high hazard potential and 136 classified as significant hazard potential. According to “Federal Guidelines for Dam Safety: Hazard Potential Classification for Dams” (FEMA, 2004), the following definitions apply to high and significant hazard dams:

“Dams assigned the high hazard potential classification are those where failure or misoperation will probably cause loss of human life.

Dams assigned the significant hazard potential classification are those dams where failure or misoperation results in no probable loss of human life but can cause economic loss, environmental damage, disruption of lifeline facilities, or can impact other concerns.”

A summary of USACE dams, with average height and age by location (District) is presented in Table 4.1. Districts not having responsibility for dams are omitted from this list.

Table 4.1: USACE Dams by District and Division

	Number of Dams	Average Height (feet)	Average Age (years)
Great Lakes & Ohio River Division (LRD)	136	107	58
Buffalo (LRB)	1	249	61
Chicago (LRC)	2	26	39
Detroit (LRE)	10	18	82
Huntington (LRH)	44	118	59
Louisville (LRL)	30	103	47
Nashville (LRN)	10	156	52
Pittsburgh (LRP)	39	79	65
Mississippi Valley Division (MVD)	102	66	60
Vicksburg (MVK)	32	83	43
St. Paul (MVP)	31	41	80
Rock Island (MVR)	28	55	69
St. Louis (MVS)	11	85	48
North Atlantic Division (NAD)	54	127	57
Baltimore (NAB)	15	106	50
New England (NAE)	32	100	55
New York (NAN)	1	20	98
Norfolk (NAO)	1	257	35
Philadelphia (NAP)	5	153	47
Northwestern Division (NWD)	80	202	51
Kansas City (NWK)	18	121	43
Omaha (NWO)	28	103	47
Portland (NWP)	20	239	52
Seattle (NWS)	6	259	62
Walla Walla (NWW)	8	289	51
Pacific Ocean Division (POD)	1	60	34
Alaska (POA)	1	60	34

	Number of Dams	Average Height (feet)	Average Age (years)
South Atlantic Division (SAD)	48	100	49
Charleston (SAC)	1	128	28
Jacksonville (SAJ)	4	34	59
Mobile (SAM)	28	105	41
Savannah (SAS)	6	137	53
Wilmington (SAW)	9	98	64
South Pacific Division (SPD)	45	189	53
Albuquerque (SPA)	9	206	51
Sacramento (SPK)	16	171	56
Los Angeles (SPL)	18	113	61
San Francisco (SPN)	2	268	43
Southwestern Division (SWD)	91	95	48
Fort Worth (SWF)	25	123	49
Galveston (SWG)	3	37	49
Little Rock (SWL)	25	118	48
Tulsa (SWT)	38	103	47

Like other federal dam owners, USACE is a self-regulating dam safety agency, which creates the potential for competing interests for cost effectively managing resources versus maintaining tolerable levels of risk to life safety for these structures.

Dam safety has been a key component of the USACE since it began to construct dams in the 1840s. Figure 4.1 illustrates the construction of USACE dams by decade. According to ER 1110-2-1156, USACE was one of the first agencies to initiate a periodic inspection and evaluation program for dams.

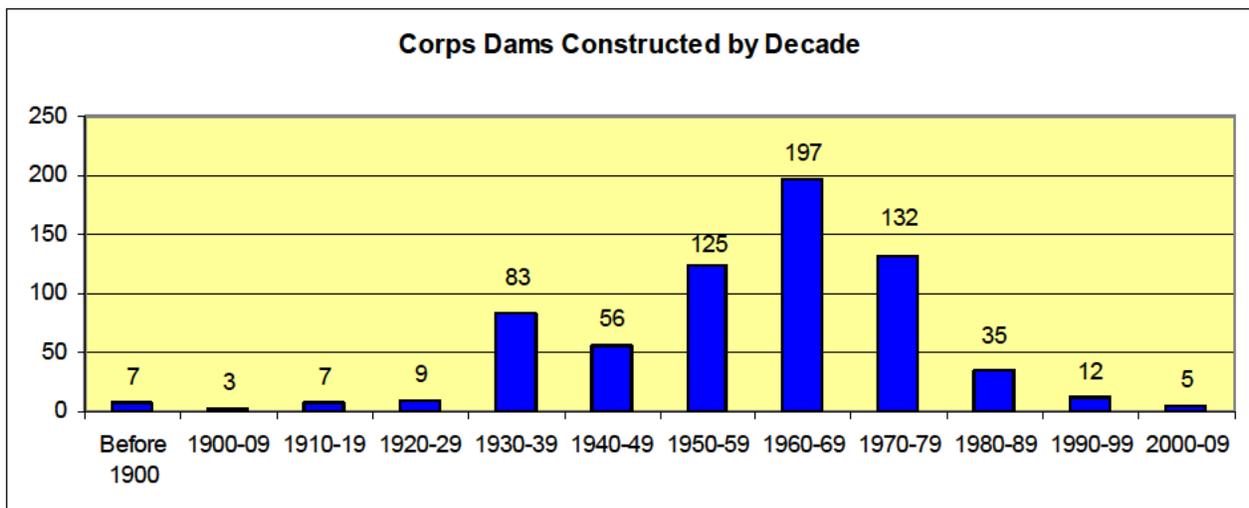


Figure 4.1: USACE Dam Construction

As illustrated in Figure 4.1, USACE went through a period of significant construction of dams between 1930 and 1980. As new dam construction slowed and the practice of dam safety evolved, USACE moved into a period of dam safety modifications to address deficiencies at existing dams. Between 1980 and 2000, USACE dam safety modifications were primarily focused on standards-based evaluations of existing structures. This included several hydrologic and seismic modifications to protect against extreme events.

Beginning in 2000, several issues were identified with regard to the USACE Dam Safety Program. This included a 2001 finding from an Association of State Dam Safety Officials (ASDSO) Peer Review noting that USACE is considered to have a “minimally acceptable Dam Safety Program” (see Section 4.5). This began a series of significant changes in the USACE Dam Safety Program, including the establishment of a Special Assistant for Dam Safety (2002), implementation of the Dam Safety Program Management Tools (DSPMT), and movement toward a risk-informed approach to evaluating the inventory of USACE dams. In 2005, Hurricane Katrina and the failures of levee systems in New Orleans provided a “wake up call” to USACE, initiating and accelerating changes in the program.

Since 2005, the USACE Dam Safety Program has performed a complete Screening Portfolio Risk Assessment of the inventory of USACE dams and established the Risk Management Center (2009), the Modeling Mapping and Consequences Production Center (2009), the Dam Safety Modifications Mandatory Center of Expertise (2012), and Dam Safety Production Centers at the Division level. In addition, dam assessment and evaluation procedures have been completely overhauled, with a focus on risk based procedures.

4.2 Safety of Dams – Policy and Procedures (ER 1110-2-1156)

This comprehensive regulation is intended to include the majority of aspects of the USACE Dam Safety Program, including “guiding principles, policy, organization, and procedures for implementation of a risk-informed dam safety program and a dam safety portfolio risk management process.” As with the overall program, ER 1110-2-1156 has undergone several revisions in the past decade, as USACE has incorporated risk as a guiding principle in program implementation.

This regulation serves as the basis for organization and implementation of the dam safety program and is considered integral to this IEPR. The copy of ER 1110-2-1156 provided to the IEPR Team and referenced within this report is annotated with “Changes Posted as of 18 May 2013.”

4.3 Organization

USACE maintains a three-level decentralized organization, including Headquarters (HQ), Major Subordinate Commands (MSC) or Divisions (aka Regions), and Districts. According to the USACE website (<http://www.usace.army.mil/Locations.aspx>), there are eight Divisions within the United States; and within each Division, there are between four and seven Districts, giving a total of 38 Districts within the United States. A map of the Divisions and Districts is provided as Figure 4.2.



Figure 4.2: USACE Divisions and Districts (from <http://www.usace.army.mil/Locations.aspx>)

Section 4.2 of ER-1110-2-1156 includes the following statements with regard to responsibility for the USACE Dam Safety Program:

“The Commanders at each level of USACE have the ultimate responsibility for dam safety within their commands. Each District Commander having responsibility for dams shall ensure that the organization has a dam safety program which complies with USACE policy and criteria, assuring compliance with the “Federal Guidelines for Dam Safety” (reference A.71). Commanders exercise this responsibility through officially designated (appointed) Dam Safety Officers (DSO) at each level. Although the DSO is located in the technical element of each organizational level, dam safety crosses all business lines and office elements, and the DSO must coordinate dam safety issues and activities with the leaders of those business lines and office elements as they manage the dam safety activities in their areas of responsibility. This includes coordination between the district office and the project field offices (that serve as the first line of defense for dam safety) concerning such issues as emergency action plans, dam safety training, and control of project documentation.”

U.S. Army Corps of Engineers
2013 Independent External Peer Review of the USACE Dam Safety Program

As shown in Table 4.1, all of the Divisions and 35 Districts have dam safety responsibilities. Each of the three levels of the organization (HQ, Divisions, and District) includes staff with dam safety experience and responsibilities. This includes a DSO and a dam safety program Manager (DSPM). In addition to these levels, the dam safety program includes several Centers, including the Risk Management Center (RMC), the Dam Safety Modification Mandatory Center of Expertise (DSMMCX), the Mapping Modeling and Consequences Production Center (MMC), and several Dam Safety Production Centers (DSPC). While reporting responsibilities may be to other entities within USACE, each of these Centers supports implementation of the dam safety program.

While the three levels are decentralized, representatives participate in and coordinate national dam safety activities. Dam safety deficiencies are prioritized nationally using risk-informed procedures, and HQ manages budgeting for dam safety studies and modifications. The Dam Safety Steering Committee (DSSC), Dam Safety Production Center Steering Committee (DSPCSC), and the Dam Safety Oversight Group (DSOG) all provide national oversight of the dam safety program. These organizations include representatives from HQ, Divisions, Districts, and Centers.

As noted above, HQ dam safety staff includes a DSO and DSPM. In addition, HQ includes the Special Assistant for Dam and Levee Safety (Special Assistant), who reports directly to the HQ DSO. The HQ DSO, DSPM, and Special Assistant qualifications, roles, and responsibilities are described in Section 4.3.2 of ER 1110-2-1156, as follows:

*“As the **USACE DSO**, this individual is responsible directly to the Chief of Engineers for all dam safety activities and shall be appointed by written order of the Chief of Engineers. The USACE DSO coordinates dam safety activities with the various elements of the Directorate of Civil Works and informs the Director concerning the condition of USACE dams. The USACE DSO is responsible for ensuring that USACE maintains a proactive dam safety program, implementing all practices and procedures outlined in the ‘Federal Guidelines for Dam Safety’ ...*

*“The **Special Assistant** acts for the USACE DSO in the execution of daily program activities and serves as Chairman of the DSSC and the DSOG... The Special Assistant provides operational direction to the director of the RMC. The Special Assistant represents the USACE DSO in the development of the budget submission, working with the appropriate Business Line Managers to ensure that dam safety priorities are addressed...*

*“The **USACE DSPM** shall be appointed in writing by the USACE Dam Safety Officer and shall work in coordination with the Special Assistant for Dam and Levee Safety. The USACE DSPM conducts the daily activities of the overall dam safety program. The USACE DSPM coordinates the HQ review of dam safety reports and prepares USACE-wide dam safety budget submissions in coordination with the DSSC and the RMC.”*

Divisions (MSCs) include a DSO, DSPM, and a Division Dam Safety Committee. At the Division Level, the DSO and DSPM have the following general responsibilities, according to ER 1110-2-1156 Section 4.4:

*“The **Division DSO** is responsible for quality assurance, coordination, and implementation of the Division dam safety program. In this capacity the Division DSO must establish procedures to ensure that the Division DSO is fully advised on all dam safety issues.*

U.S. Army Corps of Engineers
2013 Independent External Peer Review of the USACE Dam Safety Program

*The **Division DSPM** conducts the daily activities for the Division dam safety program, coordinates the review of dam safety reports, and provides support to districts within the Division. The Division DSPM works with the programs budget managers to ensure that dam safety requirements are included and properly prioritized in budget submissions.”*

While not yet staffed at every location, a Dam Safety Production Center (DSPC) is proposed for each Continental US Division and will have a DSPC Director. The DSPC is responsible for developing Dam Safety Modification Reports (DSMR), Design Documentation Reports (DDR), and construction documents in coordination with staff of the District where the dam is located.

Each District with dam safety responsibilities includes a DSO, DSPM, and a Dam Safety Committee. The DSO and DSPM roles and responsibilities are provided in Section 4.5 of ER 1110-2-1156 and generally include the following:

*“The **District DSO** is responsible for ensuring that the dam safety program is fully implemented and documented, in accordance with the District Dam Safety Program Management Plan. The District Dam Safety Committee, advisory to the DSO, should meet at least twice annually and forward meeting minutes electronically to the Division.*

*The **District DSPM** conducts the daily activities for the District dam safety program and coordinates the review of dam safety reports. The District DSPM works with the programs budget managers to ensure that dam safety requirements are included and properly prioritized in budget submissions.”*

In addition, each dam modification project will have a Dam Safety Modification (DSM) project manager, assigned by the Chief of the District Project Management Branch or Division, in full coordination with the DSO.

The general roles and responsibilities of each of the Centers that are integral to the USACE Dam Safety Program are described in Section 4.3 of ER 1110-2-1156:

*“In order to realize the full benefits of risk-informed program management, the **RMC** has been established to provide technical expertise and advisory services to assist in managing and facilitating the USACE-wide dam safety program. The RMC is a support organization, partially project funded, and located within the Institute of Water Resources (IWR). The director of the RMC reports through the IWR Director to the Director of Civil Works. The RMC has close ties to the DSO and to the Special Assistant for Dam and Levee Safety. The RMC assists the Special Assistant in implementation of dam safety policy using a combination of centralized staff as well as other national, regional, and district resources.*

*The **DSMMCX** is responsible for assisting HQUSACE with the overall coordination and oversight of the dam safety modification mission. The DSMMCX conducts sufficient reviews and coordination of the DSPCs to ensure consistency in product development and continual improvement through lessons learned. The DSMMCX promotes the development of technical competencies and facilitates coordination between the DSPCs to align resources with project needs and agency priorities.*

The [MMC] supports both the USACE Dam Safety and Critical Infrastructure Protection & Resilience (CIPR) Programs. In support of HQUSACE management of the dam safety program, the MMC performs hydraulic modeling, mapping, and consequences analysis for USACE dams in support of the Dam Safety and CIPR programs ... The MMC leverages H&H modeling, consequences analysis, and GIS mapping capabilities and resources via close coordination with USACE RMC to accomplish national mapping, hydraulic analysis, and consequences requirements for the Dam Safety and CIPR Programs."

The DSOG assists HQ in the overall management of the dam safety program by reviewing Dam Safety Action Classifications (DSAC) ratings for dams, dam safety risk assessment reports, and other dam safety decision documents. The DSOG makes recommendations on dam safety modifications to the HQ Special Assistant and DSO.

4.4 Processes

As with most other aspects of the USACE Dam Safety Program, the processes for inspection, assessment, evaluation, and modification of dams are described in detail in ER 1110-2-1156. The overall "Dam Safety Portfolio Risk Management Process" is complex, but generally includes the following activities:

- 'Routine' Operation and Maintenance (O&M) and Annual Inspections
- PI: Periodic Inspections (maximum 5 year intervals)
- PA: Periodic Assessments (maximum 10 year intervals, in conjunction with PI)
- IRRM: Implementation of Interim Risk Reduction Measures (when dam safety issues are identified)
- IES: Issue Evaluation Studies (when dam safety issues are identified)
- DSM: Dam Safety Modification Studies/Reports (when warranted based upon IES)

Dam Safety Action Classification (DSAC) reviews are conducted as part of various processes. In addition, Risk Assessments and Analyses are integral to several of these processes. Development of Design Documentation Reports (DDR) and construction contract documents (plans and specifications) commence following approval of the DSMR.

USACE guidance with regard to review of Civil Works products (i.e., design reports, drawings, etc.) is included in EC 1165-2-214, "Civil Works Review" which includes the following defined purpose:

"[EC 1165-2-214] establishes an accountable, comprehensive, life-cycle review strategy for Civil Works products by providing a seamless process for review of all Civil Works projects from initial planning through design, construction, and Operation, Maintenance, Repair, Replacement and Rehabilitation (OMRR&R). It provides the procedures for ensuring the quality and credibility of U.S. Army Corps of Engineers (USACE) decision, implementation, and operations and maintenance documents and work products. This EC puts quality on equal footing with cost and schedule compliance. It presents a framework for establishing the appropriate level of independence of reviews as well as detailed requirements, including documentation and dissemination. This circular addresses OMB peer review requirements under the "Information Quality Act" and the Final Information Quality Bulletin for Peer Review by the Office of Management and Budget (referred to as the "OMB Peer Review Bulletin"). It also provides

guidance for the implementation of both Sections 2034 and 2035 of the Water Resources Development Act (WRDA) of 2007 (Public Law 110-114)."

Other activities, processes, and responsibilities of the USACE Dam Safety Program which may be included in or ancillary to some of the processes noted above:

- Surveillance and Instrumentation
- Emergency Action Plans
- Operation of Water Control Systems
- Security of Dams

4.5 2001 Peer Review

In 2001, the Association of Dam Safety Officials (ASDSO) established a four-member panel to perform a Peer Review of the USACE Dam Safety Program. The report documenting this review is dated September 30, 2001. The report's Executive Summary (included in Appendix D) summarized the results of the Peer Review, with the following statement:

"Based on the collective experience and judgment of the Peer Review Team, the Corps of Engineers in consideration of its available resources, is currently considered to have a minimally acceptable Dam Safety Program and any further reductions in their Program will endanger their dams and the lives and property they protect."

The report included 11 specific findings and 17 specific recommendations for the USACE Dam Safety Program. While some of the findings of the 2001 Peer Review remain relevant, the IEPR Team recognizes the dramatic, seminal alteration of the USACE Dam Safety Program over the past decade. The 2001 ASDSO Peer Review is instructive to the IEPR Team in providing a historical perspective informing response to the General Charge Guidance question: "Is the direction of the program appropriate?"

The Findings and Recommendations section of this report references findings or recommendations from the 2001 Peer Review which remain relevant.

Reflection should be granted only enough time and focus to gain perspective; therefore, the focus of the IEPR Team has been directed towards the transformed USACE Dam Safety Program as it currently exists, as well as the important on-going changes, and decisions and actions that will define the future of the program.

4.6 2013 Survey Questionnaire

As part of the preparation for the IEPR, HQ and RMC developed a Survey Questionnaire that was distributed to various organizations within USACE, including Districts, Divisions, and RMC. The survey included nine "Questions for Narrative Responses" which focused on the dam safety program management and implementation, QA/QC processes, and product (deliverable) development. Another section requested that the respondents rate the following aspects of the program:

U.S. Army Corps of Engineers
2013 Independent External Peer Review of the USACE Dam Safety Program

- Organization and Management
- Management of Technical Activities
- Technical Competency.

The respondents were given space to offer explanation on these ratings. The final section consisted of 17 questions with a request for “Yes” or “No” responses along with an overall request to elaborate on these responses. These questions related to the program organization, procedures, staffing, communication, funding, costs, technical resources, standards, and training. A blank Survey Questionnaire is included in Appendix E.

The IEPR Team found the surveys to be centrally important in gaining a broad understanding of the attitudes, actions, perspectives, relationships and expectations of USACE personnel with regard to the dam safety program. Responses were received from 5 Divisions, 28 Districts and RMC. The 2013 Survey achieved an overall 70% response from Divisions and Districts. The survey provided a broader view than would have been achieved through the IEPR visits, and provided depth from having an array of responses answering the same questions from across USACE.

Many of the Findings and Recommendations presented herein were influenced by the survey responses. In many cases, responses provided a frame of reference for questions asked during visits. In some instances, survey responses spoke with a sufficiently unified voice to drive a finding. Additionally, many of the responses created inferences or conjecture that were not or could not be sufficiently corroborated to become an actionable finding.

5.0 FINDINGS AND RECOMMENDATIONS

The USACE Dam Safety Program has undergone significant changes in the past decade, most notably the shift to risk-informed management for prioritization of projects and funding across the USACE portfolio of dams. The changes in the program in the past decade have been dramatic and are continuing. As a preface to presenting the IEPR findings and answers to the “charge,” it is worth noting the progress and positive steps of the program in the past decade:

- The USACE has made a commitment to risk-informed management in the dam safety program that less than a decade ago would have been considered inconceivable. This includes the establishment of the RMC.
- Staff has been established (through new hires and education) and a new programmatic structure created to implement the risk-informed management program.
- The RMC has recognized the value and importance of education and training of the USACE staff, resulting in the ongoing development of a strong training program in risk analysis methods, facilitator training and certification, etc. The IEPR Team observed that this training has provided benefits across USACE.
- The dam safety program has established and is implementing an effective programmatic structure for managing its portfolio of dams.

The change in direction of the dam safety program to the use of risk-informed management has been extremely positive. While the IEPR findings note that this evolution is not complete, the changes in the program have been highly successful and should continue with the full support of USACE leadership.

5.1 The Charge

The IEPR was charged with addressing the following questions regarding the USACE Dam Safety Program, which are presented along with the IEPR general finding with regard to each question:

Is the direction of the program appropriate? The IEPR Team believes that the direction of the program is clearly appropriate and positive. The changes of the past decade are benefitting the program and the safety of USACE dams. This is reinforced in the discussion of many of the findings and was also clearly evident in the responses to the Survey Questionnaire.

Has USACE overlooked any critical items? The IEPR Team has identified three findings as “critical” according to the definitions provided below. In some of these cases, it may not be correct to state the USACE has “overlooked” the item, but rather not placed sufficient emphasis on the issue. One of the findings could be considered to have been overlooked by USACE (2013-A-18: Decision-Making for Time Critical Emergencies) as it was evident at several levels of USACE that this issue had not been clearly identified. In addition to those findings identified as “critical,” there are elements of the program that warrant improvement and in some cases change, as noted in the findings and recommendations presented herein.

Does the panel have any other observations to add? Many of the findings and recommendations presented herein are considered to fall into this category.

5.2 Subject Areas and Categories

The findings and recommendations presented herein have been grouped into the following subject areas, developed by the IEPR Team:

- Organization and Management
- Dam Safety Policies and Procedures
- Risk-Informed Management
- Emergency Preparedness
- Dam Safety Program Implementation
- Technical Capabilities for Dam Safety

In addition, each finding and recommendation has been assigned one of four categories, in accordance with the SOW:

- Category A – Critical
- Category B – Urgent
- Category C – Important
- Category D – Other

The IEPR Team developed the following definitions for these categories:

Critical: The issue has the potential to significantly degrade or undermine the dam safety program, or otherwise can lead to dramatic negative consequences. Includes “must do” recommendations.

Urgent: The finding is of significant importance to the program and can provide substantial dam safety benefits.

Important: The recommendation is worthy of implementation and would likely provide a definitive return on investment. Timeline for implementation could be long.

Other: Observations, considerations and perspectives worthy of USACE review regarding its dam safety program.

Findings and recommendations have been numbered in accordance with the SOW, with the following format: Year-Category-Number (2013-[A to D]-[01 to 26]).

It should be noted that unless otherwise stated, specific approaches described within the IEPR recommendations should only be considered possible solutions to address the findings. USACE should develop approaches best suited to its organization, its strategic direction and its policies and procedures.

5.3 Organization and Management

The decentralized organization of USACE presents challenges in management of the dam safety program. Reporting lines are not always logical, forcing USACE to develop multiple lines of reporting and/or communication. For example, RMC is located within the Institute of Water Resources (IWR) and the director of the RMC reports through the IWR Director to the USACE Director of Civil Works. However, as shown on the organization chart included in the “Fiscal Year 2013 Risk Management Center Program Management Plan” (January 2013), there is a reporting line (dashed) between the director of RMC and

the HQ Special Assistant for Dam and Levee Safety. These “dashed line” relationships exist within many of the organizations across the USACE Dam Safety Program. While this type of structure presents challenges, the IEPR believes that USACE is utilizing the right people in management of the program.

The following sections include the findings and recommendations of the IEPR with regard to organization and management. For each, a discussion is presented, followed by the specific finding and recommendation.

5.3.1 2013-B-01: Full Time Position in HQUSACE Dedicated to the Dam Safety Program Leadership and Management

The leadership and management of a dam safety program of the size and nationwide breadth of the USACE require a full time Dam Safety Officer (DSO) with dam safety knowledge, expertise and experience. The size and nationwide scope of the USACE Dam Safety Program alone requires this. Adding the fact that the USACE Dam Safety Program is in the middle of a very significant and challenging transformation to a significantly improved risk-informed program, the requirement for a full time DSO becomes even more essential. Finally, with the DSO and Special Assistant responsibilities for the Levee Safety Program, the USACE Dam Safety Program does not have the full time leadership that a program of this size and complexity requires.

For reference, other major Federal dam safety agencies, including Reclamation and FERC have smaller dam safety programs than USACE. However, both have full time leadership in the DSO position and additional senior support leadership dedicated full time to the dam safety program. The prevention of life loss downstream of USACE dams, the continued success in maintaining safe dams and completing the transformation to a risk-informed dam safety program requires the dedication, attention and leadership of a full time DSO with dam safety knowledge, expertise and experience.

To be clear, the entire IEPR found the current DSO to be one of the most impressive, capable, and professional engineers we have encountered in the engineering community. However, the duties and responsibilities of the Chief, Engineering and Construction alone are overwhelming without even considering his international workload and the requirements of leadership of one of the world’s largest dam safety programs. There are not enough hours in the day for the Chief, Engineering and Construction to devote the leadership that a dam safety program that owns hundreds of dams deserves and requires to continue to be successful. Mr. Dalton’s strong interests and concerns related to the USACE Dam Safety Program are evident. It is our recommendation (2013-B-02) that Mr. Dalton remain the person to whom the full-time DSO reports and provides his continued oversight, independent perspective, and strategic planning input as currently provided.

Finding: The leadership and management of a dam safety program of the size and nationwide breadth of the USACE requires a full time Dam Safety Officer with dam safety knowledge, expertise and experience. The Chief, Engineering and Construction has too many other responsibilities to be able to serve as the DSO.

Recommendation: The Dam Safety Officer of the USACE Dam Safety Program should be a full time senior level position staffed by a professional engineer with knowledge, expertise and experience in dam safety, and a clear commitment to the program’s mission.

5.3.2 2013-B-02: HQUSACE Oversight and Strategic Leadership of the Dam Safety Program

As presented in the previous finding, while the current DSO does not have extensive dam safety expertise or the availability to provide full time oversight, he provides valuable oversight, independent perspective, and strategic leadership for the USACE Dam Safety Program. This was evident through the discussions that the IEPR Team had with Mr. Dalton and other USACE staff.

Finding: In conjunction with the finding that the USACE have a full time Dam Safety Officer (DSO), it is equally important for there to be active, informed oversight of the dam safety program. This oversight can best be provided by the Chief, Engineering and Construction, whose responsibility should include the review of the overall dam safety program, and the review and contribution to the program's mission, strategic plan, and overall fiscal planning.

Recommendation: The DSO shall report to the Chief, Engineering and Construction, who should have dam safety knowledge and provide program implementation and strategic planning oversight.

5.3.3 2013-C-03: Dam Safety Team Unity

Concerns relating to management of the dam safety portfolio include effective communication (a broad-based concern at all levels) and trust (a much more personalized issue). USACE Dam Safety Program personnel have undergone a tremendous amount of change over the past five years. Changes have been on-going, with many editions of ER 1110-2-1156 and other new guidance documents being disseminated.

July 2013 DSO quote: "The amount and pace of change has been withering."

Massive change can readily lead to confusion, frustration and misunderstanding, which can easily lead to mistrust. Communications are strained as new technology, terminology and acronyms connect with new demands and alterations to organizational structures and changed responsibilities and authority.

To more fully succeed, the dam safety program needs to pull together as one team (horizontally and vertically) to quiet the 'us against them' conversations. To be one team, dam safety staff at all levels need to be recognized as mutually critical elements of the overall mission, afforded a sense of fairness and equity, and guided by a common set of principles. Based on our interviews and the survey results, there is a strong common thread of subdued, but hopeful, optimism. Issues related to communication and trust are stressed, but they are not broken, so the door is open for coalescing the team's sense of community and commitment.

The IEPR Team believes the HQ dam safety leadership is well intentioned, well educated, passionate about their work, and, most importantly, focused on success in addressing its critical dam safety objectives. HQ leadership needs to take the lead in communicating its passion and its values to all levels of the team to instill a stronger unity of purpose. More frequent communication and insights into program actions and direction are much desired by staff. Contact and communication will be well received if presented in a manner that expresses team values. At the Division and District levels, there is a sense that HQ has aligned itself with RMC and gives unwarranted credibility to RMC input over the input of others. It is important to discriminate between signal and noise, and to do so thoughtfully. HQ leadership can't afford to be distracted by the noise and it can't afford to ignore the signals, nor to play favorites. There are great ideas, great accomplishments, and great people present at every level of the USACE

Dam Safety Program. All can contribute to program achievements if they believe their voices are heard and that they are members of the same team.

Regular visits to all Divisions, Districts and Centers with a dam safety component are impractical. However, visits do provide a significant morale lift, front line feedback, and a closer connectedness with the overall program. It is recommended that units having significant dam safety responsibilities be visited by key HQ dam safety personnel often, with units having less dam safety responsibilities visited less frequently. While the benefits of these visits are difficult to quantitatively measure, the value of outreach will readily reveal itself. Increased use of newsletters, webinars and other broadly available communication tools that speak candidly, and express genuine gratitude for and celebrate successes will promote unity and trust.

Finding: Staff has undergone major change over the past five years, which can lead to frustrations and misunderstandings, and, in turn, to mistrust. Communications are strained by new demands and organizational changes. There exists a common thread of subdued, but hopeful, optimism. The door is open for coalescing team community and commitment. HQ leadership is generally viewed positively, which is a powerful message. However, Divisions and Districts sense that HQ is not giving adequate credibility to their concerns and does not communicate with sufficient candor or frequency.

Recommendation: There is a need to recognize staff at HQ, Divisions, Districts and Centers as mutually critical. Full time leadership (Finding 2013-B-01) is needed to develop a strategy that will build unity and common purpose, and better instill common passions and values to all levels. Key HQ dam safety personnel need to make more visits to Divisions and Districts. This will provide a significant morale lift, providing closer connectedness with the mission. Candid, regular communications are needed to build trust and unity. The IEPR Team applauds the HQ leadership for the exceptional job it is doing and for the passion, dedication and focus it provides. Because HQ is asking staff to do more – HQ efforts and actions need to be more visible and more accessible, so that HQ is seen as doing more than is currently visible to staff.

5.3.4 2013-C-04: Adaptation to Change

The USACE Dam Safety Program has gone through much change and has much left to accomplish. Modifications to date have advanced the dam safety program considerably. Filling positions with qualified people is and will continue to be a problem. This is a long-term proposition (in some cases requiring generational turnover), so a long view needs to be taken of this critical metamorphosis.

Survey Questionnaire Responses included the following:

“... it is sometimes frustrating trying to keep up with the changes.”

“... resources to implement the new requirements are not sufficient.”

There are two sides to the change equation: the agents of change, and those having their career concepts being retooled. While the panel sees much continued evolution needed to approach the stated goal, many on both sides of the change equation have likely had their appetites for change more than satisfied. Concerted efforts should be made toward adding staff (when possible) and advancing staff experience and expertise (training) related to the revamped procedures and processes. The panel believes that by building confidence and comfort in working with the new tools, there will be greater

opportunities for enhanced coordination, collaboration, communication and, as a result, trust building. In the end, this positions the dam safety program to accomplish much more with available resources.

Finding: The USACE Dam Safety Program has gone through considerable change; however, there remains more to be done. The evolution that has taken place to date has been extremely positive. There is considerable need to assimilate the new tools and processes. This is a long-term proposition, so a long view is needed. Building a focus on training and building confidence in working with new tools require collaboration, communication and trust (Finding 2013-C-03). These position USACE to accomplish more with available resources.

Recommendation: USACE HQ and RMC should focus on advancing staff experience and expertise related to the recent changes in processes and procedures. This could be accomplished through both training and providing opportunities for staff to work on projects led by the experts that developed the new processes. USACE should prioritize ongoing changes to streamline and advance their objectives, and regulate changes to avoid overwhelming USACE staff.

5.4 Dam Safety Policies and Procedures

The policies and procedures of the USACE Dam Safety Program are detailed in ER-1110-2-1156, "Safety of Dams." As noted herein, ER-1110-2-1156 has gone through many transformations in the past several years, most notably the inclusion of risk-informed management and risk analysis procedures. Findings related to risk-informed management are specifically addressed in Section 5.5. The IEPR Team has two findings and recommendations regarding the dam safety policies and procedures.

5.4.1 2013-B-05: Peer Review of ER 1110-2-1156

ER 1110-2-1156 is the key programmatic and technical document for the USACE Dam Safety Program. The IEPR presented herein was charged with becoming generally familiar with ER 1110-2-1156, as opposed to conducting an in-depth review of the document, and the procedures and methods contained in the regulation. In the context of the Charge to the panel, a technical review of the methodologies was not carried out (in particular, the risk analysis methodologies and all of its sub-parts [i.e., probabilistic flood frequency analysis, fragility analysis, methods of expert elicitation, uncertainty analysis, etc.]). In addition to an in-depth review of the procedures and methods in the ER, how these methods are implemented and what the USACE dam safety decision framework is should also be the subject of a future external peer review.

Based on the panel's reading of material that has been provided and interviews with dam safety program staff, there is reason to expect that a review would identify findings and recommendations regarding improvement in methodologies or approaches to implementation. A sense of this is contained in the findings of this review.

Finding: Whereas ER 1110-2-1156 is key to the USACE Dam Safety Program, a peer review of the current document has not been performed and is warranted.

Recommendation: The USACE should conduct a comprehensive external peer review of ER 1110-2-1156 and in particular its risk-informed elements (methodology, training, etc.) and how risk analysis concepts and risk-informed management are being implemented. The review should be carried out in a manner that takes full advantage of the longer and more extensive experience in other areas of civil

engineering and the sciences where risk analysis and risk-informed decision making have been implemented.

5.4.2 2013-B-06: USACE Engineering Manuals and Regulations

With the introduction and implementation of a risk-informed management approach to dam safety, it follows that engineering standards for analysis and design which the USACE is known for should be revised to be consistent with risk and performance-based methods. This was noted specifically in the finding related to the frequency of flooding and the standard for spillway design. While the IEPR panel has not systematically reviewed all USACE ERs and EMs, discussions with USACE staff suggest there are a number of ERs and EMs that require updating.

Finding: There are a number of USACE ERs and EMs that are out-of-date and/or whose basis and approach are likely inconsistent with a risk-informed/performance-based approach to engineering analysis and design.

Recommendation: It is recommended the USACE review the status of their ERs and EMs that are important to dam safety and develop a plan to systematically revise them in a manner that is consistent with risk-informed and performance-based methods. Once developed, independent external peer review of these documents should be carried out to review their technical adequacy and consistency with state-of-practice methods.

5.5 Risk-Informed Management

The degree and scale of the changes that have taken place and are ongoing in the USACE Dam Safety Program are significant and positive. The program continues to evolve and mature as the staff gains experience, training continues, etc. Clearly the process of transforming to a risk-informed management agency is not complete. This is due in part to the size of the organization, the complexity and scale of the issues that must be addressed and, as such, is simply a part of the evolutionary growing pains for an agency that is managing several critical elements of the nation's infrastructure. The fact that dams and dam safety are just one element of the USACE mission elevates the impressive progress that has been made.

One objective of the peer review is to “examine how well the USACE is implementing the federal guidelines for dam safety and executing its stated mission....”

With respect to risk-informed management aspects of the dam safety program, the federal guidelines state:

“Specifically, agencies should strive to perfect techniques for evaluating the probability of possible deficiencies causing dam failure and estimating the potential losses due to such a failure. Meanwhile, the agencies should evaluate the potential consequences of failure of the dams under their jurisdiction. Although the value of potential property losses can be estimated, it is recognized that potential loss of lives can only be quantified, but not evaluated. On new dams, potential losses can be used in study of project alternatives and in assessment of additional safety incorporated into the dam facilities. On existing dams, a risk-based analysis should be considered in establishing priorities for examining and rehabilitating the dams, or for improving their safety.”

The USACE Dam Safety Program clearly exceeds the requirements of this guidance, which is limited in its scope. As a matter of perspective, the panel notes the federal guidelines do not provide any particular guidance or even the sense of a 'standard' for measuring the adequacy of a dam safety program as it relates to risk analysis. As such, a satisfactory determination with regard to 'implementing' the federal guidelines as it pertains to the use of risk analysis methods is not considered particularly relevant to this IEPR.

In this context, the question becomes: To what standard should the risk-informed management aspects of the dam safety program be evaluated? Two standards could be considered:

- The USACE dam safety regulation, ER 1110-2-1156 itself. From the panel's perspective, ER 1110-2-1156 defines the organization of the dam safety program and defines its approach to many of the technical aspects of its risk-informed approach to dam safety management. The panel has used this regulation (along with other activities it carried out) to address the questions of the "charge." In addition, the panel also looked at the degree to which the USACE appears to be implementing its own 'standard.'
- The second resource for addressing the questions posed to the panel is the standard-of-practice in risk analysis as it is applied to civil infrastructure systems in the profession.

5.5.1 2013-D-07: General Direction of Program with Regard to Risk Management

Since the events that occurred in New Orleans during Hurricane Katrina, there have been significant changes in the USACE and in the dam safety program in particular. Certainly a cornerstone of these changes has been the agency's adoption and implementation of a risk-informed management approach to dam safety. Whereas the recommended use of risk and decision analysis methods has been 'on the books' since President Carter's 1977 letter to federal agencies regarding their dam safety practices and the original publication of the Federal Guidelines for Dam Safety (Federal Coordinating Council for Science, Engineering and Technology, Federal Guidelines for Dam Safety, prepared by the Ad Hoc Interagency Committee on Dam Safety, June 25, 1979), it is only in the last seven years that the USACE has made risk-informed management the foundation of the dam safety program. This is an enormously positive step for the agency, for staff, for use of the nation's resources, and the management of a major part of the nation's infrastructure. The USACE management and the dam safety program are to be commended for making this change.

The evolution of the USACE to be a risk-informed manager has required two major steps. The first was the strategic decision by the USACE to commit to a risk-informed management approach. Of greater significance and certainly far more difficult was the task of developing, implementing and putting into practice an agency-wide risk-informed dam safety program. The work that has gone into implementing the program (i.e., the development of regulations, training, staffing, etc.), the challenges of changing the whole dam safety paradigm, and simply achieving a comfort level across all elements of the staff of this 'new' technology by an agency the size of the USACE is monumental. Evidence of the successful implementation of the program is apparent at all levels of the USACE. Management and staff are speaking a 'common' language and have a common mindset with regard to the dam safety program. This re-direction from a standards-based program to one that is risk-informed by all levels of staff as well as at the project level is a clear measure of the scale and effectiveness of change that has taken place.

As noted in the findings and recommendations herein, the evolution is ongoing and challenges remain.

Finding: In the last seven years, the USACE has made risk-informed management the foundation of the dam safety program. This is a positive step for the agency, for staff, for use of the nation's resources, and the management of a major part of the nation's infrastructure. Re-direction from a standards-based approach to a risk-informed program is a clear measure of the scale and effectiveness of change that has taken place.

Recommendation: There is not a specific recommendation to be implemented by USACE regarding this finding. USACE is to be commended for the major positive changes in the program by incorporating risk-informed management.

5.5.2 2013-C-08: Complying with OMB Guidance

ER 1110-2-1156 clearly defines the focus of the USACE Dam Safety Program on the risk to public safety (the potential for loss-of-life as a result of dam failure or incident). This focus is reflected in the definition of a high-hazard dam and in the tolerable risk guidelines and the statement that "it is not appropriate to refer to balancing or trading off public safety with other project benefits."

A focus on public safety is clearly appropriate for dams that may have significant consequences in the event of uncontrolled release of the reservoir. However, it is not clear the current focus is consistent with the broad agency responsibility of managing a critical part of the nation's infrastructure. In fact, it appears to be inconsistent with Office of Management and Budget (OMB) principles cited in Section 2.2.4.2 of ER 1110-2-1156 which states: "USACE follows the principles recommended by OMB." This means USACE seeks to choose among alternatives that:

“. . . offer the greatest net improvement in total societal welfare, accounting for a broad range of relevant social and economic consideration such as equity, quality of life, individual preference, and the magnitude and distribution of benefits and costs (both direct and indirect, both quantifiable and non-quantifiable).” (Improving Public Safety, From Federal Protection to Shared Risk Reduction, Letter to J. Nussle, Director, Office of Management and Budget, April 16, 2008. Washington, DC: USACE).

It is clear there are dam safety issues at USACE projects that represent a significant risk to the public, and as a result major dam safety modifications are appropriate. Based on interviews with dam safety program staff, what is less clear is whether the OMB principles are being met and whether comprehensive risk analyses and a decision framework that satisfies the broad OMB guidelines and that leads to decisions that on-balance are a more effective use of resources and return a greater benefit to the country.

As part of USACE risk analyses that are performed for dams that might require dam safety modification, the range of consequences that could occur as a result of uncontrolled release of a reservoir are evaluated (i.e., potential loss-of-life, economic consequences, environmental consequence, etc.). Based on information provided to the panel and interviews with staff, it is not clear what the USACE decision framework is and the extent to which it is consistent with OMB principles. Discussions with all levels of USACE Dam Safety Program staff coupled with the statement in ER 1110-3-1156 that "it is not appropriate to refer to balancing or trading off public safety with other project benefits," suggest the program may be too narrowly focused and that OMB principles are not being met.

Finding: A focus on public safety is clearly appropriate for dams that may have significant consequences in the event of uncontrolled release of the reservoir. However, it is not clear that the current focus is consistent with the broad agency responsibility of managing a critical part of the nation's infrastructure. In fact, it appears it is inconsistent with OMB principles. The program may be too narrowly focused and OMB principles do not appear to be met.

Recommendation: The USACE should examine the focus and implementation of the dam safety program as it relates to the degree to which its practices are consistent with OMB principles which it says it is following. The USACE should conduct a comprehensive peer review of ER 1110-2-1156 (Recommendation 2013-B-05) and in particular its risk-informed elements (methodology, training, etc.) and how risk analysis concepts and risk-informed decision-making are being implemented.

5.5.3 2013-B-09: Frequency of Flooding and Use of the PMF Standard

The panel has identified two broad issues with regard to the hydrologic analysis that is performed to support risk analysis activities. The first concerns the approach to flood frequency analysis and the second is the USACE regulation (ER 1110-8-2) that defines the inflow design flood for spillways and reservoirs.

The current practice for estimating extreme inflows appears to be the extrapolation of flood frequency distribution. This approach does not take into account modern methods of statistical analysis, hydrologic and stochastic modeling methods and uncertainty analysis. An extrapolation of a standard flood frequency distribution (extension of Bulletin 17B) and the estimation of parametric uncertainty are a narrowly defined approach to estimating the frequency of extreme flood events. The lack of a modern approach that does not address epistemic uncertainties compromises the technical integrity of the results; the analyst does not, in general, know if the results yield a conservative or non-conservative estimate of the frequency of exceedance for extreme flood events. Among various shortcomings of statistical extrapolations of this type is the failure to consider alternative models, lack of consideration of physical processes that generate extreme events, and the lack of a formal evaluation of sources of epistemic uncertainty.

The current USACE regulation for the development of the inflow design flood for spillways and reservoirs is established in ER 1110-8-2. The probable maximum flood (PMF) is used for "most Corps storage projects as the Inflow Design Flood" (Webb, J.W., USACE Hydrologic Safety Assessment, Presented at the Northwest Dam Safety Regional Forum, Portland, OR, February 14-15, 2006).

On the one hand the dam safety program is taking a risk-informed approach to management decisions – this is as it should be. On the other hand, when a hydrologic deficiency is identified, ER 1110-2-1156 indicates that ER 1110-8-2 should be applied for hydrologic design of spillways. In the context of a risk-informed dam safety management program, there is no logical basis for the consideration or use of the PMF or related concepts in establishing the design basis for spillways and reservoirs or as a basis to measure the safety of a dam or the risk to the public.

From a technical perspective there is no evidence to define/decrease the frequency of 'individual' large flood events and neither is there a basis to make the case the frequency of the PMF is low enough (say relative to a tolerable risk criterion). In view of the potential sources of epistemic uncertainty involved in the assessment of extreme floods, flood events less than or even greater than a postulated PMF may, in principle, be important contributors to risk at a given project.

The panel notes this dichotomy of having a risk-informed approach to dam safety and existing, standards-based regulations for design is not unique to hydrology and spillway design.

Finding: The current practice to estimating extreme inflows appears to be the extrapolation of flood frequency distribution. This approach does not take into account modern methods of statistical analysis, hydrologic and stochastic modeling methods and uncertainty analysis. The current USACE regulation for the development of the inflow design flood for spillways and reservoirs is established in ER 1110-8-2. As described in ER 1110-8-2, the PMF is used for most USACE projects. In the context of a risk-informed dam safety management program, there is no logical basis for the consideration or use of the PMF or related concepts in establishing the design basis for spillways and reservoirs, or as a basis to measure the safety of a dam or the risk to the public.

Recommendation: USACE should develop and implement modern approaches to the assessment of flood frequencies at dams that include the assessment of epistemic uncertainties, which is the standard practice in the analysis of extreme events. The approach should include alternative levels of analysis that reflect the varying project needs of the USACE and the level of risk for dams across its portfolio. In addition, ER 1110-8-2 should be revised to reflect a full-scope probabilistic approach to developing inflow flood frequencies and design floods for spillways and reservoirs.

5.5.4 2013-C-10: Consistency/Quality of Risk Cadres

A key element of the dam safety program is the RMC risk cadres that support the implementation and performance of risk studies. In principle, the cadres are the USACE experts in risk analysis (methods and principles) and in conducting risk analysis studies. Panel interviews with RMC staff, observations at a DSOG meeting, and discussions at district offices suggest problematic variations in the consistency and quality (experience, knowledge, approach to facilitation, etc.) of the risk cadres. For instance, this variation is reflected in the approach that is taken to the evaluation of uncertainties in risk analysis (Finding 2013-B-14) and the quality of risk assessments performed as part of PAs (Finding 2013-C-11).

The consistency and knowledge issues may be due in part to the foundational educational and experience requirements RMC has established for staffing the risk cadres. Coupled with this may be the need to establish risk cadres that are formed around dam safety risk generalists. A risk generalist is a civil engineer, ideally a dam engineer (Finding 2013-B-26) – either a generalist or with a particular specialty such as structures, geotechnical engineering, etc., who has the educational and experience background in risk, risk analysis, probability, statistics, etc. This specialty can be viewed in the same way that hydrologists, geotechnical engineers, etc. are viewed and hired. They have an area of expertise in which they were specifically trained and in which they have specific on the job experience.

Finding: Observations and discussions during the IEPR suggest unwarranted variations in the consistency and quality of the risk cadres. Part of the consistency and knowledge issues may be due to foundational educational and experience requirements RMC has established for staffing the risk cadres. Coupled with this may be the need to establish risk cadres that are formed around dam safety risk generalists.

Recommendation: USACE should review and evaluate the performance of the risk cadres, how they are constituted (membership), what their roles and responsibilities are when risk studies are performed, etc. USACE should also establish a dam safety risk generalist position and include individuals in this position in each cadre. This position should have the 'specialty' educational and experience requirements similar

to what is required for other dam engineering topical areas (i.e., hydrologists, geotechnical engineers, etc.).

5.5.5 2013-C-11: Risk Analyses Performed as Part of Periodic Assessments

Periodic Assessments are a core element of the dam safety program and risk analyses are performed as part of the PAs. In this context, the quality and consistency of PAs are important to the quality of the USACE risk management program. Recent experience in performing the risk analysis part of PAs suggests there are issues with consistency and quality in applications and documentation. A series of problematic PAs were presented at the DSOG meeting attended by the IEPR panel.

On the positive side, the program does have a review process in place that has identified the consistency and quality issues. Of course, of greater concern is root cause(s) that leads to the repeated occurrence of these issues. It is likely there are a number of contributing factors that relate to experience, training, technical complexity of issues that are evaluated, the subjective and semi-quantitative nature of the assessments performed, etc.

Finding: The quality and consistency of PAs is important to the quality of the USACE risk management program. Issues with consistency and quality in applications and documentation have been identified. This included a series of problematic PAs presented at the DSOG meeting attended during the IEPR.

Recommendation: The RMC should assess the root causes of risk analyses that have failed to meet its quality and consistency standards and, as appropriate, provide more and better training, make changes to procedures, modify the role of risk cadres, clarify the role and responsibilities of facilitators, and provide uniform guidance to district staff.

5.5.6 2013-B-12: Operational Risks

Most dams involve some form of 'operation' such as the opening and closing of gates and outlets during normal conditions, floods, or different types of emergencies. These operations can involve management, on-site operators, remote operators, operating procedures, off-site factors such as upstream dams, etc. In addition to the potential complexities of dam operations, the time scales of events can be very different. As a consequence, understanding and mitigating operational risks is difficult without the benefit of systems-based risk analyses that look specifically at this aspect of dam operations and performance.

The relative importance of this issue was reflected in a comment made by a senior USACE staff member, who wondered whether the USACE might fail one of its own dams as a result of misoperation; a consequence of not understanding operational risks.

Finding: Operations at dams can involve various staff levels, processes, and structure, system and component reliability. Understanding and mitigating operational risks are difficult without the benefit of systems-based risk analyses that look specifically at these aspects of dam operations and performance. The potential for the USACE to fail one of its own dams as a result of misoperation might be a consequence of not understanding how the dam system performs during the full range of operating scenarios.

Recommendation: The USACE Dam Safety Program should include operation risk analysis, which is necessarily a systems-based assessment of dam operations. As appropriate, the results (lessons and

insights) of these studies should be integrated into project operating procedures, emergency action plans, training, etc. This recommendation is a natural subset of the recommendations associated with incorporating systems-based methods into the dam safety program (Finding 2013-B-15).

5.5.7 2013-C-13: Broad Based Application of Risk-Informed Management

The USACE Dam Safety Program is currently focused on the assessment of public safety risks and their management. This focus is appropriate (in general) and clearly an advantage of a risk-informed approach. There are, however, other opportunities for using risk concepts and the results of risk analyses to support many of the elements of the dam safety program. These areas include (but are not necessarily limited to):

- Operations training of project operators, management, etc.
- Development of emergency action plans
- Performance-based engineering and design
- Instrumentation and monitoring
- Maintenance planning
- Asset management

The USACE recognizes this in general as noted in ER 1110-2-1156 Chapter 14, where the concept of risk-informed instrumentation monitoring is discussed.

It appears the development and implementation of risk-informed concepts to all aspects of dam safety and more broadly the management of the USACE dam infrastructure has not taken place. There does not appear to be a clear plan/approach to the implementation of risk analysis insights and lessons to all aspects of the program, including operations, maintenance, incident management, emergency action plans, etc. As such, the notion of a risk-informed dam safety program is currently limited.

Finding: The USACE Dam Safety Program is currently focused on the assessment of public safety risks and their management. This focus is appropriate (in general) and clearly an advantage of a risk-informed approach. There are other opportunities for using risk concepts and the results of risk analyses to support many of the elements of the dam safety program. It appears the development and implementation of risk-informed concepts to all aspects of dam safety and more broadly the management of the USACE dam infrastructure have not occurred. There does not appear to be a clear plan/approach to the implementation of risk analysis insights and lessons to all aspects of the program. As such, the notion of having a risk-informed dam safety program is currently limited.

Recommendation: The USACE should plan for and evolve to the utilization of risk-informed approaches to support all elements of the dam safety program and asset management.

5.5.8 2013-B-14: Evaluation of Uncertainties in Risk Analysis

Section 2.2.3.2 of ER 1110-2-1156 discusses the issue of uncertainty (knowledge uncertainty) and the importance of distinguishing between different types of uncertainty and the potential influence on risk management decisions. The regulation is limited in terms of the discussion of uncertainties (in particular, epistemic uncertainties), a framework for their evaluation, and how they should be evaluated and quantified in a risk analysis. Discussions with USACE personnel indicate there is a difference in perspective as to how epistemic uncertainties can/should be evaluated. For instance, in response to a

question regarding the evaluation of uncertainties, an RMC facilitator remarked (paraphrasing), “when I am the facilitator, I have the team consider the sensitivity of the results to uncertainties, but I am not sure how others handle this.”

In practice, it appears uncertainties are addressed through sensitivity calculations only. In addition, the identification of uncertainties appears addressed in an ad hoc manner and based on the experience and guidance of the RMC facilitator. As such, the evaluation of uncertainties varies with each risk analysis.

The issue of uncertainties and how they are evaluated is in many respects at the core of performing a risk analysis. For problems such as those encountered in dam safety where the frequency of events being evaluated (risk to the public) are low, epistemic uncertainties tend to be high and in general underestimated, particularly when they are addressed in an ad hoc (non-structured) manner.

The risk analysis performed as part of a PA is one of the cornerstones of the USACE risk-informed management program. It is based to some extent (possibly even a large extent) on subjective assessments, as reflected in ER 1110-2-1156:

“A semi-quantitative risk assessment will be performed for the potential failure modes that are judged to be “risk-drivers.”

An important part of the evaluation is to capture the confidence in the selected categories for failure likelihood and consequences. The level of confidence can be expressed using qualitative descriptors as follows in Table T.3.”

In addition, PAs are based on approximate or limited quantitative evaluations (hydrologic frequency analysis, seismic hazard analysis, etc.). Given these attributes, the risk analyses performed as part of PAs are judged to provide a relative measure of risk, which is useful to support the USACE DSAC process, but the results cannot be directly compared to the tolerable risk criteria.

Finding: The guidance in ER 1110-2-1156 with regard to the evaluation of uncertainties is limited. This leads to inconsistency with respect to how uncertainties are identified, evaluated, and ultimately integrated into a risk analysis and the management of risks. In principle, there is no clear evidence the guidance in ER 1110-2-1156 is followed. While sensitivity calculations are a useful step in understanding the effects of uncertainties, they are not a replacement for a more thorough evaluation and incorporation in a risk analysis.

Recommendation: With regard to the evaluation of uncertainties:

- ER 1110-2-1156 should be expanded to include an in-depth discussion of uncertainties that includes a framework for their assessment, methods for uncertainty evaluation and recommendations for the level of analysis that is required for different applications.
- Development of training to describe the evaluation of uncertainties (material in ER 1110-2-1156), with examples, elicitation training, etc.
- Development of tools to perform the calculations required in risk quantifications where uncertainty analysis is required.

5.5.9 2013-B-15: Systems-Based Risk Evaluation

Dams are a complex integration of man-made structures, systems and components, natural structures and systems, procedures, operational staff, and authorities. In addition, the evolution of dam incidents/failures can take place on varying time scales which can make the performance of dam systems dynamic and complex.

Within the dam engineering and safety community there is a growing awareness and need to take a systems-based view of how risk analyses, even limited analyses, are carried out. At this time it does not appear that USACE risk analyses take a systems-based approach. The panel recognizes that this is not exclusively the case, but it does appear to be generally true. For instance, the concept of systems-based analysis is not discussed in ER 1110-2-1156, although the word 'system' appears 276 times in the May 2013 draft of ER 1110-2-1156.

In addition, the notion of systems-based risk analysis did not appear to be part of the experience or mindset of most USACE staff that were interviewed. Those cognizant of the need for systems-based assessments noted that budgeting is directed towards a project rather than systems of facilities, even where system-wide risks prevail.

The degree to which systems-based evaluations are required will undoubtedly vary. As such, methods and procedures should be developed that are scalable to different types of analyses that are performed.

Finding: While not exclusively the case, it appears that USACE risk analyses do not generally take a systems-based approach. In addition, the notion of systems-based risk analysis did not seem to be part of the experience or mindset of most USACE staff who were interviewed.

Recommendation: USACE should incorporate systems-based approaches to the evaluation of dams. As part of this effort, thought should be given to:

- Levels of systems-based analysis that are required for different applications.
- The elements of the dam safety program that may be supported by systems-based applications.
- Development (or acquisition) of tools to support systems-based analysis.

5.5.10 2013-B-16: Seismic Hazard Analysis

For seismic risk analysis performed as part of periodic assessments, the USACE recommends the use of the USGS national hazard map to estimate the ground motion hazard at dam sites. The analysis that is the basis for the USGS seismic maps is not adequate to support risk analyses for critical infrastructure facilities. While this view is widely held in the seismic hazard analysis community, it is best reflected by comments the former head of the USGS national hazard mapping group relayed to the DSOG at the July meeting by a USACE staff member.

Experience in comparing the USGS probabilistic seismic hazard analysis (PSHA) results to those of full-scope PSHAs in the central and eastern U.S. and the western U.S. suggests they may be conservative or non-conservative. As a consequence, they cannot be generally considered a reliable basis to estimate the seismic risk of USACE dams.

It is possible that the USACE might find limited areas where use of the USGS national seismic hazard maps meets the needs of periodic assessments. These might be in areas of very low seismicity and for the evaluation of low-hazard dams.

Finding: USACE uses the USGS national hazard map to estimate the ground motion hazard at dam sites as part of the risk analysis performed for a PA. The analysis that is the basis for the USGS seismic maps is not adequate to support risk analyses for critical infrastructure facilities. Based on experience in comparing the USGS PSHA results to the results of full-scope PSHAs in the U.S. suggests use of USGS seismic maps may be either conservative or non-conservative. As a consequence, they cannot be considered a reliable basis to estimate the seismic risk of USACE dams.

Recommendation: The USACE should examine and implement an improved approach for estimating earthquake ground motion hazards at project sites. The approach that is developed should be applicable to the various levels of analysis that are required and levels of risk. There are opportunities for doing this in a reasonable, efficient, and technically sound manner that will provide greater consistency across its portfolio. This examination should recognize and be consistent with the current standard-of-practice in PSHA.

5.6 Emergency Preparedness

The potential for significant loss of life and downstream consequences resulting from a dam failure or incident makes emergency preparedness among the most important components of a dam safety program. The IEPR identified two critical findings with regard to emergency preparedness.

5.6.1 2013-A-17: Emergency Management Procedures Oversight and Implementation

Effective Emergency Action Plans (EAP) are a major element in the USACE Dam Safety Program for preventing life loss downstream of USACE dams. However, the USACE EAP process remains a significant risk to the program. The management, implementation, and coordination of EAPs continue to exhibit the problems and deficiencies documented in the 2001 ASDSO Peer Review.

The 2001 Peer Review included the following finding:

“There is no clear or adequate guidance describing the importance of necessary coordination between the USACE staff and the local emergency management agencies (EMA). Such guidance would assure evacuation procedures, if necessary, are effective and that the affected residents are safely evacuated by their local EMAs.”

The recommendation from the 2001 Peer Review Report regarding the importance of coordination with EMAs for prevention of life loss is repeated here for emphasis.

“A Corps-wide initiative should be implemented to increase the effectiveness of the EAP by raising the awareness of the importance of close coordination between the dam owner and the downstream local emergency management agencies. The initiative should (1) require close annual coordination and collaboration to ensure the local EMA will understand what to expect during a dam related emergency, and be provided the information they need to plan the appropriate evacuation procedures, (2) utilize the Corps-wide expertise in their EOC offices and Public Affairs Offices to provide effective strategies for assisting the local EMA in developing

evacuation plans and (3) develop an effective performance measurement and monitoring system to assure the safe evacuation of downstream residents in the event of a dam safety emergency, including documentation that the local EMA has received an annually updated copy of the EAP and understood its contents.”

It is not apparent that any significant improvements have been made with this important life safety issue. During the HQ Briefing in May 2013 for this IEPR, USACE included the following response to the 2001 finding presented above: “Evacuation Planning remains the responsibility of the local EMAs and is not specifically monitored.” This implies no USACE responsibility with regard to evacuation planning.

There appears to be limited USACE management or oversight above the District office level with regard to implementation of EAPs. For a dam safety program as geographically diverse and multi-leveled as USACE, consistency and effectiveness cannot be maintained without nationwide oversight. District visits revealed that coordination with EMAs regarding evacuation planning, as well as public awareness meetings, were being carried out. However, the lack of guidance and oversight above the District level leaves the EAP program susceptible to wide variations in implementation of this critical element of the dam safety program.

The IEPR visits revealed the following:

- USACE does not maintain an adequate USACE-wide accurate tracking system to document effective (or ineffective) EAPs.
- Districts do not consistently update their EAPs annually. This includes not updating the notification lists in a timely manner.
- One District reported that it does not have effective EAPs at 20% of its dams.

The importance of a strong and collaborative relationship between USACE and the local EMAs, and close emergency management coordination and EAP functionality is considered the state of practice for dam safety programs. A successful EAP requires the dam owner and the local EMAs to work together. The panel believes that this can be accomplished, at a minimum, through an annual meeting to discuss and review the actions both parties have to take and confirm that both the dam owner and local EMAs understand their roles and responsibilities and are capable of carrying out these responsibilities. ER 1110-2-1156 states:

“In addition, annual meetings between a dam owner and emergency responders facilitate a better understanding of the roles and responsibilities and will enhance emergency readiness.”

The Federal Guidelines for Dam Safety require an annual review of every EAP to assess its workability and efficiency, i.e., timeliness of implementation, to update contact lists and to improve weak areas.

The panel found insufficient evidence that the guidance and requirements regarding the importance of a strong relationship and close coordination with local EMAs in ER 1110-2-1156 and the Federal Guidelines are broadly understood or uniformly implemented across the USACE nationwide program.

Finding: The management, implementation and coordination of EAPs continue to exhibit the problems and deficiencies documented in the 2001 ASDSO Peer Review. There appears to be no USACE management or oversight above the District office level to drive consistent, quality implementation of EAPs, including the importance of a strong and collaborative relationship between USACE and the local

EMAs, and close emergency management coordination considered the state of practice for dam safety programs.

Recommendation: With regard to implementation of EAPs:

- The management and oversight of the EAP program should be raised to the HQ level, including development of a database tracking system to certify that all USACE dams have an effective, up-to-date EAP.
- A USACE-wide initiative should be implemented to ensure the effectiveness of the EAP by raising the leadership and staff's awareness of the importance of a strong relationship and close coordination between the dam owner and the downstream local emergency management agencies.
- USACE should meet annually, at a minimum, with the local EMAs to ensure understanding of what to expect during a dam-related emergency, and be provided the information they need to plan the appropriate evacuation procedures. During the annual communication with the local EMA, USACE should specifically review the amount of time the detection and confirmation of the emergency will require, and the time it will take to notify the local EMA of the emergency. This should be compared to the amount of time before the nearest affected downstream development is impacted by the flood flows associated with the emergency and the amount of time the local EMA needs to accomplish timely notifications and/or evacuations, if necessary.

5.6.2 2013-A-18: Decision-Making for Time Critical Emergencies

EAPs are a standard element of a dam safety program and are designed to direct and guide project personnel in regard to their responsibilities and actions when an event takes place at a dam that may expose those downstream to flood hazards from uncontrolled releases. In the course of Division, District and on-site meetings, USACE staff was asked whether the lines of authority and responsibility throughout the division with regard to the management of dam incidents, as they evolve in real time, were defined, clearly communicated, and understood by all personnel, including on-site staff. By way of illustration, project managers and operators were asked what their responsibilities were in the event that communication with District and Division management was lost following an earthquake and critical decisions had to be made; situations where some form of triage was required. Similarly, Division and District commanders were asked what authorities they had communicated to project staff and whether these authorities were documented.

Finding: In the course of Division, District and on-site meetings, USACE staff were asked whether the lines of authority and responsibility throughout the Division with regard to the management of dam incidents, as they evolve in real time, were defined, clearly communicated, and understood by all personnel including on-site staff.

The findings from these discussions varied from one Division to the next, but there were common observations:

- Clear lines of authority are not defined within a Division (from the commander down to the project operators).
- Authorities and responsibilities that are conveyed from commanders to staff are ad hoc and at the discretion of the Division and District commanders.

- Evaluations (system analyses) have not been carried out to the degree the range of potential incidents that may be experienced and associated incident management challenges have been identified. Coupled with this is the fact project staff have not been trained to manage these events or know what their authorities and responsibilities are.

These findings reflect a gap in the USACE Dam Safety Program with regard to defining clear responsibilities for managing dam incidents.

Recommendation: The USACE should undertake an effort to develop comprehensive incident management authorities and responsibilities. This effort should include the development of incident management training to include project operators.

5.7 Dam Safety Program Implementation

The following findings relate to the USACE implementation of the dam safety program.

5.7.1 2013-A-19: Surveillance and Instrumentation

An essential element of a complete dam safety program is an effective surveillance and instrumentation program at project sites. Visual surveillance is critical to identifying and correcting potential issues before they worsen. Based upon interviews at several project sites, the IEPR Team believes that USACE has an effective program for training of on-site representatives to identify situations to be reported for further evaluation by engineering staff. Maintenance personnel and park rangers at projects visited appear to have a good understanding of the critical project components. While the sample size was small, the IEPR Team was impressed with the level of knowledge and the competency demonstrated during the interviews of the project staff. It appears that when there is a personnel change, training of replacement staff is prompt and thorough.

While a frequent and thorough visual surveillance program is critical, monitoring the internal performance of the dam and foundation can be as or more important. Most, if not all, USACE dams have some form of instrumentation. Based on interviews and discussions, the panel has concluded that the scheduled frequency of instrument recordings ranges from monthly to semi-annually. During periods when a project is subjected to significant events, instruments are read during or immediately after such events.

Monitoring the performance of a dam via the installed instruments is critical. Reading instruments and recording results is not adequate if insufficient time is being spent to reduce and evaluate/interpret retrieved data. Project engineers are burdened with many responsibilities so sufficient attention in interpreting data may not be occurring in a timely and comprehensive manner. The panel also understands that multiple software packages are utilized to record, reduce, and analyze data, which present a challenge.

While it appears that the project site personnel are trained in reading instrumentation and do it on a routine basis, the effectiveness of a comprehensive program is in the immediate identification of outlier readings and timely review of all data by engineers who are experienced in interpreting the data and recognizing developing issues. Based on interviews, additional instruments are installed or nonfunctional instruments replaced generally in a timely manner. The funding of instrument maintenance and monitoring is a 'routine' function and therefore falls under the general operation and maintenance budget for routine activities (see Finding 2013-C-21). Every effort should be made by the District Commander to

fully fund maintenance and replacement of project instrumentation along with sufficient monitoring and evaluation of instrumentation data.

Finding: Based on survey responses, the Dam Safety Scorecard examples provided, and interviews, current project surveillance programs appear acceptable. On-site and District personnel are trained and understand the critical nature of their work. The data acquisition phase of a project instrumentation program appears adequate, but there are concerns that the data are not always reviewed and evaluated in a timely manner by experienced engineers. Lack of timely data reviews can lead to unacceptable levels of risk. Interviews uncovered a lack of reliable exception reporting, where reading changes beyond predefined limits are not flagged for priority reporting and response. Failure to adequately collect, interpret, and report findings in a timely manner is an urgent shortcoming.

Recommendation: HQ should take a more active role in conjunction with the Divisions to ensure project engineers and project operators fully understand their roles with regard to their project instrumentation program. The panel strongly recommends that a review or audit program be developed and implemented quickly with each District DSO and DSPM for evaluating each project's instrumentation records. Developing a webinar might be useful to set standard file management practices and for training of project engineers and operators on processing and interpreting data. An integral part of a PA is the review of the historical instrumentation data. Prior to the start of a PA, the PA lead engineer should meet with the project engineer to review the instrumentation files and the quality of how the data is reduced and presented prior to the start of the PA panel work.

5.7.2 2013-B-20: Data Management

Historical records are essential to evaluation of the condition and performance of dams. The success of the USACE Dam Safety Program is predicated on conducting thorough and accurate PIs and PAs. The quality and thoroughness of these inspections and assessments depends on the ability of the project team to review the project file, which should be complete and well organized. Consequently, the conclusions and recommendations developed based upon the results of the inspection are also dependent on the ability to obtain and review historical documents.

On several occasions, the IEPR Team was informed that some project files at the District offices are incomplete or disorganized. In these situations, particularly when conducting PAs, the PA team finds it difficult to understand the complete history of the project, resulting in delays in completing the report, and more importantly, in recommendations that may not be well founded. Assessments based on incomplete data could impact DSAC ratings or start the process of an Issue Evaluation Study that might not be necessary. Alternatively, a critical project flaw may be overlooked.

At a minimum, project files should include the original design documents, investigation reports, construction records (including as-built drawings), photographs that are dated and labeled, past inspection and assessment reports, records of remedial work (both routine and non-routine), operation and maintenance manuals, and instrumentation readings with data reduction and analysis. These files should be organized such that the reviewer can easily follow and understand the history of activities at the dam. Data should be reduced, summarized, plotted, updated, etc., so that when additional data is acquired, it can be quickly compared to existing trends.

Project data management cannot be taken lightly. Because of the age of most USACE projects, files are voluminous, and if not organized and updated, will result in wasted effort, schedule delays and possibly not identifying potential developing situations that could have significant consequences.

Finding: Significant concerns were expressed to the IEPR Team related to poor data management of project files. Disorganized and incomplete files are resulting in lost time, budget overruns, and improper or unneeded project recommendations. While the panel cannot identify whether this is a widespread issue, it is of sufficient concern that actions should be taken to address the problem.

Recommendation: HQ should develop quality audit team(s) to perform project file reviews for adherence with basic data management policies and procedures. Each project has an assigned project engineer who should be held accountable for his project file and data management. District DSO and the DSPM need to be engaged with the project engineers to ensure file and data management is receiving proper attention. Division DSO and DSPM should work with Division counterparts to standardize procedures and conduct periodic and routine reviews of project files.

5.7.3 2013-C-21: Budgeting for 'Routine' Activities

The USACE Dam Safety Program has two primary funding classifications. 'Routine' activities are funded through the District's operation and maintenance budgeting process. 'Non-routine' activities are generally funded by HQ through project-specific funding channels. Routine activities include the operation and maintenance (O&M) along with PIs and PAs for dam projects. The District Commanders have the responsibility to direct O&M funding to the multitude of fixed assets and programs in their Districts. On many occasions, USACE conveyed to the IEPR Team that O&M funding for some projects can take many years. The adequacy of funding for routine activities appears to vary significantly from District to District. The importance of ensuring operational readiness of major dam operating systems and the risks that are imposed if systems do not function as designed seem not to be completely understood by all District Commanders.

A particularly serious O&M issue relates to spillway gates and their ancillary operating components. Some Districts have hundreds of gates that have aged, have pitted wire ropes long overdue for replacement, are being operated more frequently than originally anticipated, and/or have not been subjected to their design loading. If a dam operator does not have confidence that a gate can be operated in an emergency, there is a fundamental flaw in how risks are evaluated and in development of the DSAC rating. As an example, NWD has over 200 tainter gates and has redirected some O&M funding to begin the process of refurbishing the gates and ancillary electrical and mechanical facilities. The IEPR Team considers it prudent that all projects should have more emphasis placed on ensuring that major safety related project facilities work as designed when the need arises.

During interviews with USACE staff at various levels, the IEPR Team noted that the 'routine' and 'non-routine' terms unintentionally, but tangibly, de-emphasize the importance of dam safety activities which fall into the 'routine' category, such as O&M, PIs, and PAs. While mowing the grass may be routine, replacing or repairing large tainter gates or validating the proper performance of project instrumentation is not a routine function.

Finding: The USACE Dam Safety Program has implemented a fiscally responsible program to handle 'non-routine' (aka major) dam modifications. Funding for the 'routine' O&M of dams is somewhat problematic and competes with the operation and maintenance for all the other assets and programs

within a District. District Commanders may not have a thorough knowledge of the project risks. For example, many USACE dams have large gate systems that are aged with known deficiencies. There is a significant degree of uncertainty that gates will operate as designed. Additionally, the use of the terms 'routine' and 'non-routine' in separating dam safety program activities may lead to diminishing the perceived value of O&M, along with activities such as PIs, PAs, and surveillance and instrumentation.

Recommendation: A separate funding mechanism should be developed for operation and maintenance costs associated with project features that have a significant role in the operation of the project such as gate systems. Possibly a separate priority list can be developed for operating systems based on risk and consequences resulting from gate and other operating system failure, regardless of whether such failure is structural or operational. HQ's DSO should work closely with District and Division Commanders to facilitate appropriate O&M funding levels for critical dam operation components. Division personnel should quickly review with new District Commanders the need for and the current status of major dam O&M requirements. To better differentiate critical dam safety project activities from the District-funded O&M work, consider replacing the 'routine' and 'non-routine' terms to better reflect the importance of all critical dam safety program activities.

5.7.4 2013-C-22: Roles of RMC, DSMMCX, and DSPCs

USACE has developed a number of Centers to consolidate critical functions relevant to dam safety engineering and operations. Of the new dam and levee safety oriented centers, RMC is most mature and historically most central to the dam safety program evolution. Therefore, it provides much of the basis for IEPR Team discussion. Centers are aptly named in that they are central to dam safety program development, documentation, training and implementation. RMC actions and activities have been a focal point of the peer review process. RMC's primary purpose, as cited in ER 10-1-55, is to "advise HQUSACE" with risk processes for decision support, review process oversight and HQ policy support. The ER 10-1-55 definition falls far short of the depth and breadth of project oversight, support and design development observed by the panel and reflected in discussions during visits and from survey responses. It appears that RMC is currently providing considerable production oversight and guidance for studies and designs; processes ultimately to be contained within the DSMMCX and DSPCs. It is imperative that Centers recognize that while HQ provides direction, leadership and governance, 'customers' are the beneficiaries of services (e.g., Divisions and Districts). This is a critical perspective that is imperative for effective team building and collaborative project execution. Centers should view HQ as its customer only when responding to decision support requests directly from HQ.

The panel recognizes that production oversight and guidance for studies and designs have been instituted as a transient role for RMC. However, the RMC has very successfully staffed itself with considerable high-end dam engineering expertise that could significantly benefit a wider range of USACE dam safety needs than are defined in ER 10-1-55. The panel has also heard from multiple sources that the stand up of the DSMMCX has been slowed by an inability to attract needed expertise to Huntington, WV. We have also been privy to discussions of 'virtual' staffing of the DSMMCX, which the panel believes would have lesser value due to the limited ability for expert staff to closely interact and collaborate. USACE should consider relocating the DSMMCX to Denver, or co-locating a portion of the DSMMCX to Denver, where dam engineering expertise can be more readily attracted and where many of the DSMMCX and RMC staff can be readily borrowed and loaned to support both Centers as needed.

Regardless of the specifics of the stand up of the DSMMCX over time, it is important to recognize that the role of the DSMMCX, MMC and DSPCs is to be in-house consulting and design support teams. A quality consultant seeks to understand its customer's concerns and issues, takes advantage of the customer's institutional knowledge, builds trust, adds positivity, infuses a value orientation, works side by side, assists, educates and advocates for its customers. It is important for Centers to not overstep bounds in carrying out their mission. IEPR Team inquiries and the responses to the survey clearly indicate that assisting, guiding and collaborating with Districts will be welcomed. Bypassing those having primary project responsibilities will not be welcomed, and neither instructs nor builds trust.

Some members of the panel experienced interaction between RMC staff and District design personnel where a high level of customer focus was fundamental to the RMC representatives' approach to discussions. An attitude driven by mutual advocacy, support and teamwork will go a long way towards a fuller and broader acceptance of the Centers' missions and, therefore, advancement of dam safety, as well as enhancement of dam safety engineering capabilities and execution at the District level.

Survey and interview feedback has offered much broad-based praise for RMC driven policies, procedures and technical support. Surveys also provided considerable cautionary commentary on non-consistency of responses over time, overreaching of authority, ever-changing standards, the addition of unfunded mandates and, occasionally, an aura of perceived dominant authority. Centers need to recognize that the Districts hold command and control responsibility for dam projects. While Districts rightfully would not choose to surrender that responsibility, in many locations, they appear to the panel to be eager to have allies willing to walk the path with them in collaboration and to offer them guidance and counsel along the way.

Finding: Of the new dam and levee safety oriented centers, RMC is most mature and historically most central to the dam safety program. RMC actions and activities have been a focal point of the peer review process. RMC functions as the HQUSACE Dam Safety Program implementation, oversight and support entity. It appears to the panel that RMC is currently providing considerable production oversight and guidance for studies and designs; processes ultimately to be contained within the DSMMCX and DSPCs. The RMC has very successfully staffed itself with considerable high-end dam engineering expertise that could significantly benefit a wider range of USACE dam safety needs than are defined in ER 10-1-55. The panel has heard from multiple sources that the stand up of the DSMMCX has been slowed by an inability to attract needed expertise to Huntington, WV.

The Districts hold command and control responsibility for dam projects ("The Commanders at each level of USACE have the ultimate responsibility for dam safety within their commands."). While Districts rightfully would not choose to surrender that responsibility, in many locations, they appear to be eager to have allies willing to walk the path with them in collaboration and to offer them guidance and counsel along the way.

Recommendation: Promoting service to customers is imperative in developing positive relationships between Centers and Districts, and in rebuilding expertise at Districts and Divisions. Centers will best advance the USACE dam safety mission by providing collaborative support for dam safety demands within the District's mission. USACE should consider relocating the DSMMCX to Denver, or co-locating a portion of the DSMMCX to Denver, where dam engineering expertise can be more readily attracted and where many of the DSMMCX and RMC staff can be readily borrowed and loaned to support both Centers as needed.

5.7.5 2013-B-23: Technical Review Processes

Quality control and quality assurance reviews are essential, as is quality process competency, effectiveness, efficiency and staff consensus. Both streamlining and a more purposeful focus can be achieved, bearing significant benefits to schedules, budgets and the peace of mind of dam safety engineering staff at all levels and functions. The quality processes in place, if judged solely on effectiveness, are considered adequate. However, processes need significant attention when considered with regard to:

- Judiciousness
- Cost
- Schedule impacts
- Post-review closure concurrence documentation between reviewers and reviewed
- Accountability that drives adherence to safety, performance and economy

Getting life safety issues right is vitally important. Getting life safety issues right in a prudent, collaborative, efficient and schedule-sensitive manner is an achievable goal. Achieving this goal, in turn, elevates focus, camaraderie and mission accomplishment that drives greater buy-in and commitment at all levels. It also frees up immediate funding and staffing for additional dam safety analyses or upgrades.

While the 'reviewed' can, at times, be critical of reviewers, as well as the costs and schedule impacts imposed by quality processes, the IEPR Team did not find it overly difficult to separate signal from noise in reviewing survey and interview responses. Current practice, as judged by survey findings and discussions during IEPR visits, entails redundant reviews of questionable value and focus. Most dam safety program review milestones appear to represent major stall points for project progress. There is also a critical concern that some units are not even performing baseline calculation checks. Additionally, accountability for quality processes at the Division and District levels, and perhaps at Centers as well, is lacking.

Selected responses to the Survey Questionnaire included:

"Fundamental checking of engineering calculation is not often observed, and in several important projects [calculation corrections] has led USACE down a drastically different path."

"The review process is often taking as long as the study itself."

Post-process reviews are, by their very nature, frustrating, confrontational, time consuming and of more limited value, unless these post-process reviews are to memorialize an on-going collaborative process. Retreating from dead-ends and doubling back to redo work is extraordinarily costly, in terms of dollars, time, relationships, accomplishment and staff motivation.

In general, personnel involved with dam safety functions reported strong support for quality reviews that are focused on benefitting their projects in a timely and actionable manner. They are frustrated by long-duration, 'check the box' processes that drain resources and team focus, as well as impede progress (sometimes for extended time frames), without a satisfying return on investment. This perspective is broad-based and has a common foundation across all reporting groups.

There is broad-based criticism of current review processes, and a broadly recognized need for enhancing quality processes. Because there is a common concern and a common cause, overhauling procedures and requirements to significantly improve quality reviews is achievable. Productive, value-added reviews are so central to engineering practice to merit an action classification of Urgent for all levels of review. Reducing impacts on schedules, budgets and the tolerances of both production and review personnel is also a reasonable expectation.

The panel recognizes that while updated dam safety policies and procedures have been put in place, implementation is more of a work in progress. It is sometimes difficult for an external team (and perhaps, also for those within USACE) to differentiate issues in the cross-over area between policy development and implementation. As an example, we recognize that ATR teams are being targeted for earlier involvement and for enhanced team continuity throughout project development phases, but that this is a work in progress affected by availability of appropriate staff, project logistics and organizational relationships (e.g., some Districts have been identified as playing the 'schedule card' to defer or deflect reviews).

Of particular note, project IEPRs attracted a number of survey and interview responses. IEPR Type I engagements were broadly judged to be very costly and of limited value. IEPR Type II engagements received more varied responses, with a primary criticism related to the limited value of Type II reviews triggered late in the project development process.

Dam safety leadership needs to incentivize quality oriented behaviors with rewards, and correct resistant groups. Rewards can entail individual praise, broad-based performance acknowledgement, less frequent future audits and transition to "on-board review" opportunities for units with appropriate levels of compliance. For units that are stubbornly out of compliance, formal critiques, and more frequent and intense audits will be needed. Because adherence to high quality standards for dams should never be negotiable, in a worst case scenario, HQ should move to have a District's responsibility for dams delegated to one or more adjacent commands having acceptable compliance standards with quality processes.

The panel applauds the intended focus on having central reviewers stay with a project from the PA forward. Early and regular involvement is critical to minimizing frustration, maximizing open dialogue, and acceptance of new ideas and approaches. Accommodation of on-board reviews that focus on making course corrections early and often, while not stalling project development, is recommended. As was discussed earlier, accommodation of on-board reviews can be provided to those commands embracing quality review processes.

Finding: Current review processes entail redundant reviews of questionable value and focus. Review milestones are major stall points for project progress. It is reported that some units do not perform baseline calculation checks. Accountability for quality processes at the Division and District levels, and perhaps at Centers, is lacking. Concerns with quality processes are broad-based and have a common foundation across all reporting entities.

Recommendation: Quality processes need significant attention. Quality reviews need to be improved to reduce schedule and budget impacts, and to focus on issues of importance to production and review personnel. Dam safety quality audit teams should be created to visit Districts and perform project file reviews for adherence with calculation checking, as well as with policies and standards of practice for

quality reviews and comment resolution. HQ may want to consider quality compliance ratings that define a range of types and frequencies for future reviews based on audited compliance and process effectiveness.

Quality oriented behaviors should be incentivized, with rewards, including less frequent future audits and transition to “on-board review” opportunities for units with increasing levels of compliance. For units stubbornly out of compliance, formal critiques, and more frequent and intense audits are needed. Accommodation of on-board reviews that don’t stall project development are recommended for those commands embracing quality review processes. The panel recommends that the ATR, IEPR Type II and Board of Consultants’ concepts be integrated into an updated ATR concept (to the extent allowed by law), with outside experts added to ATR teams to eliminate the need for separate and sometimes overlapping appraisals. This recommendation better integrates independent (outside) perspectives into design guidance and review processes and helps to address the acknowledged shortage of senior dam engineering expertise.

5.7.6 2013-C-24: Project Design and Construction Costs

The IEPR Team was exposed to projects where engineering costs for planning through construction were well above 50% of construction cost. One project was presented as having total project engineering fees of approximately 70% of construction (not including NEPA or other non-engineering related activities). Several million dollars for engineering had already been expended, so this estimate is implied to be reasonably advanced.

Private sector dam engineering costs for planning, design, construction, start-up and EAP/O&M analyses and documentation are commonly in the general range of 20% to 30% of construction cost, with a moderately higher percentage range for small projects and a lower percentage range for very large projects. It is recognized that owner and regulatory costs are external to private sector services, but internal to USACE. If these activities can be separated out, direct comparisons could be made. If inseparable, owner and regulator related costs can be estimated as a percentage of overall engineering costs (e.g., increasing engineering services costs by about 30% to account for these considerations would result in a range of roughly 25% to 40% of construction cost).

Plotting of engineering costs as a percentage of construction cost over a number of projects can provide a very revealing trend line, especially if benchmarked against other federal agencies, as well as the private sector. If sub-category data (e.g., pre-design, design, bid & construction) can be acquired on a reasonably common basis, this information can better identify specific areas of inquiry.

It is imperative for the dam safety program to accomplish more with the funds that are made available to the program. For life safety issues to be truly paramount, prudent management of funds to achieve improved levels of economy is also paramount, so that dollars can be stretched to accomplish more. Improved efficiency in engineering analysis, design and construction will measurably benefit the USACE Dam Safety Program. During IEPR visits to HQ, Divisions, Districts and RMC, the panel was exposed to project designs that appeared to have overly conservative and/or misdirected design elements. With rare exception, fundamental design issues should be settled long before reaching the DSOG. The panel recommends that, starting as soon as possible, additional learned guidance and expert review begin no later than the dam safety modification process to provide more appropriate approaches to design

analyses and prudent and economical project features, creating what can likely amount to substantial residual funds that could be directed towards more timely addressing of additional project needs.

Given that this programmatic IEPR was focused towards office activities and processes, the panel did not obtain sufficient evidence of field engineering and construction QA services to develop findings related to these activities. However, anecdotal evidence from many discussions provides fairly clear evidence that construction engineering services and improved contract documents and/or contract management may also offer opportunities for significant cost savings.

Many recommendation elements fold into one another. More relevant and cost efficient construction measures can reduce engineering costs. More effective and better focused quality reviews can improve construction recommendations, trim project schedules and reduce both design and construction costs. The panel is mindful that the dam safety program is a work in progress, and work is still needed to improve performance. On-going progress needs to be made in training staff, streamlining processes and instilling a one-team mentality focused on excellence (esprit de Corps).

Finding: There is considerable concern regarding funding and, therefore, staffing levels to meet recognized demands. Based on economic conditions and political stalemates, it should be assumed budgets will continue to shrink. The panel was exposed to dam projects with engineering costs (planning through construction) well above 50% of construction cost. Private sector dam engineering costs for planning through construction are commonly in the range of 20% to 30% of construction cost. The panel was also exposed to project designs that were overly conservative and/or included misdirected design elements and/or approaches. Additional guidance and expert reviews beginning early in the dam safety modification process will provide significant benefits. DSOG deliberations exposed both technical and cost issues that are concerning.

Recommendation: A “doing more with less” attitude needs to be broadly adopted. To the extent possible, USACE should benchmark the costs of dam design activities against other federal agencies and the private sector. The re-maturation of USACE dam safety expertise needs to include a significant focus on economy of design and construction along with the redevelopment of dam safety engineering expertise discussed in Finding 2013-B-26.

Enhancing design effectiveness, cost-effectiveness of construction engineering services and construction contract management will reap great benefits. Many elements fold into one another to compound benefits. More relevant and cost efficient construction measures reduce engineering costs. Better reviews improve direction, trim schedules and reduce costs. Dam safety leadership needs to undertake a thorough review of costs for engineering, effectiveness and judiciousness of designs, and construction cost management.

The dam safety program needs to undertake a thorough review of:

- The utility of cost streams for engineering services
- The feasibility, effectiveness and judiciousness of design measures
- The costs to translate designs into completed remediation projects

Areas of improvement need to be prioritized, action plans developed to enhance performance standards and expectations, and accountability measures put into place to drive actions. The panel believes that

the dam safety program has the potential, over time, to improve the effectiveness of its work product delivery.

5.7.7 2013-C-25: IRRM Financial Impacts

It is clear that many IRRMs entail significant benefits reductions, and that IRRMs are many times put into place because funding for structural upgrades is infeasible for years to decades. Annual benefits losses translate to collateral impacts that, for some projects, have been reported to sum to many hundreds of millions of dollars.

Impacts related to IRRMs can therefore include direct revenue losses, such as decreased head and storage regulation for hydropower production. Indirect impacts relate to loss of functions beneficial to the public at large, such as reduction of flood protection levels, diminished recreational access and opportunities, and reductions in the reliability of environmental flows and municipal and industrial (M&I) water demands. Creative avenues should be fully considered for translating these benefit losses into additional budget to accelerate construction funding for projects shedding significant benefit dollars due to IRRMs. Alternative funding mechanisms need to be explored, as do considerations related to funding transfers, where the release of IRRMs provides tangible benefits that diminish non-dam safety risks and, therefore, diminish impacts. Where benefit reductions due to IRRMs are planned for extended time frames, local community cost-sharing to expedite benefit recovery needs to be further explored.

This thought process is also applicable to projects that have been judged not to incur loss of life, but do represent the potential for extreme economic losses. Loss of direct income streams is easiest to address as providing a rationale for acting sooner rather than later (recovered revenues more tangibly pay for themselves). The panel recognizes that a project such as Bonneville Dam generates sufficient income such that monies to address structural upgrading can be self-supplied by operations. Indirect benefit streams quantified using GAO-accepted procedures should also be able to provide additional funding leverage. If a required IRRM translates to a loss of indirect benefits (in terms of increased flood risk costs; or lost revenues, taxes, employment, etc.), shouldn't those impacts be translated into annual cost streams to provide leverage for accelerated repair funding that would restore those benefits. As an example, the ability to decrease flood risk exposure through structural upgrades that eliminate IRRMs translates to FEMA funds for flood damage mitigation that won't be needed and lives and property that will avoid disruption. Because we are not intimate with details of federal budgeting processes, the panel leaves it to USACE to define how, when and where this type of leverage can be used to accelerate dam safety upgrade programs.

Community-based funding support can be considered from a number of perspectives to provide new or alternative perspectives on cost sharing. New or expanded quantity M&I water contracts should be examined based on regional market values for new raw water sources. Flood risk reduction benefits have been provided free of charge for many millions of people and many billions of dollars in property. Projects that tangibly protect lives and assets deliver protective services with a reasonably definable value. Even at discounted rates, flood protection afforded by many USACE dams can translate into significant annual revenues that can be directed towards maintaining these projects to afford the full levels of flood risk mitigation designed into them. Equal consideration can be explored for recreational, environmental and other USACE dam project benefits.

If, using GAO-approved procedures to sum IRRM cost impacts, it can be shown to be more cost-effective for the US Government (as a whole) to advance remediation more quickly even where loss of life is not directly implicated, funding initiatives should be pursued to present interim losses to power revenues, increased local/regional economic damage potential, losses of local, state and/or federal tax revenues, preventable flood and/or drought damages, etc., as US Government costs that can effectively and beneficially be eliminated.

The accelerated recovery of these benefits ought to be central to project funding and scheduling discussions with both the legislative and administrative branches. Indirect benefit losses such as flood risk reductions that can be tracked to federal cost streams outside of USACE could also be traced to cost-effective project upgrades sufficient to recover these benefits. Where IRRMs that increase flood risks can be shown to translate to increased federal funding needed for flood recovery operations, in addition to the potential for mitigating considerable human suffering and other collateral economic damages, shifting budget monies provides a net benefit to the federal government and to the American people.

Risk-informed processes used for assessing dam safety performance can equally be applied to characterize economic risks. Where the risk costs due to IRRMs plus community cost sharing to restore benefits exceed upgrading costs for project facilities (singly and/or as systems), additional expenditures translate to the US Government doing more with less. “What is good for the goose is good for the gander” related to interagency budget trading as a cost-saving measure is a discussion item worthy of engagement.

Finding: Many IRRMs entail significant reductions in benefits, which can be tied to direct (hydropower) or indirect (flood protection, recreation, etc.) income streams and/or functions that benefit the public. IRRMs are many times used to defer structural measures. Benefits losses present collateral impacts that for some projects are reported to sum to many hundreds of millions of dollars. Risk-informed processes, discussed as separate findings, can equally be applied to characterize economic risks (and rewards). Where IRRM costs significantly reduce upgrading costs (singly and/or as systems), expediting expenditures can provide a net benefit.

Recommendation: For IRRMs that are costly in terms of lost benefits, creative avenues should be considered to turn benefit losses into funding to accelerate structural upgrades. Creative cost sharing measures should be explored to accelerate restoration of full project operations. Accelerated benefits recovery should be central to project funding and scheduling discussions.

5.8 Technical Capabilities for Dam Engineering

Like other dam safety organizations, USACE is faced with the loss of dam engineering experts through retirement from the program at a time when increased numbers of experts are needed. Maintaining technical expertise and developing new expertise are essential to the success of the USACE Dam Safety Program. USACE has some of the world’s leading experts on dam safety, particularly at the HQ and Centers (RMC, MMC, DSMMCX). However, USACE also has a significant backlog of dam evaluations, studies, and designs and the overall complement of trained staff to complete this work is limited. At some District levels, engineering staff have responsibilities for all types of infrastructure projects, including dams. This presents a challenge, both in attracting technical expertise and in training of staff.

5.8.1 2013-B-26: Resources and Expertise

Dam safety engineering has great need for specialists (dam engineers) who have an array of skills and experiences related to dams, their foundations and their ancillary structures. A dam engineer has attained a baseline level of competency with regard to soils, foundations, geology, structures, hydrology, hydraulics, mechanical features and a broad array of ancillary engineering design activities as they apply to dams. Dam engineers will also develop depth as a subject area expert in one or more specialty areas. These multidisciplinary dam engineering skills are also an important foundation for Risk Cadres (discussed separately in Finding 2013-C-10).

While focused areas of expertise are limited for any individual, a dam engineer is equipped to have a working knowledge of entire dam projects; including intakes, gates and valves, embankments, concrete structures, spillways, embankment filters and drains, discharge channels, and the foundations upon which they are all built. Dam engineering expertise is essential for mitigating project deficiencies with design, construction and operational processes that are life safety protective, technically viable and cost effective.

The experience footprint of a dam engineer typically spans from periodic visual inspections of dams and appurtenant facilities to performing design and construction services for dam projects. Dam engineers are at heart civil engineering generalists who specialize in dams. They see dams in terms of the dynamics between a broad set of physical, mechanical and time-dependent interdisciplinary relationships.

Selected responses to the Survey Questionnaire included:

“Dam design and dam safety experience has likely never been in such short supply.”

“Program has been littered with reports that could not be completed on schedule because of a shortfall in human resources with the background to advance the reports.”

USACE has great depth of engineering expertise, but much of that expertise is focused within sub-disciplines (silos). Therefore, execution of USACE’s major, long-term dam safety modification program will significantly benefit from the expanded development of dedicated dam engineering specialists. The safety of dams is often driven by the effectiveness of treatments at feature interfaces (e.g., conduits through embankments), and at discipline interfaces (e.g., hydraulic forces on structural elements). Competently and cost-effectively addressing these situations is best left to engineers that have a career focus on dams and their unique features, and physical and performance characteristics.

Expanded development of dedicated dam engineering specialists is recommended to lead execution of USACE’s major, long-term dam safety upgrading program. The panel recommends that HQ work with Divisions, Districts and applicable Centers to earmark interested and capable engineers for an expanded developmental program for careers focused on dam engineering.

USACE has a major decades-long backlog of dam modification projects and lacks sufficient dam engineering experience and expertise to effectively and efficiently advance program demands. The dam engineering consulting community provides a reservoir of additional expertise to bridge this shortfall for the near term, and be a long-term supplement to development of internal staff. Some projects can be outsourced, while others would best benefit from an infusion of outside expertise into USACE design teams.

The dam engineering consulting community needs to be better leveraged to provide the additional expertise needed to bridge this shortfall. Increased engagement of outside expertise could provide the dual function of infusing USACE dam engineering teams with experiences representing independent value perspectives as well as providing enhanced opportunities for training and development of USACE dam design staff. An infusion of additional expertise is of significant benefit to the cost-effective development of designs critical to the USACE Dam Safety Program and to training a new generation of highly capable dam design engineers.

Finding: Dam engineering has a great need for generalists who have an array of skills and experiences related to dams, their foundations and their ancillary structures. These multidisciplinary dam engineering skills are also an important foundation for Risk Cadres (discussed separately). USACE has depth of engineering expertise, but much of that expertise is focused within sub-disciplines (silos). USACE has a major decades-long backlog of dam remediation projects, and shares a broadly held recognition that its dam safety program lacks sufficient dam engineering experience and expertise.

Recommendation: Expanded development of dedicated dam engineering specialists is recommended to lead the execution of the USACE's major, long-term dam safety upgrading program. It is recommended that Divisions, Districts and applicable Centers be directed to earmark interested and capable engineers for an expanded developmental program for careers focused on dam engineering. The dam engineering consulting community should be better leveraged to provide additional expertise to bridge the shortfall in internal talent.

5.9 Summarizing the State of the USACE Dam Safety Program

The previous sections of this report have identified findings and recommendations related to various aspects of the dam safety program. As a means of summarizing the state/maturity of the program, the panel used the Maturity Matrix approach to provide an aggregate assessment of the state of each program category. This is a high level use of the Maturity Matrix concept that gives the panel a means to communicate the overall assessment.

A Maturity Matrix is a visual decision-making tool that can be used to review program activities against regulatory requirements, industry standards, guidelines, and best practices (Bennett, T. and C. Sykes [2010] "Improving Communications Within a Dam Safety Program Using a Maturity Matrix Approach, Canadian Dam Association Conference"). It is presented as a matrix that is used to display the maturity of a program; in this case the USACE Dam Safety Program. Rows of the matrix correspond to specific program activities, categories or goals. Columns, moving from left to right, reflect increasing levels of maturity. When developed in detail, individual cells of the matrix refer to specific criterion or levels of accomplishment/achievement.

Based on a review of a particular program as measured against the established performance criteria, each program element is assessed with regard to its level of maturity. Cells or rows are shaded to highlight the level of maturity. In addition to characterizing the current state of a program, the Maturity Matrix can provide a systematic approach for identifying opportunities and priorities for improvement. A number of dam safety programs have begun to use the Maturity Matrix approach, including Ontario Power and the Ireland Electricity Supply Board. It is also being shared with CEATI's Dam Safety Interest Group.

A first step in using the Maturity Matrix tool is to define the criteria or standard that will be used to evaluate each element of the program. The IEPR Team defined a set of criteria for each subject area in which findings have been made. A 'maturity scale' is defined in terms of broad categories/maturity levels:

- Developing
- Maturing
- Mature

These maturity levels have been selected specific to this review and were used as a general guide for the panel to provide an assessment of the maturity level of the dam safety program elements (i.e., they are not used as 'bins' [mutually exclusive categories]). In fact, the assessment of maturity is more of a continuous, sliding scale that depends on a number of factors, such as:

- How has the IEPR Team rated the findings?
- Are some or all of the criteria being implemented well?
- Are they being implemented at all districts and levels within the dam safety program?

The maturity levels provide a measure of the overall maturity of the dam safety program. Two of the three levels of maturity reflect the notion of a transitioning program or a work in progress, thus the characterizations of "Developing" and "Maturing." The last level indicates an achieved level of maturity. In the broader use of the Maturity Matrix approach, the center or middle level of the maturity scale could be interpreted as "Mature" and the far right of the scale would indicate transition to excellence, and/or exceptional.

Table 5.1 summarizes the criteria used to evaluate the maturity of each category. In a given category, if all criteria are being carried out well by all elements of the USACE, the program would be judged to be mature.

Table 5.1: Maturity Matrix Criteria for the USACE Dam Safety Program

Category	Criteria for Evaluating Maturity Level
Organization and Management	A mature dam safety organization is one in which senior management of the dam safety program is: <ul style="list-style-type: none"> • Properly staffed • The dam safety officer is dedicated full-time to the management and implementation of the dam safety program • Senior management provides oversight of the strategic direction of the dam safety program • The dam safety officer is the authority to obtain funds for and to address dam safety problems in a timely manner
Dam Safety Policies and Procedures	A mature dam safety program has policies and procedures which are: <ul style="list-style-type: none"> • Current and up to date • Well documented and consistent across disciplines • Well written and readily understood by those implementing or following them • Represent, at a minimum, the current state of practice in the industry • Consistent with a risk-informed management program • Reviewed by experts outside of the organization that developed them.
Risk-Informed Management	A mature risk-informed management program is one in which: <ul style="list-style-type: none"> • Risk-based evaluations are used to inform all major aspects of a dam safety program • Alternative levels of analysis are applied to meet programmatic and decision making needs • Uncertainties are appropriately evaluated • Decision making frameworks satisfy OMB guidelines • Staff has the educational background, training and experience to implement risk analysis methods and decision processes
Emergency Preparedness	A dam safety program is mature with respect to emergency preparedness if: <ul style="list-style-type: none"> • Emergency action plans have been developed for all dams • Emergency action plans are maintained • USACE personnel meet with local emergency managers annually • The public is provided information (inundation maps) about flood risks associated with controlled and uncontrolled releases from USACE projects • Lines of authority and responsibility regarding incident management have been developed, are clearly defined, and staff receive regular training

Table 5.1: Maturity Matrix Criteria for the USACE Dam Safety Program (continued)

Category	Criteria for Evaluating Maturing Level
Dam Safety Program Implementation	The implementation of a dam safety program is mature if the following criteria are met: <ul style="list-style-type: none"> • Standard reporting activities (dam inspection reports) are carried out in a timely and effective manner • Activities are carried out consistently • Resources are available to address time sensitive dam safety issues • Program activities such as design and construction are carried out efficiently and effectively • Dam safety regulations as defined in ER 1110-2-1156 are fully implemented and the quality of the implementation is carried out well and consistently throughout the USACE
Technical Capabilities for Dam Engineering	A dam safety program is founded on the fundamentals of dam engineering; geotechnical engineering, structural engineering, dam safety inspections, dam instrumentation and monitoring, etc. A program is mature if: <ul style="list-style-type: none"> • All engineering elements of a dam safety program are well staffed and well integrated • Regular dam safety activities (dam inspections, dam monitoring, etc.) are carried out on a reliable, timely basis and are well documented • Project staff are well trained to identify and respond to dam safety deficiencies that may be observed in the field

Based on the IEPR findings and the characterization (i.e., Urgent, Critical, etc.) of each finding, a consensus assessment of the maturity of each category was made. The findings are color coded:

- Developing – Red
- Maturing – Yellow
- Mature – Green

Figure 5.1 presents the IEPR summary of the maturity of the USACE Dam Safety Program in each of the six subject areas. The maturity of each includes a range that reflects:

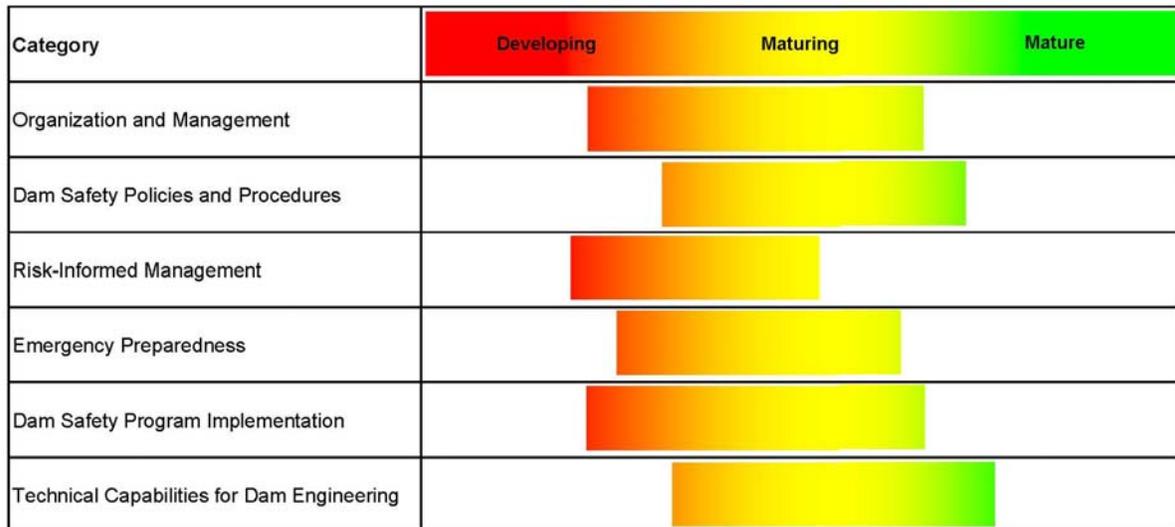
- The IEPR Findings and Recommendations in each category.
- IEPR Team consensus that is based on the range of individual member assessments, team discussion of the reasoning and basis for the assessments, and a final interpretation to reflect the assessed state of the program.
- Factors and inter-relationships between subject areas that are not necessarily reflected in the individual Findings (i.e., the impact of Organization and Management issues on downstream activities related to implementation).

For a given category, the width of the bar reflects the consistency or quality control (a variation in the quality of work that is being carried out), and/or incompleteness (e.g., something is missing or is not being carried out yet by all districts). Narrow bars suggest the IEPR Team finds that activities are being carried out consistently and completely; wider bars reflect negative diversity/undesirable variability.

Where a bar is placed along the maturity scale, it reflects the IEPR assessment of the general or central tendency of where the program is at this time. Overall the panel's assessment indicates the USACE Dam Safety Program is maturing (in a central tendency sense) in all categories. At the same time, there are

aspects in each category where there are areas of quality and/or incompleteness, while at the same time there are areas where a level of maturity has been achieved.

Figure 5.1: Maturity Matrix for the USACE Dam Safety Program



In summary, the Maturity Matrix reflects the IEPR assessment that the USACE Dam Safety Program has evolved significantly in a positive direction in the past decade – the course of the ship has been dramatically reversed. As a consequence, the Maturity Matrix provides a measure of the dam safety program that is generally mature (in a central tendency sense). At the same time, however, the process of maturing is ongoing. The width of the bars reflects the observations of inconsistency, incompleteness and/or the need for further development in all phases of the program. Undoubtedly, some (if not much) of this is a by-product of the considerable and ongoing evolution of an organization as large as the USACE, which is moving from a “procedure and standards-based” organization to one that is implementing risk-informed management. The IEPR Team is encouraged by the fact that a foundation is well-established, and is confident that USACE will continue to make improvements.

To provide further explanation of the Maturity Matrix concept, the “Risk-Informed Management” category can be expanded upon as an example. At the time of the 2001 ASDSO peer review and beyond (to 2005 or later), the assessment of the dam safety program approach to risk-informed management would likely have been depicted with a narrow, red bar (very consistent), anchored to the left of the chart. In less than a decade, there are elements of the program (with respect to risk-informed management) that are generally mature (the center of mass has changed); but there remains work to be done.

Risk-informed management is the core of the USACE Dam Safety Program. By any measure this represents a major paradigm shift for an agency that had been a traditional industry stalwart of ‘procedure and standards-based methods.’ This change was so significant that the Army was compelled to notify the OMB (USACE, 2008) of this change.

For the staff required to implement these changes, the shift has been even more dramatic as measured by:

- The need for new skills.
- The need for additional staff.
- A change for the staff and management in mindset and perspective when addressing dam safety issues that may be counter-intuitive to the standards-based methods in which they were trained.
- Broader dimensionality of risk-based evaluations.
- A realization that traditional approaches to dam safety evaluations which were ingrained in the USACE program were incomplete and/or mis-guided.

These and related factors define the backdrop and context for the significant changes and successes of the dam safety program. As senior management has found, it is a difficult task to move the agency into full-scale implementation of a risk-informed approach for dam safety management. What has been accomplished in a relatively short period of time is an impressive feat in itself.

The job of transitioning the agency is ongoing and incomplete. Within the broad spectrum of changes that have occurred, the IEPR assessment of the maturity of the dam safety program with regard to risk-informed management reflects our findings and discussions with USACE staff on a broad range of issues and a sharing of perspectives that provides insight into the mindset of those charged with successful implementation.

In addition to the IEPR specific findings, the assessment of the dam safety program's maturity with regard to risk-informed management reflects:

- Selected staff that has not embraced the concept of risk and risk management, either due to a lack of understanding or a differing philosophical perspective.
- A wide range of foundational educational and experience background throughout USACE with regard to probability, risk analysis and risk-management.
- A sense that not all staff is fully implementing all aspects of the risk guidelines (i.e., uncertainty analysis).
- Technical elements of the program which require updating or improvement.
- Apparent variation in the approaches that are used to perform risk analyses (i.e., expert elicitations).
- Variations in the quality of the analyses.

There appears to be a trend within the hydropower industry toward adopting the Maturity Matrix as a tool to evaluate their dam safety program. Among the advantages of using an approach like the Maturity Matrix is the level of detail it brings to the assessment of the program and the ability to measure progress over time. While this IEPR used the Maturity Matrix to provide a high-level programmatic assessment, the USACE could consider this approach to provide ongoing detailed programmatic evaluation.

5.10 Independent External Peer Review – Lessons Learned

Based on our experience with this peer review, the IEPR Team has developed the following “lessons learned” and recommendations for future peer reviews.

Planning and Development of IEPR Scope: USACE should provide future panels with clear expectations (a better defined scope at the time of the Work Order request). To the extent possible, allow in-coming IEPR Team representatives to participate in defining expectations and scope. Within the overall budget framework, allow the IEPR to engage HQ to collaborate in defining timing, travel

destinations, visit durations and sequencing for HQ, Division, District, Center, construction site and facility visits to best deliver value in achieving the scoped expectations of the peer review assignment.

The POA visit directed the IEPR Team to a District with responsibility for a single dam, with technical support outsourced to the Northwest Division. The inclusion of this visit within the scope was not considered to be of significant value to the IEPR. This in no way reflects poorly upon the dedication, capabilities or accommodating nature of the personnel who hosted this visit. We found them to be knowledgeable, focused, friendly and supportive.

The omission of an RMC visit, if not discovered early, would have significantly diminished the overall content and value of the IEPR.

The IEPR Team recommends that the next peer review include a visit to an active dam construction site.

Consistency of Team Members: To succeed in peer review inquiries, a considerable institutional knowledge development process is required to understand USACE organization, processes and documents, technical approaches, key acronyms and terminology, etc. This background understanding is critical to interpreting survey responses, engaging staff in discussions and insightfully developing findings. The IEPR Team recommends changing out no more than two members from the immediately prior review team for the next peer review to limit the time in bringing new team member(s) up to speed, while adding additional perspectives and areas of expertise. In general, the 2013 IEPR Team began to absorb its mission, USACE organization, technical and process directives and internal relationships towards the end of our visit to NWD/NWP. The team's education has continued throughout the entire process.

Communications Across USACE Regarding IEPR: Early visits for discussions with Division and District personnel revealed that the purpose of the peer review visits was unclear to those being visited. Awareness of that lack of clarity tended to come later in the visits when greater opportunities for sidebar discussions revealed the issue. The IEPR Team recognizes that more would have been gained from the initial visits if a greater clarity of purpose of the peer review intent had been communicated to the hosts and the hosts were provided with a clear foreknowledge of the breadth of the panel's inquiries and interests. Some personnel thought we were visiting to evaluate their operation's performance.

Content and Agenda for IEPR Team Visits: Many of the early presentations were directed towards a broad range of activities and accomplishments (show and tell) that provided little benefit to the panel in understanding dam safety issues of concern or in providing the dam safety program with actionable recommendations. In addition to HQ clarification of the panel's mission, future panels should provide each visited facility with a summary list of discussion topics and questions at least two weeks in advance, and including a list of personnel to be interviewed and specific work products or documents to be made available for each visit. Clear direction needs to be provided to host offices that presentations need to focus directly on the panel's discussion topics and on answering questions provided in advance.

2013 Survey: Surveys were found to be centrally important to the panel in gaining a broad understanding of the attitudes, actions, perspectives, relationships and expectations of USACE personnel with regard to the organization's dam safety mission. For future peer reviews, responses should be received from HQ, all Centers having a dam safety mission, and all Divisions and Districts having dam safety responsibilities. We also recommend that future surveys be organized such that information is presented in a spreadsheet

or database so the panel can sort responses by question, respondent, etc. A numbered (i.e. 1 to 5) scale should be used for all questions ('yes' or 'no' answers result in too many implied shades of gray).

Additionally, to prompt better responses to Question 9, consider re-wording the question as follows: "In what ways is the USACE Dam Safety Program not aligned with the agency Strategic Vision and Campaign Plan?"

Surveys should be provided to the panel at the beginning of the process. Comparison of surveys over time is likely to be highly indicative of program direction.

RMC Participation in IEPR: Having a liaison affiliated with RMC (lead for dam safety activities) is not necessarily supportive to the purposes of the peer review. However, the panel greatly appreciated having a guide to assist with coordination and provision of needed documents and presentations. Having a liaison with long and diverse experiences with USACE assisted greatly in allowing the panel to get up to speed more quickly.

5.11 IEPR Panel Consensus

The SOW notes the following regarding the panel findings:

"All review panel comments shall be...team comments that represent the group and be non-attributable to individuals. The project manager is to seek consensus, but where there is a lack of consensus, note the non-concurrence and why."

As part of the development of the findings and recommendations presented in this report, the IEPR project manager solicited opinions from the panel regarding each finding and recommendation. While there were differences in opinions regarding either the emphasis or specific wording of selected findings and recommendations, it is the opinion of the IEPR Team that there is general consensus for all of the findings and recommendations presented herein. It should be noted that, based on expertise and/or commitment to lead a given line of inquiry, each panel member focused, in part, on certain aspects of the program. Therefore, to some extent, other panel members relied on a given individual's interpretation of the review of various documents and elements of the program.

5.12 Summary and Follow Up

The findings and recommendations included herein vary in nature and with regard to ease of implementation by USACE. It should be noted that some recommendations are considered to be long term improvements and may take many years to fully implement. The categories (critical, urgent, important, and other) are one way for the USACE to plan for implementation of the recommendations.

To maximize the benefit of the 2013 IEPR, within 90 days of the final IEPR report, USACE should develop and provide to USACE Leadership a response to the findings and recommendations included in this report, which includes:

- Proposed approach to implementing the recommendation.
- Proposed schedule for implementing the recommendation.
- A summary of and response to the Survey Questionnaire of the Districts, Divisions, RMC, etc., which was performed as part of the Peer Review.

**U.S. Army Corps of Engineers
2013 Independent External Peer Review of the USACE Dam Safety Program**

Unless otherwise stated, specific approaches described within the IEPR recommendations should only be considered possible solutions to address the findings. USACE should develop approaches best suited to its organization, its strategic direction and its policies and procedures.

APPENDIX A

USACE STATEMENT OF WORK

SECTION SF 30 BLOCK 14 CONTINUATION PAGE

SUMMARY OF CHANGES

SECTION SF 30 - BLOCK 14 CONTINUATION PAGE

The following have been added by full text:
MOD 2 - SOW

3 June 2013

Revised 4 June 2013 Noted by Rev 0003 in document

PROJECT NAME: Assessment, Analysis, and Evaluation of the USACE Dam Safety Program Review.

LOCATION: Various Sites

P2#: 326042

STATEMENT OF WORK

1. TITLE.

Assessment, Analysis, and Evaluation of the USACE Dam Safety Program Review.

2. GENERAL.

The task order for which this Statement of Work (SOW) applies will be issued under IDIQ Contract W912QR -10-D-0031. Provisions of the IDIQ Contract are applicable to this task order unless otherwise indicated. This SOW and attached or referenced exhibits provide specific instructions for this project and, in the case of conflicts, take precedence over the requirements of the IDIQ.

3. OBJECTIVE.

The objective of this work is to examine how well the USACE is implementing the federal guidelines for dam safety and executing its stated mission through a process known as Type II Independent External Peer Review (IEPR) Safety Assurance Review (SAR) for the Corps' Dam Safety Program in accordance with the Water Resources Development Act (WRDA) 2007 (Public Law 110-114), Section 2035. The SAR shall provide an external view of the policies, procedures, and performance of the Corps' dam safety program. This should provide the Corps with an external examination of its internal workings, with external ideas to improve performance, and a level of comfort that the Corps is leading industry dam safety practices. The

review should also provide a level of transparency for the Corps and the public that will determine if the Corps is effectively and efficiently managing risks for its inventory of high and significant hazard dams.

The review panel shall focus on answering the general questions listed in Appendix B. The review will encompass routine and non-routine dam safety activities being done by HQUSACE, the Risk Management Center (RMC), Dam Safety Production Centers (DSPC), the Modeling, Mapping, and Consequence Center (MMCC), Divisions (MSC's), and Districts.

USACE officials may attend panel meetings. USACE is not a voting member of the group. USACE officials must refrain from participating in the development of any reports or final work product of the group.

The following documents will be provided by the USACE for review:

- ER 1110-2-1156, Safety of Dams – Policy and Procedures
- 3 recent Periodic Inspection Reports (PI)
- 3 recent Periodic Assessment Reports (PA)
- 2 recent Issue Evaluation Reports (IES)
- 2 recent Dam Safety Modification Reports (DSMR)
- The most recent scorecard from the Dam Safety Program Management Tool (DSPMT)
- A compilation of the results of a survey given to each USACE District Office.

The following supporting documents will be provided by the USACE:

- Federal Guidelines for Dam Safety
- Draft Federal Risk Management Guidelines

The following references to USACE regulations shall be followed in conducting the IEPR. The most recent Engineering Regulation (ER) documents shall be used and are available at <http://140.194.76.129/publications/eng-circulars/> or <http://www.hnd.usace.army.mil/techinfo/engpubs.htm> . The IEPR Contractor shall recommend any additional references or criteria not listed below to the COR for a determination of adding them to the scope of work.

IEPR teams are not expected to be knowledgeable of Army and administration policies, nor are they expected to address such concerns. However, an IEPR team should be given the flexibility to bring important issues to the attention of decision makers

General

- 2001 ASDSO Peer Review Results
- EC 1165-2-214, Water Resources Policies and Authorities, Civil Works Review Policy, 15 December 2012
- ER 1110-1-12, Engineering and Design, Quality Management, 30 September 2006;

- ER 1110-1-8159, Engineering and Design, DrChecks, 10 May 2001.
- ER 1110-2-1150, Engineering and Design, Engineering and Design for Civil Works Projects, 31 August 1999

Cost Engineering

- ER 1110-1-1300 - Cost Engineering Policy and General Requirements, 26 March 1993
- ER 1110-2-1302 - Civil Works Cost Engineering, 15 September 2008

Geotechnical Engineering

- EM 1110-2-1902, Engineering and Design, Slope Stability, 31 October 2003
- EM 1110-2-2502, Engineering and Design, Retaining and Flood Walls, 29 September 1989
- EM 1110-2-1901, Engineering and Design, Seepage Analysis and Control for Dams, 30 September 1986
- EM 1110-2-1908, Engineering and Design, Instrumentation of Embankment Dams and Levees, 30 June 1995

Structural Engineering

- EM 1110-2-2100, Engineering and Design, Stability Analysis of Concrete Structures, 1 December 2005
- EM 1110-2-2104, Engineering and Design, Strength Design for Reinforced-Concrete Hydraulic Structures, 20 August 2003
- EM 1110-2-2200, Engineering and Design, Gravity Dam Design, 30 June 1995
- EM 1110-2-2502, Engineering and Design, Retaining and Flood Walls, 29 September 1989

Hydraulic Engineering

- EM 1110-2-1602, Engineering and Design, Hydraulic Design of Reservoir Outlet Works, 15 October 1980
- EM 1110-2-1603, Engineering and Design, Hydraulic Design of Spillways, 16 January 1990
- EM 1110-2-3600 (<http://140.194.76.129/publications/eng-manuals/em1110-2-3600/toc.htm>) Engineering and Design - Management of Water Control Systems

Mechanical Engineering

- EM 1110-2-2105, Engineering and Design, Design of Hydraulic Steel Structures, 31 May 1994
- EM 1110-2-2701, Engineering and Design, Vertical Lift Gates, 30 November 1997

Materials Engineering

- EM 1110-2-2000, Engineering and Design, Standard Practice for Concrete for Civil Works Structures, 31 March 2001
- EM 1110-2-2302, Engineering and Design, Construction with Large Stone, 24 October 1990

Engineering Geology

- EM 1110-1-2908, Engineering and Design, Rock Foundations, 30 November 1994
- EM 1110-2-2100, Engineering and Design, Stability Analysis of Concrete Structures, 1 December 2005
- EM 1110-2-2200, Engineering and Design, Gravity Dam Design, 30 June 1995

4. SPECIFIC TASKS.

The IEPR Contractor experienced in the assessment, analysis, and evaluation of SAR projects conducted through their established IEPR process of design, engineering, and construction peer reviews shall provide general and specific tasks.

The SAR team shall perform reviews and site visits in accordance with milestones identified in this scope. The SAR panel may recommend to HQUSACE additional or alternate milestones. HQUSACE should approve these recommendations when they are warranted and reasonable. The SAR is a strategic level review.

The following general tasks shall be performed independent of government supervision, direction or control to fulfill independence criteria of an IEPR:

Task 1. Peer Review Quality Control Plan: The IEPR Contractor shall prepare a draft and final peer review quality control plan (PRQCP) for the work covered under this task order. The IEPR Contractor shall conduct the IEPR in accordance with this PRQCP to assure that all services are performed, evaluated, reviewed and provided in a manner that meets professional engineering quality standards. The PRQCP shall include a Communications Plan (All communication to the Dam Safety Program Review team will come through Tom Bishop, Review Manager, RMC) and any required safety plans related to site visits in accordance with EM 385-1-1.

The IEPR Contractor shall establish processes to maintain independence and individuality of each expert reviewer's respective discipline, comments, assessments, evaluations, and reports associated with design criteria and project components inherent and related to their respective professional design/engineering and construction discipline to ensure the integrity of the safety assurance review criteria.

Task 2. Identify Type II Independent External Peer Review (IEPR) Panel: The peer review panel should take the form of a panel of consultants. The peer review can work concurrent with on-going work, be interactive as needed, and provide real time over the shoulder input.

The IEPR Contractor shall identify 4 experts at dam safety, dam engineering, and management of a dam safety program from the list of disciplines below to serve on the IEPR Panel. The experts will also be referenced as expert reviewers. Selection will be based on availability, technical credentials, and absence of perceived or actual conflict of interest (expert reviewers selected are preferred to fully support subsequent Type II IEPRs for the Dam Safety Program Review in order to ensure consistency for review). The IEPR Contractor or Panel shall not have any financial or litigation association with the USACE. The IEPR Panel shall fully disclose any known or potential conflict of interest that may arise from the performance of the work. Areas of

conflict may include current employment by the Federal or State governments and paid or unpaid participation in litigation against the USACE.

Selection of expert reviewers for IEPR efforts will adhere to the National Academy of Science (NAS) Policy on Committee Composition and Balance and Conflicts of Interest. Prior to submitting the IEPR panel for approval, the IEPR Contractor shall obtain a statement from each of the panel members indicating willingness to participate and the absence of a conflict of interest. The IEPR Contractor will be required to submit the NAS COI form for all reviewers with the proposed list of panel members. The following website provides academy guidance for assessing composition and the appropriate forms (also available in Appendix C) for prospective panel members in General Scientific and Technical Studies:

<http://www.nationalacademies.org/coi/index.html> . The contractor shall also develop criteria for determining if review panels are properly balanced, as defined by criteria in the contract, both in terms of professional expertise as well as in points of view on the study or project at hand. If necessary, the contractor shall remove and replace panel members with approval from the USACE Technical Representative during a review if a conflict arises. All potential reviewers carry professional and personal biases, and it is important that these biases be disclosed when reviewers are considered and selected. The contractor leading the review shall determine which biases, if any, will disqualify prospective reviewers.

The IEPR Contractor will provide the USACE with the final independent external expert reviewer list, including their credentials and NAS forms, for approval. Expert reviewers shall be industry leaders in their required field of review stated below and have experience in design and construction of projects similar in scope to the Dam Safety Program Review. Expert reviewers shall be registered professionals in their discipline in the United States, or similarly credentialed in their home country. The expert reviewers must also have a college degree in their discipline. A graduate degree in engineering is preferable, but not required, as hands-on relevant engineering experience in the listed disciplines is more important. Expert reviewers included in the proposal for selection of the base contract shall be submitted first. If the expert reviewer submitted for selection of the base contract is unavailable or if the IEPR Contractor believes another individual not originally submitted has equal or better credentials and meets all of the minimum requirements for the level of reviewer required, that individual can be submitted for approval.

For all disciplines required for the IEPR described below, the following experience level requirements apply: Level 1 reviewers shall have a minimum of 7 years of general experience in their field; Level 2 reviewers shall have a minimum of 10 years of specialized experience in their field; Level 3 reviewers shall have a minimum of 15 years of specialized experience and are considered to be a recognized expert in their field. Level 2 and Level 3 reviewers shall also have relevant dam and levee experience (except for the Cost Engineers) and experience in failure mode analysis and risk assessment of large complex systems with emphasis on dam and levee safety issues.

The IEPR Contractor shall identify 4 experts at dam safety, dam engineering, and management of a dam safety program with recent and relevant experience on multi-million dollar projects from the list of disciplines below to serve on the IEPR Panel:

Geotechnical Engineer (Level 3) shall have experience in the field of geotechnical engineering, analysis, design, and construction of embankment dams and levees. The Geotechnical engineers shall have experience in subsurface investigations, soil mechanics, retaining wall design, seepage & piping, slope stability evaluations, erosion protection design, and earthwork construction. The Geotechnical engineers shall have knowledge and experience in the forensic investigation of seepage, settlement, stability, and deformation problems associated with embankments constructed on karst, weathered rock, alluvial soils, glacial outwash, and other geological formations.

Instrumentation Engineer (Level 3) shall demonstrate extensive experience in installing, maintaining and monitoring instruments for geotechnical and structural engineering purposes. First-hand knowledge of dam safety instruments, including but not limited to piezometers, inclinometers, tiltmeters, inverted pendulums, movement indicators, survey monuments, strain gages, flow meters, automated instrumentation, automated data acquisition systems, as well as the collection / reduction / presentation / evaluation of instrumentation data from these type instruments is critical to the position. Experience with the USACE Application WinIDP is preferred.

Hydraulic Engineer (Level 3) shall have experience in hydraulic engineering with an emphasis on large public works projects, or be a professor from academia with extensive background in hydraulic theory and practice, with a minimum MS degree or higher in engineering. The Hydraulic Engineers shall have experience in the analysis and design of hydraulic structures related to flood control reservoirs including the design of hydraulic structures including spillways, outlet works, and stilling basins. The Hydraulic Engineers must demonstrate knowledge and experience with physical modeling and the application of data from physical model testing to the design of stilling basins and scour protection, and in the ability to coordinate, interpret, and explain testing results with other engineering disciplines, particularly structural engineers, geotechnical engineers, and geologists. In regard to hydrologic analysis, the Hydraulic Engineers must demonstrate knowledge and experience with the routing of inflow hydrographs through multipurpose flood control reservoirs utilizing multiple discharge devices, including gated sluiceways and gated spillways. The Hydraulic Engineers shall be familiar with Corps application of risk and uncertainty analyses in flood damage reduction studies and also have a familiarity with standard Corps hydrologic and hydraulic computer models used in drawdown studies, dam break inundation studies, hydrologic modeling and analysis for dam safety investigations.

Engineering Geologist (Level 3) shall have extensive experience in the type of work being performed. The Engineering Geologists shall be proficient in assessing seepage and piping through and beneath dams constructed on or within various geologic environments, including but not limited to karstic and solution prone rock formations, fractured & faulted rock, as well as glacial materials. The Engineering Geologists shall be familiar with identification of geological hazards, exploration techniques, field & laboratory testing, and instrumentation. The Engineering Geologists shall be experienced in the design of grout curtains & cutoff walls and must be knowledgeable in grout

rheology, concrete mix designs, and other materials used in foundation seepage barriers. When assessing a concrete gravity structure, the Geologists must possess additional proficiency in uplift pressures, rock mechanics, rock strength parameters development, and specialized techniques specific to grouting in galleries.

Civil Engineer (Level 3) shall have extensive experience in the design, layout, and construction of flood control structures including dams and levees. The Civil Engineers shall have demonstrated knowledge regarding hydraulic structures, erosion control, earthwork, concrete placement, design of access roads, and relocation of underground utilities.

Structural Engineer (Level 3) shall have extensive experience and be proficient in performing stability analysis using limit equilibrium analysis, in the design of post tensioned high strength steel anchors to stabilize mass concrete gravity dams and structures, in the stability analysis and structural design of mass concrete scour protection and stilling features including the design of baffles, end sills, and training walls.

In addition, the IEPR Contractor shall provide a Project manager to lead the IEPR Panel. The Project Manager shall be a registered engineer or geologist with a minimum of 5 years project management experience related to the above discipline descriptions.

The panel responsibilities shall include, but not limited to, the following:

- a. Conduct the review for the subject project in a timely manner in accordance with the study and RP schedule;
- b. Follow the “Charge”, but when deemed appropriate by the team lead, request other products relevant to the project and the purpose of the review;
- c. Receive from USACE any public written and oral comments provided on the project;
- d. Provide timely written and oral comments throughout the development of the project, as requested;
- e. Assure the review focuses on the questions in the “Charge”, but the panel can recommend additional questions for consideration. The SAR panel may recommend to the RMO additional or alternate questions;
- f. Offer any lessons learned to improve the review process;
- g. Submit reports in accordance with the review plan milestones;
- h. The team panel lead shall be responsible for insuring that comments represent the group, be non-attributable to individuals, and where there is lack of consensus, note the non-concurrence and why.

Task 3. Orientation Briefing: The IEPR Contractor Project Manager and the 4 Expert Reviewers will participate in an orientation briefing conducted by the USACE. Briefing materials will be provided by the USACE one (1) week prior to the briefing. The briefing will take place at HQUSACE.

Task 4. *Monthly* E-mail Updates and Conference Call Discussions/Updates: *Monthly* e-mail updates of progress and status shall be sent to Tom Bishop, Review Manager, USACE Technical Representative and Chris Hogan, USACE Alternate Technical Representative. The *monthly* e-mail updates will include progress conducted during the previous *month* period, planned progress for the next *month*, and any problems encountered. One or two conference call discussions and updates may be required to maintain and convey progress and to collect/exchange critical information by all parties pertinent to the respective subject matter.

Task 5. Survey Form Review: Each USACE District Office will have completed a short survey. The panel will be provided with these forms and will be expected to review these prior to the Orientation Briefing.

Task 6. NWD Site Visit: The panel will visit the Northwest Division office and interview managers and staff selected by the NWD Dam Safety Officer.

Task 7. POD Site Visit: The panel will visit the Alaska District office and interview managers and staff selected by the POD Dam Safety Officer.

Task 8. SWD Site Visit: The panel will visit the Southwest Division office and interview managers and staff selected by the SWD Dam Safety Officer.

Task 9. Prepare Draft Report: The IEPR Contractor shall prepare a Draft Review Report that answers the charge questions and recommends courses of action to HQUSACE. The expert panel, in addition to their overall observations, shall include a set of numbered recommendations that they believe would improve the program. These recommendations should be grouped into three types:

- Category A – Critical
- Category B – Urgent
- Category C – Important
- Category D – Other

The recommendations should be formatted as Year-Category-Number (ex. 2011-A-07).

Task 10. Brief HQUSACE Senior Leaders: Prior to finalizing the report, the IEPR Contractor Project Manager and the 4 panel members will brief HQUSACE on the contents of the report. This brief should be in person at HQUSACE.

Task 11. Prepare Final Report: The IEPR Contractor shall finalize the Review Report following the HQUSACE briefing. The Final Review Report shall focus on answering the general questions in Appendix B and the review panel shall clearly address these questions in the report.

The Final Review Report shall be submitted for USACE approval within 30 calendar days after the brief to HQUSACE Senior Leaders. All comments shall be entered in DrChecks by the IEPR Contractor Project Manager or Representative. The IEPR Contractor shall review the expert reviewer comments prior to placing them in DrChecks, remove any duplicate comments and resolve all contradicting comments. All review panel comments shall be entered as team comments that represent the group and be non-attributable to individuals. The Project Manager is to seek consensus, but where there is a lack of consensus, note the non-concurrence and why. The USACE shall evaluate the IEPR Contractor's comments and provide responses in DrChecks. The IEPR Contractor shall close all comments once the USACE response has been entered. Concurrence of comments is not necessary. A comment review conference call may be held to clarify comments. All comments in the report will be finalized by the panel prior to the report being submitted for USACE approval. The Final Report is intended to provide final documentation of the IEPR process for the project.

Rev 0003 *****

Task 12. RMC/ Dams Senior Oversight Group (DSOG) Meeting Site Visit: The 4 Expert Reviewers will visit the RMC West office and interview managers and staff of the RMC, MCX and MMC selected by the organization Directors and attend portions of the DSOG July Meeting. The meeting will take place at the RMC West Division office in Lakewood, CO.

Rev 0003 *****

5. REPORTING REQUIREMENTS.

The IEPR Contractor shall provide all reproduction. The IEPR Contractor shall provide ten (10) hard copies of the Final Report (Task 9) to the COR. Electronic submittals of the Draft and Final Report shall contain all electronic files in both Microsoft Word and Adobe PDF formats on DVD or CD. The briefings for the expert reviewers will be furnished in Microsoft PowerPoint. Reports generated by the IEPR Contractor, expert reviewers or their subcontractors shall not be released for publication or dissemination without the USACE contracting officer's written approval following coordination with the COR. The USACE shall solely own all reports and information, and publish accordingly as governed by USACE criteria.

See Appendix A for table of Deliverables and Milestones by task.

6. QUALIFICATION REQUIREMENTS.

The IEPR Contractor shall have the following qualifications:

- a. Experience establishing and administering design, engineering, and construction independent external peer reviews,
- b. Free from conflicts of interest with the HQUSACE Dam Safety Program and,
- c. Proven ability to deliver under significant time constraints.

7. PERIOD OF PERFORMANCE, WORK DAYS AND TRAVEL.

a. Place of Performance. A majority of the work will be conducted at the IEPR Contractor's facilities with the exception of the following tasks.

- Task 3: Orientation Briefing is expected to consist of a full day **meeting on day 1 followed by a reading day and closeout meeting on day 2** at HQUSACE in Washington, D.C., all arrangements for the meeting to be made by USACE but does not include Contractor's travel arrangements.
- Task 6: NWD site visit is expected to consist of a full day visit to NWD in Portland, OR; a full day visit to **Portland District in Portland, OR**; and a ½ day site visit to a **Portland District project to be named**. All arrangements for the meeting to be made by USACE but does not include Contractor's travel arrangements.
- Task 7: POD site visit is expected to consist of a full day visit to Anchorage District in Anchorage, AK and a ½ day site visit to Moose Creek Dam in Fairbanks, AK. All arrangements for the meeting to be made by USACE but does not include Contractor's travel arrangements.
- Task 8: SWD site visit is expected to consist of a full day visit to SWD in Dallas, TX; a full day visit to Tulsa District in Tulsa, OK; and a ½ day site visit to Pine Creek Dam in Valliant, OK. All arrangements for the meeting to be made by USACE but does not include Contractor's travel arrangements.
- Task 10: HQUSACE Senior Leader Briefing is expected to consist of a full day project briefing at HQUSACE in Washington, D.C. All arrangements for the meeting to be made by USACE but does not include Contractor's travel arrangements.
-

Rev 0003 *****

- **Task 12: DSOG meeting is expected to consist of 3 full days of meetings in Lakewood, CO at the RMC West Division Office (address: 12596 W Bayaud Ave, Suite 400, Lakewood, CO 80228-2019. All arrangements for the meeting to be made by USACE but does not include Contractor's travel arrangements.**

Rev 0003 *****

b. Estimate Travel. Travel will be from the IEPR Contractor's facilities to HQUSACE, NWD, POD, and SWD as described below. The number of people indicated below refers to the expert reviewers. The IEPR Contractor Project Manager will also participate.

- Task 3: 1 trip/3 days including travel/4 expert reviewers plus one IEPR Contractor Project Manager to Washington, D.C.
- Task 6: 1 trip/5 days including travel/4 expert reviewers plus one IEPR Contractor Project Manager to Portland, OR.

- Task 7: 1 trip/5 days including travel/4 expert reviewers plus one IEPR Contractor Project Manager to Anchorage, AK and Fairbanks, AK.
- Task 8: 1 trip/5 days including travel/4 expert reviewers plus one IEPR Contractor Project Manager to Dallas, TX; Tulsa, OK and Valliant, OK.
- Task 10: 1 trip/3 days including travel/4 expert reviewers plus the IEPR Contractor Project Manager to Washington, D.C.

Rev 0003 *****

- **Task 12: 1 trip/5 days including travel/4 expert reviewers to Lakewood, CO.**

Rev 0003 *****

c. Period of Performance: The period of performance shall be 12 months after contract award. See Appendix A.

8. RESTRICTIONS. There are no known conflicts of interest with the Corps' Dam Safety Program, the USACE, or the IEPR that are assembled.

9. SECURITY. Security clearance is not required.

10. CONTRACTING OFFICER'S REPRESENTATIVE.

Name: Dan Corrigan
Address: 600 Dr. Martin Luther King Jr. Pl., Suite 973, Louisville, KY, 40202
Phone Number: 502-315-6485
Email: daniel.corrigan@usace.army.mil

11. USACE TECHNICAL REPRESENTATIVE.

Name: Thomas Bishop
Address: 12596 West Bayaud Ave, Suite 400, Lakewood, CO 80228
Phone Number: 303-963-4556
Email: thomas.w.bishop@usace.army.mil

12. USACE ALTERNATIVE TECHNICAL REPRESENTATIVE.

Name: Christopher Hogan
Address: 600 Dr. Martin Luther King Jr. Pl., Louisville, KY, 40202
Phone Number: 502-315-7449
Email: christopher.j.hogan@usace.army.mil

13. USACE PROJECT MANAGER

Name: Thomas Bishop
Address: 12596 West Bayaud Ave, Suite 400, Lakewood, CO 80228
Phone Number: 303-963-4556
Email: thomas.w.bishop@usace.army.mil

14. RECOMMENDED SOURCE.

Primary Contact:

Name: Scott A. Raschke
Address: 1380 Wilmington Pike
Suite 100
West Chester, PA 19382
Phone Number: 610-696-6066
Email: sraschke@schnabel-eng.com

Alternate Contact :

Name: Michael C. Canino
Address: 1380 Wilmington Pike
Suite 100
West Chester, PA 19382
Phone Number: 610-696-6066
Email: mcanino@schnabel-eng.com

15. RELEVANCE.

Independent External Peer Review of this project is required by public law WRDA 2007 (Public Law 110-114), Section 2035.

16. CAPABILITY STATEMENT.

By public law WRDA 2007 the peer review must be done by reviewers external to the Government, thus the requesting agency does not have the necessary in-house capability to perform the tasks specified in this statement of work.

APPENDIX A. IEPR Reporting and Milestone Schedule

The IEPR Contractor will propose a schedule based on the milestones and deliverables listed below:

IEPR Schedule of Deliverables for HQUSACE Dam Safety Program Review

Rev 0003 *****

Task #	Deliverable (D) or Milestone (M)	Action/Activity	Calendar Days After NTP	Due Date	Comments
	M	Type II IEPR Safety Assurance Review NTP			
1	D	Submit Final Peer Review QCP (PRQCP)	14		
2	D	Submit list of final IEPR expert reviewers	14		
2	M	Expert reviewers under contract	21		
3	M	Corps provides materials for Orientation Briefing		21 May 2013	
3	M	Orientation Briefing at HQUSACE in Washington, D.C.		30-31 May 2013	
3	M	Final Charge to Expert Reviewers	56		
6	M	Expert reviewers visit NWD in Portland, OR; NWP in Portland, OR and a Portland District Project to be named		18 June 2013	
7	M	Expert reviewers visit POD in Anchorage, AK and Moose Creek Dam in Fairbanks, AK		9 July 2013	
12	M	Expert reviewers attend July DSOG Meeting in Lakewood, CO		23 July 2013	
8	M	Expert reviewers visit SWD in Dallas, TX; SWT in Tulsa, OK and Pine Creek Dam in Valliant, OK		30 July 2013	
9	D	Submit draft report to USACE	171		
10	D	Brief to USACE Senior Leaders in Washington, D.C.		22 October 2013	
11	D	Submit Final IEPR SAR Report		22 November 2013	
	M	Project Closeout	300		

Rev 0003 *****

NOTE: The Due Dates shown in this table are tentative dates scheduled by HQUSACE and are subject to change.

APPENDIX B. General Charge Guidance

The expert reviewers shall address the numbered questions listed below. The panel shall address the following questions regarding the overall Corps' Dam Safety Program:

- Is the direction of the program appropriate?
- Has USACE overlooked any critical items?
- Does the panel have any other observations to add?

1.

APPENDIX C. BI/COI NAS Form

BI/COI FORM 3

THE NATIONAL ACADEMIES
Advisers to the Nation on Science, Engineering, and Medicine

National Academy of Sciences
National Academy of Engineering
Institute of Medicine
National Research Council

**BACKGROUND INFORMATION
AND
CONFIDENTIAL CONFLICT OF INTEREST DISCLOSURE**
For General Scientific and Technical Studies and Assistance

NAME: _____ TELEPHONE: _____

ADDRESS: _____

EMAIL ADDRESS: _____

CURRENT EMPLOYER: _____

NAS/NAE/IOM/NRC COMMITTEE: _____

There are two parts to this form, Part I Background Information, and Part II Confidential Conflict of Interest Disclosure. Complete both parts, **sign** and **date** this form on the last page, and return the form to the responsible staff officer for *The National Academies* project and committee activity to which this form applies. **Retain a copy for your records.**

PART I BACKGROUND INFORMATION

INSTRUCTIONS

Please provide the information requested below regarding **relevant** organizational affiliations, government service, public statements and positions, research support, and additional information (if any). Information is "relevant" if it is related to -- and might reasonably be of interest to others concerning -- your knowledge, experience, and personal perspectives regarding the subject matter and issues to be addressed by the committee activity for which this form is being prepared. If some or all of the requested information is contained in your curriculum vitae, you may if you prefer simply attach your CV to this form, supplemented by additional responses or comments below as necessary.

I. ORGANIZATIONAL AFFILIATIONS. Report your relevant business relationships (as an employee, owner, officer, director, consultant, etc.) and your relevant remunerated or volunteer non-business relationships (e.g., professional organizations, trade associations, public interest or civic groups, etc.).

II. GOVERNMENT SERVICE. Report your relevant service (full-time or part-time) with federal, state, or local government in the United States (including elected or appointed positions, employment, advisory board memberships, military service, etc.).

III. RESEARCH SUPPORT. Report relevant information regarding both public and private sources of research support (other than your present employer), including sources of funding, equipment, facilities, etc.

IV. PUBLIC STATEMENTS AND POSITIONS. List your relevant articles, testimony, speeches, etc., by date, title, and publication (if any) in which they appeared, or provide relevant representative examples if numerous. Provide a brief description of relevant positions of any organizations or groups with which you are closely identified or associated.

V. ADDITIONAL INFORMATION. If there are relevant aspects of your background or present circumstances not addressed above that might reasonably be construed by others as affecting your judgment in matters within the assigned task of the committee or panel on which you have been invited to serve, and therefore might constitute an actual or potential source of bias, please describe them briefly.

PART II CONFIDENTIAL CONFLICT OF INTEREST DISCLOSURE

INSTRUCTIONS

It is essential that the work of committees of the institution used in the development of reports not be compromised by any significant conflict of interest. For this purpose, **the term "conflict of interest" means any financial or other interest which conflicts with the service of the individual because it (1) could significantly impair the individual's objectivity or (2) could create an unfair competitive advantage for any person or organization.** Except for those situations in which the institution determines that a conflict of interest is unavoidable and promptly and publicly discloses the conflict of interest, no individual can be appointed to serve (or continue to serve) on a committee of the institution used in the development of reports if the individual has a conflict of interest that is relevant to the functions to be performed.

The term "conflict of interest" means something more than individual bias. There must be an *interest*, ordinarily financial, that could be directly affected by the work of the committee.

Conflict of interest requirements are *objective* and *prophylactic*. They are not an assessment of one's actual behavior or character, one's ability to act objectively despite the conflicting interest, or one's relative insensitivity to particular dollar amounts of specific assets because of one's personal wealth. Conflict of interest requirements are objective standards designed to eliminate certain specific, potentially compromising situations from arising, and thereby to protect the individual, the other members of the committee, the institution, and the public interest. The individual, the committee, and the institution shall not be placed in a situation where others could reasonably question, and perhaps discount or dismiss, the work of the committee simply because of the existence of conflicting interests.

The term "conflict of interest" applies only to *current interests*. It does not apply to past interests that have expired, no longer exist, and cannot reasonably affect current behavior. Nor does it apply to possible interests that may arise in the future but do not currently exist, because such future interests are inherently speculative and uncertain. For example, a pending formal or informal application for a particular job is a current interest, but the mere possibility that one might apply for such a job in the future is not a current interest.

The term "conflict of interest" applies not only to the personal interests of the individual but also to the *interests of others* with whom the individual has substantial common financial interests if these interests are relevant to the functions to be performed. Thus, in assessing an individual's potential conflicts of interest, consideration must be given not only to the interests of the individual but also to the interests of the individual's spouse and minor children, the individual's employer, the individual's business partners, and others with whom the individual has substantial common financial interests. Consideration must also be given to the interests of those for whom one is acting in a fiduciary or similar capacity (e.g., being an officer or director of a corporation, whether profit or nonprofit, or serving as a trustee).

Much of the work of this institution involves scientific and technical studies and assistance for sponsors across a broad range of activities. Such activities may include, for

example: defining research needs, priorities, opportunities and agendas; assessing technology development issues and opportunities; addressing questions of human health promotion and assessment; providing scientific and technical assistance and supporting services for government agency program development; assessing the state of scientific or technical knowledge on particular subjects and in particular fields; providing international and foreign country science and technology assessments, studies and assistance. Such activities frequently address scientific, technical, and policy issues that are sufficiently broad in scope that they do not implicate specific financial interests or conflict of interest concerns.

However, where such activities address more specific issues having significant financial implications -- e.g., funding telescope A versus telescope B, government development or evaluation of a specific proprietary technology, promotion or endorsement of a specific form of medical treatment or medical device, connecting foreign research facilities to specific commercial interests, making recommendations to sponsors regarding specific contract or grant awards, etc. -- careful consideration must be given to possible conflict of interest issues with respect to the appointment of members of committees that will be used by the institution in the development of reports to be provided by the institution to sponsoring agencies.

The overriding objective of the conflict of interest inquiry in each case is to identify whether there are interests -- primarily financial in nature -- that conflict with the committee service of the individual because they could impair the individual's objectivity or could create an unfair competitive advantage for any person or organization. The fundamental question in each case is does the individual, or others with whom the individual has substantial common financial interests, have identifiable interests that could be directly affected by the outcome of the project activities of the committee on which the individual has been invited to serve? For projects involving advice regarding awards of contracts, grants, fellowships, etc., this institution is also guided by the principle that an individual shall not participate in any decision regarding the award of a contract or grant or any other substantial economic benefit to the individual or to others with whom the individual has substantial common financial interests or a substantial personal or professional relationship.

The application of these concepts to specific scientific and technical studies and assistance projects must necessarily be addressed in each case on the basis of the particular facts and circumstances involved. The questions set forth below are designed to elicit information from you concerning possible conflicts of interest that are relevant to the functions to be performed by the particular committee on which you have been invited to serve.

1. **FINANCIAL INTERESTS.** (a) Taking into account stocks, bonds, and other financial instruments and investments including partnerships (but excluding broadly diversified mutual funds and any investment or financial interests valued at less than \$10,000), do you or, to the best of your knowledge others with whom you have substantial common financial interests, have financial investments that could be affected, either directly or by a direct effect on the business enterprise or activities underlying the investments, by the outcome of the project activities of the committee on which you have been invited to serve?

(b) Taking into account real estate and other tangible property interests, as well as intellectual property (patents, copyrights, etc.) interests, do you or, to the best of your knowledge others with whom you have substantial common financial interests, have property interests that could be directly affected by the outcome of the project activities of the committee on which you have been invited to serve?

(c) Could your employment or self-employment (or the employment or self-employment of your spouse), or the financial interests of your employer or clients (or the financial interests of your spouse's employer or clients) be directly affected by the outcome of the project activities of the committee on which you have been invited to serve?

(d) Taking into account research funding and other research support (e.g., equipment, facilities, industry partnerships, research assistants and other research personnel, etc.), could your current research funding and support (or that of your close research colleagues and collaborators) be directly affected by the outcome of the project activities of the committee on which you have been invited to serve?

(e) Could your service on the committee on which you have been invited to serve create a specific financial or commercial competitive advantage for you or others with whom you have substantial common financial interests?

If the answer to all of the above questions under FINANCIAL INTERESTS is either "no" or "not applicable," check here ____ (NO).

If the answer to any of the above questions under FINANCIAL INTERESTS is "yes," check here ____ (YES), and briefly describe the circumstances on the last page of this form.

2. **OTHER INTERESTS.** (a) Is the central purpose of the project for which this disclosure form is being prepared a critical review and evaluation of your own work or that of your employer?

(b) Do you have any existing professional obligations (e.g., as an officer of a scientific or engineering society) that effectively require you to publicly defend a previously established position on an issue that is relevant to the functions to be performed in this committee activity?

(c) To the best of your knowledge, will your participation in this committee activity enable you to obtain access to a competitor's or potential competitor's confidential proprietary information?

(d) If you are or have ever been a U.S. Government employee (either civilian or military), to the best of your knowledge are there any federal conflict of interest restrictions that may be applicable to your service in connection with this committee activity?

(e) If you are a U.S. Government employee, are you currently employed by a federal agency that is sponsoring this project? If you are not a U.S. Government employee, are you an employee of any other sponsor (e.g., a private foundation) of this project?

(f) If the committee activity for which this form is being prepared involves reviews of specific applications and proposals for contract, grant, fellowship, etc. awards to be made by sponsors, do you or others with whom you have substantial common financial interests, or a familial or substantial professional relationship, have an interest in receiving or being considered for awards that are currently the subject of the review being conducted by this committee?

(g) If the committee activity for which this form is being prepared involves developing requests for proposals, work statements, and/or specifications, etc., are you interested in seeking an award under the program for which the committee on which you have been invited to serve is developing the request for proposals, work statement, and/or specifications -- or, are you employed in any capacity by, or do you have a financial interest in or other economic relationship with, any person or organization that to the best of your knowledge is interested in seeking an award under this program?

If the answer to all of the above questions under OTHER INTERESTS is either "no" or "not applicable," check here _____ (NO).

If the answer to any of the above questions under OTHER INTERESTS is "yes," check here ____ (YES), and briefly describe the circumstances on the last page of this form.

EXPLANATION OF "YES" RESPONSES:

During your period of service in connection with the activity for which this form is being completed, any changes in the information reported, or any new information, which needs to be reported, shall be reported promptly by written or electronic communication to the responsible staff officer.

YOUR SIGNATURE

DATE

Reviewed by: _____
Executive Director

Date

APPENDIX B

LIST OF DOCUMENTS PROVIDED BY USACE

**INDEPENDENT EXTERNAL PEER REVIEW OF THE USACE DAM SAFETY PROGRAM, 2013
DOCUMENTS PROVIDED BY USACE TO IEPR TEAM**

The following documents were provided by USACE at the start of the peer review:

1. ER 1110-2-1156: Safety of Dams – Policy and Procedures
 - a. Document (pdf) dated 28 October 2011
 - b. Document (doc) marked as “Changes Posted as of 18 May 2013”
 - c. Summary of changes to ER marked “as of 8 April 2013”
 - d. Dam Safety Processes – Figure, as requested by panel
2. Periodic Inspection Reports
 - a. Clearwater Lake Dam (Little Rock), November 2012
 - b. Lavon Lake Dam (Fort Worth), April 2012
3. Periodic Assessment Reports
 - a. J. Percy Priest (Nashville), April 2012
 - b. Soo Locks (Detroit), July 2012
4. Dam Safety Modification Reports
 - a. Isabella Dam (Sacramento), October 2012
 - b. Rough River Dam (Louisville), July 2012
5. Dam Safety Program Scorecard (PowerPoint presentation), April 2013
6. Interim Risk Reduction Measures Plans
 - a. Edward MacDowell Lake Dam (New England), July 2012
 - b. Terminus Dam (Sacramento), January 2012
 - c. Union Village Dam (New England), October 2012
7. Dams Senior Oversight Group (DSOG) Meeting Minutes, July 2012
8. Memoranda – Appointment of Dam Safety Officer
 - a. NWK, March 2012
 - b. NWP, September 2011
 - c. NWW, June 2012
9. USACE Dam Safety Program Peer Review, Survey Questionnaire, 2013
 - a. Responses: Walla Walla, Kansas City, Portland, Baltimore, Pacific Ocean Division, Alaska, Buffalo, North Atlantic Division, Northwest Division, St. Louis, St. Paul, Vicksburg, Charleston, South Atlantic Division, Jacksonville, Mobile, Savannah, Wilmington, Tulsa, Little Rock, Fort Worth, Southwestern Division, Huntington, New England, San Francisco, Albuquerque, Sacramento, Seattle, Louisville, Pittsburgh, Omaha, Galveston, Los Angeles, South Pacific Division
 - b. RMC Consolidated Response
 - c. RMC Individual Responses (provided on request from IEPR Team)
10. Peer Review of the Dam Safety Program of the US Army Corps of Engineers, Final Report, ASDSO, September 2001

The following documents were provided at the request of the IEPR Team during the course of the peer review.

11. Fourteenth Periodic Review, US Department of the Interior, Bureau of Reclamation, Dam Safety Office, ASDSO, April 2013
12. Dam Safety Investment Plan for Major Modifications, April 2013

13. ER 1110-1-8161, Roles and Responsibilities, Modeling, Mapping, and Consequences Production Center, Draft, May 2013.
14. DSPMT spreadsheets (High Hazard Dams only), May 2013
 - a. EAP information, May 2013
 - b. Scorecard details, May 2013
 - c. EAP information, with expanded headings, June 2013
15. Risk Management Center (RMC) information
 - a. Fiscal Year 2013 Risk Management Center Program Management Plan, January 2013
 - b. Risk Management Center 2013 Strategic Plan, September 2012
 - c. ER 1110-1-8166, Roles and Responsibilities of the Risk Management Center, Draft, May 2013
 - d. ER 10-1-55, Roles and Responsibilities, Risk Management Center, June 2013
 - e. RMC Organization Chart, May 2013
 - f. Risk Management Center – presentation to IEPR
16. ER 10-1-51, Roles and Responsibilities, Dam Safety Modification Mandatory Center of Expertise, September 2012.
17. 2012 Dam and Levee Safety Training Plan, June 2012
18. Dam Failure Inundation Maps correspondence, etc.
 - a. Usage Rights for Government Furnished Information, sample agreement, Portland District
 - b. Dam Failure Inundation Maps, sample transmittal letter, Portland District
 - c. Engineering and Construction Bulletin, Interim USACE Policy on Release of Inundation Maps, March 2008
19. MMC documents related to breach modeling
 - a. Breach Parameter Estimation FY2011 Standard Operating Procedures, February 2011
 - b. Breach Reference FY2011 Standard Operating Procedures, February 2011
 - c. Breach equations template spreadsheet (xls)
20. Periodic Assessment Workshop – presentations and handouts
 - a. Agenda – Periodic Assessment Training (handout)
 - b. Estimating Consequences, October 2012
 - c. Hydrologic Failure Modes and Contributing Factors, July 2012
 - d. Potential Failure Modes Related to Internal Erosion for a PA
 - e. Operational Failure Modes
 - f. Example Exercises (2 handouts)
 - g. New Periodic Assessment Process Overview, July 2012
 - h. Introduction: MMC Program Overview
 - i. Seismic Potential Failure Modes for Embankments, August 2012
 - j. Structural Failure Modes
21. Dam Inventory information (spreadsheets, xls), August 2013
 - a. USACE Projects, height and age
 - b. USACE Projects, normal storage
22. EC 11-2-204, Corps of Engineers Civil Works Direct Program Budget Development Guidance, Fiscal Year 2013, March 2013
23. Dam and Levee Safety: Measures of Success (.doc), includes the following mission: *The mission of the Dam and Levee Safety Program is to assess, communicate and manage risks to life, property and the environment within the broader context of flood risk and asset management.*

24. RMC Position Descriptions

- a. Engineering Geologist GS-1350-14
- b. Supervisory Civil Engineer GS-0810-14
- c. Civil Engineer GS-0810-14
- d. Cost Engineer GS-0810-14
- e. Civil Engineer (Geotechnical) GS-0810-14
- f. Civil Engineer (Hydraulic) GS-0810-14
- g. Civil Engineer (Structural) GS-0810-14

25. Asset Management information

- a. Asset Management Component List spreadsheet (xls), June 2013
- b. Overview of Inland Navigation OCA Software presentation (ppt)
- c. NWD Asset Management Hydro spreadsheet (xls)
- d. Operational Condition Assessment Process for Inland Navigation, Instruction Manual & Software User Guides, Version 1.2, February 2010
- e. SWD FRM Asset Management spreadsheet (xls)

In addition to the above documents, USACE provided various materials during or following the IEPR visits, including the agenda, presentations (PowerPoint) given during the visits, organization charts for the Division and/or District.

APPENDIX C

INFORMATION FROM IEPR VISITS

HQ Briefing
HQ DSO Interview
NWD/NWP Visit
POA Visit
RMC Visit
SWD/SWT Visit

U.S. Army Corps Of Engineers

Safety Programs

5/29/2013

Title:	Safety Program Review
Location:	HQUSACE
Date:	5/30/2013

Start	End	Time	Item	Lead
8:30:00 AM	9:00:00 AM	0:30	Introduction	
9:00:00 AM	9:30:00 AM	0:30	History of the Dam Safety Program	
9:30:00 AM	10:00:00 AM	0:30	Dam Safety Officer Introduction	Dalton
10:00:00 AM	10:30:00 AM	0:30	Break	
10:30:00 AM	11:00:00 AM	0:30	2001 ASDSO Peer Review	
11:00:00 AM	11:45:00 AM	0:45	Program Overview / Program Framework	
11:45:00 AM	12:30:00 PM	0:45	Lunch	
12:30:00 PM	1:00:00 PM	0:30	Management of the Dam Safety Program	
1:00:00 PM	1:30:00 PM	0:30	Tolerable Risk Guidelines / Federal Risk Management	
1:30:00 PM	2:00:00 PM	0:30	Prioritization of Risk Management Activities	
2:00:00 PM	2:30:00 PM	0:30	IRRM	
2:30:00 PM	3:00:00 PM	0:30	Routine Activities	
3:00:00 PM	3:30:00 PM	0:30	Break	
3:30:00 PM	4:30:00 PM	1:00	Issue Evaluation Studies / Modification Studies	
4:30:00 PM	5:00:00 PM	0:30	Periodic Inspections / Periodic Assessments	
5:00:00 PM	5:30:00 PM	0:30	Questions / Closeout	
Total		9:00		

Title:	Safety Program Review
Location:	HQUSACE
Date:	5/31/2013

Start	End	Time	Item	Lead
8:30:00 AM	2:00:00 PM	5:30	Reading Time for the Panel	
2:00:00 PM	3:00:00 PM	1:00	Closeout	
Total		6:30		

Name Title Role in Dam Safety Phone Email

Senior Review Mgr. RMC 816 389 3808

Dam Safety Program manager POD 808-835-4106

DS Program Manager NAD 347-370-4595

DS Program Manager NWD 402-996-3830

DSPM SWD 918-669-7148

VD RMC Director RMC 303-963-4573

DSMMCX Director DSMMCX 304-397-4983

DS Program Manager, HQ 202-761-4643
USACE

DSPM, SPD 916-601-6003

MMC Director 601-631-5023

LRD DSPM 513-684-3804

Ch, OD Tech Support DSSC 816 808 2518

S.A.D.L.S. 202-761-7662

CH E&C Little Rock



1380 Wilmington Pike, Suite 100
 West Chester, PA 19382
 T/ 610-696-6066
 F/ 610-696-7771

MEMORANDUM

TO:	Barbara Schuelke, PE	DATE:	September 16, 2013
COMPANY:	USACE HQ	SUBJECT:	HQ DSO Interview
ADDRESS:	Barbara.R.Schuelke@usace.army.mil	PROJECT NAME/NO.:	Independent External Peer Review of the USACE Dam Safety Program / 11615026.08
FROM:	Greg Paxson, PE	CC:	Tom Bishop (RMC)

This memorandum provides an overview of the objective of the peer review, along with questions that the peer review team will be discussing with James Dalton, PE, the Dam Safety Officer (DSO).

Key resources necessary to effectively implement a Dam Safety Program, namely human resources, dam safety expertise, and available timely funding, are distributed nation-wide throughout the USACE across many organizational units and geographical locations. Further, within the Dam Safety Program, the responsibility for many components is distributed among four major levels: HQ, MSCs, Districts, and the specialized centers such as RMC and MMCC (Centers).

The above is the reality of a large Federal dam owner with hundreds of dams and thousands of staff across the United States. In this type of arrangement, however, it is essential that a dam safety program has a highly developed and effective cooperation, collaboration, and communication protocol in place. Among other things, the peer review team is examining:

- The technical efficacy of the dam safety regulations
- USACE staff understanding of the Dam Safety Program
- The consistency and quality of implementation of the USACE Dam Safety Program across the United States
- Evidence of cooperation, collaboration, and communication internal to USACE, as well as between USACE and local Emergency Managers (for implementation of effective EAPs)

The Federal Guidelines for Dam Safety (FEMA 93) state: "The head of each Federal agency having responsibility for design, construction, operation, or regulation should establish a dam safety office (officer) which reports directly to the head of the agency or his designated representative."

FEMA 93 notes the duties of the dam safety office (officer) to include:

- Surveillance and evaluation of administrative and technical/regulatory practices related to dam safety
- Recommending improvements in the practices when deficiencies in the program are identified
- Maintaining an inventory of agency dams

It is our understanding that the DSO has control of the decision-making process.

SENT VIA: First Class Mail Overnight Service Email Other

IDIQ Contract W912QR-10-D-0021 LRL Task Order 0002
Assessment, Analysis and Evaluation of the USACE Dam Safety Program

To assist in the process, the peer review team has developed the following initial list of questions. While many of these questions may not be directly asked by the panel, they provide a framework for our discussions. If the DSO feels it would benefit the discussions, the panel welcomes participation by the DSPM.

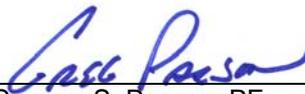
1. The DSO has certain responsibilities as defined in the Federal Guidelines and ER 1110-2-1156. However, when new leaders take a new position, they often have a vision for where they want or feel they need to take the program. What is your vision for the USACE dam safety program? What are USACE's dam safety obstacles in achieving this vision at this time?
2. What are your dam safety program priorities?
3. What are the strengths and weaknesses of the program?
4. What are your top concerns about the program? (What keeps you awake at night?)
5. Are there planned changes and improvements?
6. For practical purposes, the dam safety program is focused on public safety in its quantification of risks, the setting of tolerable risk criteria and decision making. Without fully looking at the breadth of risks, benefits and costs that USACE dam projects present to communities and the nation, what case can you make that the current program approach is spending public funds effectively. Stated slightly differently, how does the USACE decision-making framework for reducing risks explicitly evaluate the level of risk if no action is taken, and recognize the monetary and non-monetary costs and benefits of reducing risks when making decisions.
7. Could you describe the current relationship (communication, coordination, sense of partnership) between HQ, the Divisions, and Districts.
8. Discuss the organization and processes of the dam safety program, with ER 1110-2-1156 and the various process flow charts as the basis for this discussion.
9. Regarding the evolution of the USACE Dam Safety Program over the past 8 to 10 years:
 - a. What have been the challenges?
 - b. What has or has not worked?
 - c. What has been gained?
 - d. Where can further gains be most easily achieved (low hanging fruit)?
 - e. Reflect on the effectiveness and relevancy of the scorecard system.
10. Rate internal dam safety capabilities and execution (1-5, with 1 being poor and 5 being excellent) for the following areas:
 - a. Periodic Inspections
 - b. Instrumentation monitoring, interpretation and response
 - c. Periodic assessment
 - d. Risk mitigation
 - e. Interim and permanent risk reduction method applications
 - f. Design (contract plans and specifications)
 - g. Construction field engineering and QA
 - h. Construction engineering office support

IDIQ Contract W912QR-10-D-0021 LRL Task Order 0002
Assessment, Analysis and Evaluation of the USACE Dam Safety Program

- i. Project operations and maintenance (routine activities)
 - j. Emergency action planning and preparedness
 - k. Dam Safety Modification Studies
11. Describe the current communication, cooperation, and collaboration between the vertical levels within USACE and the local Emergency Management Agencies with regard to notification and evacuation of downstream development, which could be impacted by an emergency at a USACE dam.
 12. Time-sensitive EAPs are EAPs where the downstream development is located so close to the dam that there is not enough time to warn or evacuate the people with normal USACE/local EMA coordination. How many time-sensitive EAPs do you have and are they treated differently?
 13. What input or control does the DSO have on funding for projects and O&M? Are you satisfied with your level of input on budgeting processes to facilitate and promote dam safety activities, both for O&M and for project remedial activities?
 14. Where multiple EAPs are likely to be triggered by a single event (e.g., Cascadia Subduction Zone), are there integrated (system-wide) EAP coordination and response processes in place?
 15. Do you find that for a non-complex DSMS there are too many levels of reviews?
 16. Do you have opinions regarding organizational changes, notably the development of the Dam Safety Modification Mandatory Center of Expertise and the Dam Safety Production Centers? In particular, comment on USACE ability to staff these centers?
 17. What is your opinion regarding the strengths, weaknesses and opportunities for improvement of the DSOG process?
 18. Does HQ solicit bottom-up feedback input from Districts and Divisions in developing procedures, guidelines, etc.?
 19. Do you feel the right metrics are being measured in the scorecard system?
 20. In discussions with various Division, District, and Project staff, it was not clear that there are clear lines of authority spelled out to deal with a dam incident. These authorities would lay out roles and responsibilities of the DSO or, in his absence, operations personnel at a dam site, particularly in critical time-sensitive situations with limited communication. Could you provide your reaction to this observation?

Feel free to email me at gpaxson@schabel-eng.com or call me if you would like to discuss these topics.

SIGNED:



Gregory S. Paxson, PE
Principal

GSP:DBC:jlc

DRAFT 5 AGENDA
Dated 12 June 2013

**PEER REVIEW VISIT TO NORTHWESTERN DIVISION
AND PORTLAND DISTRICT**

TIME/ACTIVITY

TRANS/REMARKS

Monday, 17 June, 2013

Uniform:
Business Casual

TRAVEL DAY

1400 [REDACTED] arrive Portland

Tuesday, 18 June 2013

Uniform:
Business Casual

0730 Peer Reviewers
Arrive at NWD Portland HQ
(1125 NW Couch Street, Portland, OR)
Check in / Get Security Badges

Meet 5th Floor Security Desk

MEETING WITH NWD DAM SAFETY COMMITTEE Lewis and Clarke Room

Web Meeting Address: [REDACTED]
Call in phone number: [REDACTED]
Participant Code: [REDACTED]
Security Code [REDACTED]

0800 Introduction to NWD Dam Safety Committee
Opening Remarks by [REDACTED] (Dam Safety Officer),
Dr. James Hearn (SES) and Mr. David Ponganis (SES)

0815 NWD Dam Safety Program Overview by [REDACTED]

0945 Break

1000 Joined by NWD Commander, Gen. Anthony Funkhouser
Group Discussion – Dam Safety Program Successes and Challenges

1100 Continue Group Discussions /Q&A Gen. Funkhouser Depart

1115 Lunch On Your Own

TIME/ACTIVITY

TRANS/REMARKS

DISTRICT PROJECT BRIEFINGS AND INTERVIEWS

Web Meeting Address: [REDACTED]
Call in phone number: [REDACTED]
Participant Code: [REDACTED]
Security Code [REDACTED]

- 1245 Kansas City District by [REDACTED] (Chief Hydraulics and Hydrology)
– Rathbun and Harlan County Water Management Challenges
- 1315 Omaha District by [REDACTED] (Assistant Chief Engineering Division)
- Post Flood Repairs for 2011 Missouri River Great Flood
- 1345 Interview with Ms. [REDACTED] (Chief Missouri Basin Water Management) and Mr. [REDACTED] (Columbia Basin Water Management Division)
- 1400 Break
- 1415 Seattle District by [REDACTED] (Dam Safety Program Manager)
- Dam Safety Challenges at Lake Washington Ship Canal
- 1445 Walla Walla District by [REDACTED] (District Dam Safety Program Manager)
– Little Goose Lock and Dam Periodic Assessment
- 1515 Group Interview with [REDACTED], Dr. James Hearn, Mr. David Ponganis, [REDACTED] (Chief Program Support Division) & [REDACTED] (Chief CW Programs)
- 1545 Interview with [REDACTED], Geotechnical Engineering Technical Expert
- 1600 Final Q&A with [REDACTED] and [REDACTED]
- 1630 Adjourn for the Day

TIME/ACTIVITY

TRANS/REMARKS

Wednesday, 19 June 2013

Uniform:
Business Casual

VISIT TO PORTLAND DISTRICT OFFICE

- 0730 Peer Reviewers
Arrive at Portland District
(333 S.W. First Ave, Portland, OR) Meet in Lobby, check in at
Security Desk for visitor badges
- 0800 Introductions and Briefing - Applegate Room, 9th Floor
- Portland District Dam Safety Program Activities (per ER 1110-2-1156) -
Program Overview and Management
Risk Management Activities
O&M Activities
Funding Processes
DSPMT Scorecard
- 1200 Lunch
- 1300 Interviews with NWP staff (panel discussion), proposed interviewees:
[REDACTED], acting Dam Safety Officer (Hydrology Chief)
[REDACTED], Dam Safety Program Manager
[REDACTED], Dam Safety Section Staff
[REDACTED], acting Chief, H&H Branch (Water Management Chief)
[REDACTED], acting Chief Tech Resources Branch (H&H Branch Chief)
[REDACTED], Chief, Design Branch
- 1400 Presentations by Portland District (technical issues):
Cascadia Subduction Zone and Seismic Studies ([REDACTED])
Spillway Gates – Issues and Repairs Progress ([REDACTED])
Bonneville Spillway Capacity ([REDACTED])
FERC hydropower projects in NWP ([REDACTED])
- 1700 Adjourn for the day



TIME/ACTIVITY

TRANS/REMARKS

Thursday, 20 June 2013

Uniform:
Business Casual
(Steel Toe Boots required for
Project Tour)

VISIT TO LOOKOUT POINT DAM / WILLAMETTE VALLEY PROJECT OFFICE

- 0630 Depart, Portland District Office
Travel via vehicle to Lookout Point Dam
Meet in front of lobby
(NWP to provide van. Peer Reviewers will also have a vehicle.)
- 0915 Arrive Lookout Point
- 0930 Introductions and Briefing –
Willamette Valley Overview
Water Management Issues
Dam Safety Issues
Inundation Maps
Exercises & Local Emergency Preparedness Partnerships
Lookout Point OCA
- 1100 Begin Tour of Project Features – LOP Control Room
- 1200 Lunch
Box lunches at project/lake
- 1300 Continue Tour of Project Features - dam crest and spillway, RO access gallery
- 1430 Return to Portland, OR (stop to see Dexter spillway gate work, return to I-5 via Jasper-Lowell highway)

TIME/ACTIVITY

TRANS/REMARKS

Friday 21 June 2013

Uniform:
Business Casual

TRAVEL DAY
Peer Reviewers Return Home

LIST OF CONTACT NUMBERS:

PARTICIPANTS:

CELL PHONE NUMBER:

HQUSACE: N/A

NWD:

[REDACTED], Chief, Business Technical Division (503) 997-6764
[REDACTED], Dam Safety Program Manager (402) 203-7464

NWP:

[REDACTED], Dam Safety Program Manager (503) 539-9817
[REDACTED], Dam Safety Section (503) 522-7694
[REDACTED], OPM, Willamette Valley Project (541) 510-9024

RMC:

[REDACTED] (303) 963-4556

Peer Review Panel Team:

Greg Paxson (PM)
gpaxson@schnabel-eng.com
610-656-4425

Randy Bass
rbass@schnabel-eng.com
678-772-2806

Dave Campbell
DAVEC@schnabel-eng.com
610-751-4437

Dan Mahoney
dmahoney217@gmail.com
443-764-7015

Marty McCann
mccann@jbaslc.best.vwh.net
650-814-0878

ATTENDEES
NWD Dam Safety Peer Review Visit

18 June 2013

NAME	OFFICE SYMBOL
GREG PRISON	Peer Review Team
Randy Bass	Peer Review Team
Dan Mahoney	Peer Review Team
Wayne Campbell	Peer Review Team
[REDACTED]	CENWD - PDC
	CENWP - EC
	CENWD - RBT
	CENWD - DDE
	CENWD - DDE
	CEIWR - RMC
	CENWD - RBT
	CENWD - WM - RCC
	CENWD - RBT
	Marty McCann
[REDACTED]	CENWK
	CENWS
	CENWS
	CENWS
	CENWD
Jim Hearn	CENWD - RB
ANTHONY FUNKHOUSER	NWD
Dave Pongonis	NWD

+ more



1380 Wilmington Pike, Suite 100
 West Chester, PA 19382
 T/ 610-696-6066
 F/ 610-696-7771

MEMORANDUM

TO:	Laila Berre	DATE:	June 13, 2013
COMPANY:	USACE NWD	SUBJECT:	NWD Visit – Advance Questions
ADDRESS:	Laila.M.Berre@usace.army.mil	PROJECT NAME/NO.:	Independent External Peer Review of the USACE Dam Safety Program / 11615026.08
FROM:	Greg Paxson, PE	CC:	Tom Bishop (RMC)

This memorandum provides an overview of the objective of the peer review, along with questions that the peer review team will be discussing with various USACE staff, including the Dam Safety Officer (DSO), Dam Safety Program Manager (DSPM), and other key members of the dam safety program.

Key resources necessary to effectively implement a dam safety program, namely human resources, dam safety expertise, and available timely funding, are distributed nation-wide throughout the USACE across many organizational units and geographical locations. Further, within the Dam Safety Program, the responsibility for many components is distributed among four major levels: HQ, MSCs, Districts, and the specialized centers such as RMC and MMCC (Centers).

The above is the reality of a large Federal dam owner with hundreds of dams and thousands of staff across the United States. In this type of arrangement, however, it is essential that a dam safety program has a highly developed and effective cooperation, collaboration, and communication protocol in place. Among other things, the peer review team intends to examine:

- The technical efficacy of the dam safety regulations.
- USACE staff understanding of the Dam Safety Program.
- The consistency and quality of implementation of the USACE Dam Safety Program across the United States.
- Evidence of cooperation, collaboration, and communication internal to USACE, as well as between USACE and local Emergency Managers (for implementation of effective EAPs).

QUESTIONS FOR DSO, DSPM, AND DISTRICT/DIVISION DAM SAFETY STAFF

To assist in the process, the peer review team has developed the following initial list of questions for USACE key staff involved in dam safety:

1. Provide a copy of the organization charts of key staff and reporting relationships between District, Division, HQ, and the Centers (RMC, MMC, and DSMMCX).
2. Regarding the evolution of the USACE Dam Safety Program over the past 8 to 10 years.
 - a. What are the challenges?
 - b. What is or is not working?
 - c. What has been gained?
 - d. Where can further gains be most easily achieved (low hanging fruit)?

SENT VIA: First Class Mail Overnight Service Email Other

IDIQ Contract W912QR-10-d-0021 LRL Task Order 0002
Assessment, Analysis and Evaluation of the USACE Dam Safety Program

3. Review a typical instrumentation program for a dam and discuss data monitoring and follow-up procedures.
4. Describe your areas of compliance and non-compliance with ER 1110-2-1156 including where you feel you exceed the requirements of this ER.
5. Discuss issues related to the project review processes (ATR, DSOG, and Type I and Type II IEPR).
 - a. Timeliness
 - b. Relevance
 - c. Value
 - d. Coordination
 - e. Cost
 - f. Overlap
6. Rate internal dam safety capabilities and execution (1 – 5) for the following areas:
 - a. Periodic Inspections
 - b. Instrumentation monitoring, interpretation and response
 - c. Periodic assessment
 - d. Risk mitigation
 - e. Interim and permanent risk reduction method applications
 - f. Design (contract plans and specifications)
 - g. Construction field engineering and QA
 - h. Construction engineering office support
 - i. Project operations and maintenance
 - j. Emergency action planning and preparedness
 - k. Dam Safety Modification Studies
7. Processes, coordination, and communication.
 - a. For an IES is it common for the DSPM to be the lead engineer for the Product Delivery Team?
 - b. We understand that Districts are responsible for DSMS. Do you find the District has adequate technical capabilities for these studies?
 - c. Have you had any issues with getting assistance from other Districts?
 - d. We understand that for the District to initiate an IES, the District shall have received a priority ranking from HQ/RMC. Is the HQ/RMC prompt in developing the ranking? If you disagree with the ranking, is there an appeals process?
 - e. How often are instrumentation readings obtained between PIs?
8. What is your coordination with the asset management program?
 - a. What systems does the asset management program monitor, fix, etc., that also have a role in the safe operations of dams?
 - b. How do you find out about issues associated with the reliability of mechanical, electrical or electronic equipment?
9. The peer review will include interviews of the individual(s) at each level or office in the Dam Safety Program that is involved in developing and implementing effective EAPs, including managers, reviewers, QC, and the USACE contact with local Emergency Managers.

QUESTIONS FOR THE DSO

The Federal Guidelines for Dam Safety (FEMA 93) state: "The head of each Federal agency having responsibility for design, construction, operation, or regulation should establish a dam safety office (officer) which reports directly to the head of the agency or his designated representative."

FEMA 93 notes the duties of the dam safety office (officer) to include:

- Surveillance and evaluation of administrative and technical/regulatory practices related to dam safety
- Recommending improvements in the practices when deficiencies in the program are identified
- Maintaining an inventory of agency dams

The DSO at the Division and District levels has similar duties.

It is our understanding that the DSO has control of the decision-making process; however, the DSO does not have control of funding.

Given the roles and responsibilities of the DSO, the peer review team has the following questions for discussion with the DSO. In addition, it may be beneficial to have the DSPM participate in this discussion.

1. What is a good dam safety program?
2. What are your dam safety program priorities?
3. What are USACE's dam safety strong points?
4. What are the weaknesses?
5. What are your top concerns about the program?
6. What changes and improvements are planned?
7. Describe the current communication, cooperation, and collaboration between the vertical levels within USACE and the local Emergency Management Agencies with regard to notification and evacuation of downstream development which could be impacted by an emergency at a USACE dam.
8. Time-sensitive EAPs are EAPs where the downstream development is located so close to the dam that there is not enough time to warn or evacuate the people with normal USACE/local EMA coordination. How many time-sensitive EAPs do you have?
9. Are you satisfied with your level of input on budgeting processes to facilitate and promote dam safety activities, both for O&M and for project remedial activities?
10. Do you find that for a non-complex DSMS there are too many levels of reviews?
11. Do you have opinions regarding the organizational changes, notably the development of Dam Safety Modification Centers of Excellence?
12. What has been your experience with DSOG reviews?
13. Do you consider the current methods for determining the score card rankings to be adequate?

We appreciate your time and effort in coordinating the visit to NWD and NWP and look forward to meeting you and other USACE staff. Feel free to email me at gpaxson@schabel-eng.com or call me if you would like to discuss these topics.

SIGNED: 

Gregory S. Paxson, PE
Principal

**DRAFT AGENDA
Dated 19 June 2013**

PEER REVIEW VISIT TO ALASKA DISTRICT

TIME/ACTIVITY

TRANS/REMARKS

Monday, 8 July, 2013

TRAVEL DAY

Hilton Garden Inn
4555 Union Square Drive
Anchorage, Alaska 99503
1-907-729-7000
\$219/ night + tax (You must call for this rate!)

0600 (morning) [REDACTED] arrives Anchorage

TIME/ACTIVITY

TRANS/REMARKS

Tuesday, 9 July 2013

Uniform:
Business Casual

0800 Peer Reviewers arrive at Boniface Gate
Joint Base Elmendorf/Fort Richardson

[REDACTED] to provide CAC
card for review team access
Rental Vehicle Required

0830 Arrive at Alaska District
2204 3rd Street
Fort Richardson, AK 99506
Meet in Chief, Engineering Division Office

0900 Introduction to POD/POA Dam Safety Staff
General remarks by Dam Safety Staff
POD Dam Safety Program
POA Dam Safety Program
Chief, Operations Division

Tally Room

1000 Overview of Moose Creek Dam
Situation Report, Moose Creek Dam

Tally Room

1100 Joined by District Engineer
Group Discussion – Dam Safety Program Perceptions

1200 Lunch Glacier Brew House

1330 One-on One Interviews with POD/POA staff: Tally Room

Proposed Interviews – (15 +/- minutes each):

[REDACTED] Dam Safety Officer, POD (by phone)
Alternate, [REDACTED] POD
[REDACTED] Dam Safety Program Manager, POD
[REDACTED] Dam Safety Officer, POA
[REDACTED] Dam Safety Program Manager, POA
[REDACTED] Project Manager, POA
[REDACTED] Chief Operations, POA
[REDACTED] Chief, Hydraulics/Coastal, POA

1600 Adjourn for the Day

TIME/ACTIVITY

TRANS/REMARKS

Wednesday, 10 July 2013

Uniform:
Casual, Boots/Tennis
For Project Tour

0700 Depart Anchorage for Fairbanks (Alaska
Air # 181)

0800 Arrive Fairbanks

0945 Arrive Moose Creek Dam Project Office

Transportation by District

1000 Introductions and Briefing by Project Staff

1030 Tour of Project Features

1200 Lunch

1300 Continue Tour of Project Features

1400 Tour downstream inundation areas (if time is available)

1730 Depart Fairbanks for Anchorage (Alaska
Air # 190)

1825 Arrive Anchorage

Thursday, 20 June 2013

Uniform:
Business Casual

0800 Depart Anchorage Hotel

0830 Unfinished business in District
(if determined necessary)

1200 Peer Reviewers Dismissed, Return Home



LIST OF PARTICIPANTS AND CONTACT NUMBERS:

PARTICIPANTS:

PHONE NUMBER:

PACIFIC OCEAN DIVISION:

██████████, Dam Safety Officer (By Phone)	(808) 835-4650
██████████, Dam Safety Program Manager	(808) 835-4106

ALASKA DISTRICT:

██████████, Dam Safety Officer
██████████, Dam Safety Program Manager
██████████, Chief Operations
██████████, Chief, Hydraulics/Coastal
██████████, Project Manager

(Additional staff will participate at Moose Creek Dam)

RISK MANAGEMENT CENTER:

██████████, Senior Program Manager	(303) 963-4556
------------------------------------	----------------

PEER REVIEW PANEL MEMBERS:

Gregory Paxson, Principal, Schnabel Engineers	(610) 656-4425
Member # 2	
Member # 3	
Member # 4	



1380 Wilmington Pike, Suite 100
 West Chester, PA 19382
 T/ 610-696-6066
 F/ 610-696-7771

MEMORANDUM

TO:	James Pennaz	DATE:	June 28, 2013
COMPANY:	USACE POH	SUBJECT:	POD Visit – Preparation and Advance Questions
ADDRESS:	James.Pennaz@usace.army.mil	PROJECT NAME/NO.:	Independent External Peer Review of the USACE Dam Safety Program / 11615026.08
FROM:	Greg Paxson, PE	CC:	Tom Bishop (RMC)

This memorandum provides an overview of the objective of the peer review, along with questions that the peer review team will be discussing with various USACE staff, including the Dam Safety Officer (DSO), Dam Safety Program Manager (DSPM), and other key members of the dam safety program.

Key resources necessary to effectively implement a Dam Safety Program, namely human resources, dam safety expertise, and available timely funding, are distributed nation-wide throughout the USACE across many organizational units and geographical locations. Further, within the Dam Safety Program, the responsibility for many components is distributed among four major levels: HQ, MSCs, Districts, and the specialized centers such as RMC and MMCC (Centers).

The above is the reality of a large Federal dam owner with hundreds of dams and thousands of staff across the United States. In this type of arrangement, however, it is essential that a dam safety program has a highly developed and effective cooperation, collaboration, and communication protocol in place. Among other things, the peer review team intends to examine:

- The technical efficacy of the dam safety regulations
- USACE staff understanding of the Dam Safety Program
- The consistency and quality of implementation of the USACE Dam Safety Program across the United States
- Evidence of cooperation, collaboration, and communication internal to USACE, as well as between USACE and local Emergency Managers (for implementation of effective EAPs)

INFORMATION TO BE PROVIDED BY USACE AT THE MEETINGS

1. A listing of the anticipated participants, including their affiliation and title. A sign in sheet should be provided during the meetings.
2. Organization chart (5 copies) of the District and Division, highlighting staff involved in the dam safety program.
3. Electronic and hard copies (5) of any powerpoint presentations used during the meetings.
4. One copy of the most recent version of ER 1110-2-1156 should be available during the meeting.

QUESTIONS FOR DSO, DSPM, AND DISTRICT/DIVISION DAM SAFETY STAFF

To assist in the process, the peer review team has developed the following initial list of questions for USACE key staff involved in dam safety. While many of these questions may not be directly asked by the panel, USACE should focus

SENT VIA: First Class Mail Overnight Service Email Other

presentations, etc., toward answering these questions. Presentations need not be focused on technical aspects of the project as much as the effectiveness of the implementation of the dam safety program and the Division/District experience with the various components of the dam safety program.

1. Discuss the organization and processes of the dam safety program, with ER 1110-2-1156 and the various process flow charts as the basis for this discussion.
2. Regarding the evolution of the USACE Dam Safety Program over the past 8 to 10 years:
 - a. What are the challenges?
 - b. What is or is not working?
 - c. What has been gained?
 - d. Where can further gains be most easily achieved (low hanging fruit)?
 - e. Effectiveness and relevancy of the scorecard system.
3. Review a typical instrumentation program for a dam and discuss data monitoring and follow-up procedures.
4. Describe your areas of compliance and non-compliance with ER 1110-2-1156 including where you feel you exceed the requirements of this ER.
5. Discuss issues related to the project review processes (District/Division/RMC Reviews, ATR, DSOG, Type I and Type II IEPR, etc.):
 - a. Timeliness
 - b. Relevance
 - c. Value
 - d. Coordination
 - e. Cost
 - f. Overlap
6. Rate internal dam safety capabilities and execution (1-5) for the following areas:
 - a. Periodic Inspections
 - b. Instrumentation monitoring, interpretation and response
 - c. Periodic assessment
 - d. Risk mitigation
 - e. Interim and permanent risk reduction method applications
 - f. Design (contract plans and specifications)
 - g. Construction field engineering and QA
 - h. Construction engineering office support
 - i. Project operations and maintenance
 - j. Emergency action planning and preparedness
 - k. Dam Safety Modification Studies
7. Processes, coordination, and communication:
 - a. For an IES, is it common for the DSPM to be the lead engineer for the Product Delivery Team?
 - b. We understand that Districts are responsible for DSMS. Do you find the District has adequate technical capabilities for these studies?
 - c. Have you had any issues with getting assistance from other Districts?

- d. We understand that for the District to initiate an IES, the District shall have received a priority ranking from HQ/RMC. Is the HQ/RMC prompt in developing the ranking? If you disagree with the ranking, is there an appeals process?
 - e. How often are instrumentation readings obtained between PIs?
8. What is your coordination with the asset management program?
- a. What systems does the asset management program monitor, fix, etc., that also have a role in the safe operations of dams?
 - b. How do you find out about issues associated with the reliability of mechanical, electrical or electronic equipment?
9. The peer review will include interviews of the individual(s) at each level or office in the Dam Safety Program who are involved in developing and implementing effective EAPs, including managers, reviewers, QC, and the USACE contact with local Emergency Managers.

QUESTIONS FOR THE DSO

The Federal Guidelines for Dam Safety (FEMA 93) state: "The head of each Federal agency having responsibility for design, construction, operation, or regulation should establish a dam safety office (officer) which reports directly to the head of the agency or his designated representative."

FEMA 93 notes the duties of the dam safety office (officer) to include:

- Surveillance and evaluation of administrative and technical/regulatory practices related to dam safety
- Recommending improvements in the practices when deficiencies in the program are identified
- Maintaining an inventory of agency dams

The DSO at the Division and District levels has similar duties.

It is our understanding that the DSO has control of the decision-making process; however, the DSO does not have control of funding.

Given the roles and responsibilities of the DSO, the peer review team has the following questions for discussion with the DSO. In addition, it may be beneficial to have the DSPM participate in this discussion.

1. What is a good dam safety program?
2. What are your dam safety program priorities?
3. What are USACE's dam safety strong points?
4. What are the weaknesses?
5. What are your top concerns about the program?
6. What changes and improvements are planned?
7. Describe the current communication, cooperation, and collaboration between the vertical levels within USACE and the local Emergency Management Agencies with regard to notification and evacuation of downstream development which could be impacted by an emergency at a USACE dam.
8. Time-sensitive EAPs are EAPs where the downstream development is located so close to the dam that there is not enough time to warn or evacuate the people with normal USACE/local EMA coordination. How many time-sensitive EAPs do you have?

IDIQ Contract W912QR-10-D-0021 LRL Task Order 0002
Assessment, Analysis and Evaluation of the USACE Dam Safety Program

9. Are you satisfied with your level of input on budgeting processes to facilitate and promote dam safety activities, both for O&M and for project remedial activities?
10. Do you find that for a non-complex DSMS there are too many levels of reviews?
11. Do you have opinions regarding the organizational changes, notably the development of Dam Safety Modification Centers of Excellence?
12. What has been your experience with DSOG reviews?
13. Do you consider the current methods for determining the scorecard rankings to be adequate?
14. Does HQ solicit input in developing procedures, guidelines, etc., from the District/Division, i.e., bottom up feedback?
15. Do you have confidence in the downstream emergency responders?
16. Does your Public Affairs officer work with staff and the local communities in getting the right message out? Is open communication with the community encouraged?
17. Do you feel the right metrics are being measured in the scorecard system?
18. In the event of an incident at a dam, what authorities does the DSO, or in his absence, operations personnel at a dam site have to make critical time-sensitive decisions?

We appreciate your time and effort in coordinating the visit to NWD and NWP and look forward to meeting you and other USACE staff. Feel free to email me at gpaxson@schnabel-eng.com or call me if you would like to discuss these topics.

SIGNED:



Gregory S. Paxson, PE
Principal

GSP:DBC:jlc

U.S. Army Corps Of Engineers

USACE National Centers

Title:	Safety Program Review
Location:	RMC Western Division Office, 12596 West Bayaud Ave Suite 400, Lakewood, CO 80228
Date:	7/23/2013

Start	End	Time	Item	Lead
8:30:00 AM	9:00:00 AM	0:30	Introduction - Methods of Delivery	
9:00:00 AM	10:00:00 AM	1:00	Risk Management Center - Overview	
10:00:00 AM	10:30:00 AM	0:30	Break	
10:30:00 AM	11:00:00 AM	0:30	Civil Works Reviews	
11:00:00 AM	11:30:00 AM	0:30	Roles and Responsibilities for National Centers	
11:30:00 AM	12:30:00 PM	1:00	Lunch	
12:30:00 PM	1:30:00 PM	1:00	Dam Safety Modification MCX and Production Centers	
1:30:00 PM	2:30:00 PM	1:00	Modeling, Mapping, and Consequence Center	
2:30:00 PM	5:00:00 PM	2:30	Individual Interviews	All
5:00:00 PM	5:30:00 PM	0:30	Closeout	All
Total		9:00		

Title:	Safety Program Review
Location:	RMC Western Division Office, 12596 West Bayaud Ave Suite 400, Lakewood, CO 80228
Date:	7/24/2013

Start	End	Time	Item	Lead
8:30:00 AM	5:00:00 PM	8:30	Panel Attends Senior Oversight Group	
5:00:00 PM	5:30:00 PM	0:30	Closout	
Total		9:00		

Title:	Safety Program Review
Location:	RMC Western Division Office, 12596 West Bayaud Ave Suite 400, Lakewood, CO 80228
Date:	7/25/2013

Start	End	Time	Item	Lead
8:30:00 AM	5:00:00 PM	8:30	Panel Attends Senior Oversight Group	
5:00:00 PM	5:30:00 PM	0:30	Closout	
Total		9:00		



1380 Wilmington Pike, Suite 100
 West Chester, PA 19382
 T/ 610-696-6066
 F/ 610-696-7771

MEMORANDUM

TO:	Tom Bishop	DATE:	July 15, 2013
COMPANY:	USACE Risk Management Center (RMC)	SUBJECT:	RMC/DSOG Visit – Preparation and Advance Questions
ADDRESS:	Thomas.W.Bishop@usace.army.mil	PROJECT NAME/NO.:	Independent External Peer Review of the USACE Dam Safety Program / 11615026.08
FROM:	Greg Paxson, PE	CC:	

This memorandum provides an overview of the objective of the peer review, along with questions that the peer review team will be discussing with various USACE HQ, RMC, and other staff involved in the Dams Senior Oversight Group (DSOG), including the Dam Safety Officer (DSO), Dam Safety Program Manager (DSPM), Special Assistant for Dam and Levee Safety, RMC Director and Chiefs, and other key members of the USACE dam safety program.

Key resources necessary to effectively implement a Dam Safety Program, namely human resources, dam safety expertise, and available timely funding, are distributed nation-wide throughout the USACE across many organizational units and geographical locations. Further, within the Dam Safety Program, the responsibility for many components is distributed among four major levels: HQ, Divisions, Districts, and the specialized centers such as RMC, the Dam Safety Modification Mandatory Center of Expertise (DSMMCX), Mapping, Modeling and Consequence Center (MMC), and Dam Safety Production Centers (DSPC).

The above is the reality of a large Federal dam owner with hundreds of dams and thousands of staff across the United States. In this type of arrangement, however, it is essential that a dam safety program has a highly developed and effective cooperation, collaboration, and communication protocol in place. Among other things, the peer review team intends to examine:

- The technical efficacy of the dam safety regulations
- USACE staff understanding of the Dam Safety Program
- The consistency and quality of implementation of the USACE Dam Safety Program across the United States
- Evidence of cooperation, collaboration, and communication internal to USACE, as well as between USACE and local Emergency Managers (for implementation of effective EAPs)

INFORMATION TO BE PROVIDED BY USACE AT THE MEETINGS

1. Please provide the following in advance of the meeting:
 - a. Meeting agenda.
 - b. The completed survey from RMC.
2. A listing of the anticipated participants, including their affiliation and title. A sign in sheet should be provided during the meetings.
3. Organization chart (5 copies) of the entire dam safety program (including HQ, RMC, MMC, and DSMMCX).

SENT VIA: First Class Mail Overnight Service Email Other

IDIQ Contract W912QR-10-D-0031 LRL Task Order 0002
Assessment, Analysis and Evaluation of the USACE Dam Safety Program

4. Annotated work flow diagrams for the various processes that are part of the dam safety program, including Periodic Inspections (PI) and Assessments (PA), Issue Evaluation Studies (IES), Dam Safety Modification Studies (DSMS), Design and Construction of Dam Safety Modifications and major maintenance. Each of these flow diagrams should include the planning, analysis, reviews and approvals, noting who is responsible for each phase of the process.
5. Electronic and hard copies (5) of any PowerPoint presentations used during the meetings.
6. One copy of the most recent version of ER 1110-2-1156 should be available during the meeting.

QUESTIONS FOR HQ, RMC, AND DSOG

To assist in the process, the peer review team has developed the following initial list of questions for USACE key staff involved in dam safety. While many of these questions may not be directly asked by the panel, USACE should focus presentations, discussions, etc., toward answering these questions. Presentations need not be focused on technical aspects of projects as much as the effectiveness of the implementation of the dam safety program and HQ and RMC experiences in communicating and collaborating with Divisions, Districts, Centers, etc. in carrying out the various components of the dam safety program.

1. Discuss the organization and processes of the dam safety program, with ER 1110-2-1156 and the various process flow charts as the basis for this discussion. Comment on the responsibilities of and relationships between HQ, RMC, Centers, Divisions, and Districts.
2. Regarding the evolution of the USACE Dam Safety Program over the past 8 to 10 years:
 - a. What are the challenges?
 - b. What is or is not working?
 - c. What has been gained?
 - d. Where can further gains be most easily achieved (low hanging fruit)?
 - e. Effectiveness and relevancy of the scorecard system.
3. How does HQ/RMC plan to utilize the results of the recent surveys of the Districts/Divisions? What are your general opinions regarding the survey responses?
4. Review a typical instrumentation program for a dam and discuss data monitoring and follow-up procedures.
5. Describe compliance and non-compliance with ER 1110-2-1156 within USACE, including where you feel the requirements of this ER are known to require additions or changes.
6. Discuss issues related to the project review processes (District/Division/RMC Reviews, ATR, DSOG, Type I and Type II IEPR, etc.):
 - a. Timeliness
 - b. Relevance
 - c. Value
 - d. Coordination
 - e. Cost
 - f. Overlap
7. Rate USACE dam safety capabilities and execution (1-5, 5 being best) for the following areas:
 - a. Periodic Inspections
 - b. Instrumentation monitoring, interpretation and response

IDIQ Contract W912QR-10-D-0031 LRL Task Order 0002
Assessment, Analysis and Evaluation of the USACE Dam Safety Program

- c. Periodic assessment
 - d. Risk mitigation
 - e. Interim and permanent risk reduction method applications
 - f. Design (contract plans and specifications)
 - g. Construction field engineering and QA
 - h. Construction engineering office support
 - i. Project operations and maintenance
 - j. Emergency action planning and preparedness
 - k. Dam Safety Modification Studies
8. Processes, coordination, and communication:
- a. We understand that Districts are responsible for DSMS. Do you find the Districts have adequate technical capabilities for these studies?
 - b. Describe your experience with communication and coordination between HQ, RMC, MMC, DSMMCX, and the Divisions/Districts.
 - c. Survey and interview feedback has offered much praise for RMC driven policies/procedures and technical support. It has also provided commentary on non-consistency of responses over time, overreaching of authority, ever-changing standards and the addition of unfunded mandates. Discuss HQ's and RMC's fundamental values, philosophy and approach in attaining broad and consistent dissemination of technical guidance and support to Divisions and Districts.

QUESTIONS FOR THE DSO AND SPECIAL ASSISTANT FOR DAM AND LEVEE SAFETY

The Federal Guidelines for Dam Safety (FEMA 93) state: "The head of each Federal agency having responsibility for design, construction, operation, or regulation should establish a dam safety office (officer) which reports directly to the head of the agency or his designated representative."

FEMA 93 notes the duties of the dam safety office (officer) to include:

- Surveillance and evaluation of administrative and technical/regulatory practices related to dam safety
- Recommending improvements in the practices when deficiencies in the program are identified
- Maintaining an inventory of agency dams

The DSO at the Division and District levels has similar duties.

It is our understanding that the DSO has control of the decision-making process and has input on and control over much of the funding related to dam safety modifications.

Given the roles and responsibilities of the DSO, the peer review team has the following questions for discussion with the DSO. In addition, it may be beneficial to have the DSPM and Special Assistant for Dam and Levee Safety participate in this discussion.

1. What is a good dam safety program?
2. What are your dam safety program priorities?
3. What are USACE's dam safety strong points?
4. What are the weaknesses?
5. What are your top concerns about the program?
6. What changes and improvements are planned?

IDIQ Contract W912QR-10-D-0031 LRL Task Order 0002
Assessment, Analysis and Evaluation of the USACE Dam Safety Program

7. Describe the current communication, cooperation, and collaboration between the vertical levels within USACE, along with communication with the local Emergency Management Agencies with regard to notification and evacuation of downstream development which could be impacted by an emergency at a USACE dam.
8. Time-sensitive EAPs are EAPs where the downstream development is located so close to the dam that there is not enough time to warn or evacuate the people with normal USACE/local EMA coordination. How many time-sensitive EAPs do you have?
9. Are you satisfied with your level of input on budgeting processes to facilitate and promote dam safety activities, both for O&M and for project remedial activities?
10. In your role as DSO for the USACE, you either indirectly or directly administer and control budgeting for all dam safety program activities. However, your DSO role is subsidiary to your role as Chief, Engineering and Construction for the USACE, which requires you to attend to a far wider realm of responsibilities. Define your balance between these duties. To what extent does your Chief, Engineering and Construction role allow you to advocate for or restrain you from advocating for dam safety program funding as the DSO?
11. Comment on the level of reviews for DSMS, IES, and design documents. Do you feel the number of reviews is insufficient, adequate, or excessive?
12. Do you have opinions regarding the organizational changes, notably the development of RMC, DSMMCX, MMC, and DSPC?
13. What has been your experience with DSOG reviews? How do you perceive the reactions/responses from the Districts and Division regarding the decisions by the DSOG?
14. Do you consider the current methods for determining the scorecard rankings to be adequate? Do you feel the right metrics are being measured in the scorecard system?
15. Significant program and departmental transitions have taken place over the past 5-8 years. Some departments, such as RMC, are maturing in the midst of staffing up. Others are less mature have yet to be 'stood up'. Discuss how the Dam Safety Program as a whole is working towards its planned organizational framework. Include discussion of planning and budgeting issues that impact overall scheduling, as well as how 'learn as we go' lessons are affecting the planned model.
16. Does HQ solicit input in developing procedures, guidelines, etc., from the District/Division, i.e., bottom-up feedback?
17. Do you have confidence in the downstream emergency responders in the event of a dam safety emergency?
18. In the event of an incident at a dam, what authorities does the DSO or, in his absence, operations personnel at a dam site have to make critical time-sensitive decisions?

We appreciate your time and effort in coordinating the visit to RMC and look forward to meeting you and other USACE staff. Feel free to email me at gpaxson@schabel-eng.com or call me if you would like to discuss these topics.

SIGNED:



Gregory S. Paxson, PE
Principal

GSP:DM:DBC:MM:RB:jlc

Dam Safety Peer Review
Tulsa District, Southwestern Division, USACE
Sign-in Sheet
31 July 2013

Name	Office	Phone Number	Email
	SWD-DSPC	918-669-7456	
	CEIWR-RMC	303 968 4556	
	CESWT-DSPC	918-669-7145	
	CESWT-EC-D	918-669-7146	
Greg Paxson	IEPR	610-696-6066	gpaxson@schmabel-eng.com
Randy Bass	IERP	770-781-8008	rbass@schmabel-eng.com
	SWT-Infrastr	918-669-4313	
	SWT-INFRASTRUCTURE	918-669-7117	
	SWT Engineering of Constructo-	918-669-7611	
Marty McCann	IEPR Panel	650 0140878	mccann@jbasdc.best.vwh.net
Dan Mahoney	IEPR Panel	443 764-7015	dmahoney217@gmail.com
Dave Campbell	Schnabel Engrg.	610-751-4437	davec@schmabel-eng.com
	CESWT-DSPC	918-669-7654	
	CESWD	918-669-7148	
	CESWT DSPC	918-669-7014	
Charles Thompson			Charles Thompson
	EC-DI	918-669-7161	
	CESWT-EC-H	918-669-7182	
	CESWT-EC-HM	918-669-7509	

DRAFT AGENDA

**PEER REVIEW VISIT TO SOUTHWESTERN DIVISION
AND TULSA DISTRICT**

TIME/ACTIVITY

TRANS/REMARKS

Monday, 29 July 2013

Uniform:
Business Casual
(Steel Toed Boots and Hard
Hat Required at sites)

TRAVEL DAY –

Travel to: SOUTHWESTERN DIVISION, CORPS OF ENGINEERS
1100 COMMERCE STREET, Suite 831
DALLAS, TEXAS 75242-1317

Hotel on your own.

TIME/ACTIVITY

TRANS/REMARKS

Tuesday, 30 July 2013

Uniform:
Business Casual

0730 Peer Reviewers
Arrive at SWD in Dallas
(1100 Commerce Street, Suite 831, Dallas, TX)
Check in / Get Security Badges

Meet 1st Floor Security Desk

Meeting Address: [REDACTED]
Call in phone number: [REDACTED]
Participant Code: [REDACTED]
Security Code [REDACTED]

0800 Introduction to SWD Dam Safety Committee
Opening Remarks by [REDACTED], P.E. (DSO),
Robert Slockbower (SES)

DETS Conference Room

0830 SWD Dam Safety Program Overview by [REDACTED]

0900 Break

0915 Joined by SWD Commander, Gen. Thomas W. Kula
Group Discussion – Dam Safety Program Successes and Challenges

- 1000 Gen. Kula Depart
- 1015 Dam Safety from the DSO Perspective
Presented by [REDACTED] (DSO at SWL)
- 1100 Group Interview with Richard Muraski (Deputy Commander), Robert Slockbower (Programs Director), Ray Russo (Acting Business Director)
- 1145 Lunch On Your Own
- 1300 Group Interview with [REDACTED] (Chief, Operations), [REDACTED] (Operations), [REDACTED] (FRM PM, Operations)
- 1345 Group Interview with [REDACTED] (Chief, Real Estate), [REDACTED] (Chief, Planning)
- 1430 Break
- 1445 Final Q&A with [REDACTED], [REDACTED], and [REDACTED]
- 1515 Panel Members depart for Tulsa, OK via rental vehicle
- 2015 Panel Members arrive in Tulsa, OK

TIME/ACTIVITY

TRANS/REMARKS

Wednesday, 31 July 2013

Uniform:
Business Casual

VISIT TO TULSA DISTRICT OFFICE

0730 Peer Reviewers
Arrive at Tulsa District Office
(1645 S. 101st E. Ave., Tulsa, OK 74128)

Meet in Lobby

0800 Introduction and Briefing

Room 501, 5th Floor

Tulsa District Dam Safety Program Overview - Activities related to requirements of ER1110-2-1156
 Program Overview and Management
 Risk Management Activities
 O&M Activities
 Funding Processes
 DSPMT Scorecard

0945 Break

1000 Briefing by Tulsa District (continue Program Overview)

1100 SWD DSPC Overview by [REDACTED]

1200 Lunch

1300 Dam Safety Program Management (Budget, Manpower, Work Product)

Group Interviews with:

[REDACTED], Dam Safety Officer (Chief E&C),
[REDACTED], Deputy Chief, E&C,
[REDACTED], Chief, Design Branch,
[REDACTED], Acting Dam Safety Program Manager
[REDACTED], Previous Dam Safety Program Manager,
[REDACTED], Infrastructure Safety Section Staff

1345 Inspection, Monitoring, Instrumentation (PI, PA, AI, etc).

Group Interviews with:

[REDACTED], Acting Dam Safety Program Manager
[REDACTED], Previous Dam Safety Program Manager,
[REDACTED], Infrastructure Safety Section Staff
[REDACTED], PI Report Coordinator
[REDACTED], PA Report Coordinator
[REDACTED], Geotechnical Engineer

1430 Flood/Emergency Situation (EAP, Flood Routing, Deviations, Water Control Manual Updates, etc.)

Group Interview with:

[REDACTED], Chief, H&H Branch
[REDACTED], Chief, Water Management
[REDACTED], Acting Dam Safety Program Manager
[REDACTED], Previous Dam Safety Program Manager,
[REDACTED], Infrastructure Safety Section Staff
[REDACTED], PI Report Coordinator
[REDACTED], PA Report Coordinator
[REDACTED], Geotechnical Engineer

1515 Group Interview with DSPC

[REDACTED], Director, SWD Dam Safety Production Center
[REDACTED], Lead Engineer
[REDACTED] Project Engineer

1600 Presentations by Tulsa District \ DSPC (technical issues):
Canton Dam Modification
Pine Creek DSMS

1700 Adjourn for the day

TIME/ACTIVITY

TRANS/REMARKS

Thursday, 01 August 2013

Uniform:

Business Casual
(Steel Toe Boots and Hard
Hats required for Project
Tour)

VISIT TO PINE CREEK DAM

0630 Depart, Tulsa District Office
Travel via vehicle to Pine Creek Dam
200 miles

Meet in front of lobby
(Panel Members provide their
own rental vehicle)

1000 Arrive at Pine Creek Dam

1010 Introductions and Briefing

1030 Tour of Project Features

1230 SWT personnel return to Tulsa, OK
Panel Members return to Dallas, TX

TIME/ACTIVITY

TRANS/REMARKS

Friday 02 August 2013

Uniform:

Business Casual
(Tennis Shoes / Work Boots)

TRAVEL DAY

Peer Reviewers Return Home



LIST OF CONTACT NUMBERS:**PARTICIPANTS:****CELL PHONE NUMBER:****HQUSACE: N/A****SWD:**

██████████, Chief, Business Technical Division, DSO (469) 487-7079
 ██████████, Dam Safety Program Manager (918) 669-7148

SWT:

██████████, Acting Dam Safety Program Manager (918) 669-4313
 ██████████, Chief, Infrastructure Safety Section (918) 669-7117
 ██████████, Chief, Business Technical Division, DSO (469) 487-7079
 ██████████, Lead Park Ranger, Pine Creek Dam (580) 212-8746
 ██████████, Lake Manager (580) 317-7648
 ██████████, Operations Project Manager (580) 286-8707

SWD DSPC:

██████████, Director, DSPC (918) 857-2842
 ██████████, DSPC (918) 669-7651

RMC:

██████████ (303) 963-4556

Peer Review Panel Members:

Greg Paxson (PM)
gpaxson@schnabel-eng.com
 610-656-4425

Randy Bass
rbass@schnabel-eng.com
 678-772-2806

Dave Campbell
DAVEC@schnabel-eng.com
 610-751-4437

Dan Mahoney
dmahoney217@gmail.com
 443-764-7015

Marty McCann
mccann@jbaslc.best.vwh.net
 650-814-0878



1380 Wilmington Pike, Suite 100
 West Chester, PA 19382
 T/ 610-696-6066
 F/ 610-696-7771

MEMORANDUM

TO:	Michael Southern, PE	DATE:	July 9, 2013
COMPANY:	USACE SWD	SUBJECT:	SWD Visit – Preparation and Advance Questions
ADDRESS:	Michael.W.Southern@usace.army.mil	PROJECT NAME/NO.:	Independent External Peer Review of the USACE Dam Safety Program / 11615026.08
FROM:	Greg Paxson, PE	CC:	Tom Bishop (RMC)

This memorandum provides an overview of the objective of the peer review, along with questions that the peer review team will be discussing with various USACE staff, including the Dam Safety Officer (DSO), Dam Safety Program Manager (DSPM), and other key members of the dam safety program.

Key resources necessary to effectively implement a Dam Safety Program, namely human resources, dam safety expertise, and available timely funding, are distributed nation-wide throughout the USACE across many organizational units and geographical locations. Further, within the Dam Safety Program, the responsibility for many components is distributed among four major levels: HQ, MSCs, Districts, and the specialized centers such as RMC and MMCC (Centers).

The above is the reality of a large Federal dam owner with hundreds of dams and thousands of staff across the United States. In this type of arrangement, however, it is essential that a dam safety program has a highly developed and effective cooperation, collaboration, and communication protocol in place. Among other things, the peer review team intends to examine:

- The technical efficacy of the dam safety regulations
- USACE staff understanding of the Dam Safety Program
- The consistency and quality of implementation of the USACE Dam Safety Program across the United States
- Evidence of cooperation, collaboration, and communication internal to USACE, as well as between USACE and local Emergency Managers (for implementation of effective EAPs)

INFORMATION TO BE PROVIDED BY USACE AT THE MEETINGS

1. A listing of the anticipated participants, including their affiliation and title. A sign in sheet should be provided during the meetings.
2. Organization chart (5 copies) of the District and Division, highlighting staff involved in the dam safety program.
3. Electronic and hard copies (5) of any PowerPoint presentations used during the meetings.
4. One copy of the most recent version of ER 1110-2-1156 should be available during the meeting.

SENT VIA: First Class Mail Overnight Service Email Other

QUESTIONS FOR DSO, DSPM, AND DISTRICT/DIVISION DAM SAFETY STAFF

To assist in the process, the peer review team has developed the following initial list of questions for USACE key staff involved in dam safety. While many of these questions may not be directly asked by the panel, USACE should focus presentations, etc., toward answering these questions. Presentations need not be focused on technical aspects of the project as much as the effectiveness of the implementation of the dam safety program and the Division/District experience with the various components of the dam safety program.

1. Discuss the organization and processes of the dam safety program, with ER 1110-2-1156 and the various process flow charts as the basis for this discussion.
2. Regarding the evolution of the USACE Dam Safety Program over the past 8 to 10 years:
 - a. What are the challenges?
 - b. What is or is not working?
 - c. What has been gained?
 - d. Where can further gains be most easily achieved (low hanging fruit)?
 - e. Effectiveness and relevancy of the scorecard system.
3. Review a typical instrumentation program for a dam and discuss data monitoring and follow-up procedures.
4. Describe your areas of compliance and non-compliance with ER 1110-2-1156 including where you feel you exceed the requirements of this ER.
5. Discuss issues related to the project review processes (District/Division/RMC Reviews, ATR, DSOG, Type I and Type II IEPR, etc.):
 - a. Timeliness
 - b. Relevance
 - c. Value
 - d. Coordination
 - e. Cost
 - f. Overlap
6. Rate internal dam safety capabilities and execution (1-5, with 1 being poor and 5 being excellent) for the following areas:
 - a. Periodic Inspections
 - b. Instrumentation monitoring, interpretation and response
 - c. Periodic assessment
 - d. Risk mitigation
 - e. Interim and permanent risk reduction method applications
 - f. Design (contract plans and specifications)
 - g. Construction field engineering and QA
 - h. Construction engineering office support
 - i. Project operations and maintenance
 - j. Emergency action planning and preparedness
 - k. Dam Safety Modification Studies
7. Processes, coordination, and communication:
 - a. For an IES, is it common for the DSPM to be the lead engineer for the Product Delivery Team?

- b. We understand that Districts are responsible for DSMS. Do you find the District has adequate technical capabilities for these studies?
 - c. Have you had any issues with getting assistance from other Districts?
 - d. We understand that for the District to initiate an IES, the District shall have received a priority ranking from HQ/RMC. Is the HQ/RMC prompt in developing the ranking? If you disagree with the ranking, is there an appeals process?
 - e. How often are instrumentation readings obtained between PIs?
8. What is your coordination with the asset management program?
- a. What systems does the asset management program monitor, fix, etc., that also have a role in the safe operations of dams?
 - b. How do you find out about issues associated with the reliability of mechanical, electrical or electronic equipment?
9. The peer review will include interviews of the individual(s) at each level or office in the Dam Safety Program who are involved in developing and implementing effective EAPs, including managers, reviewers, QC, and the USACE contact with local Emergency Managers.

QUESTIONS FOR THE DSO

The Federal Guidelines for Dam Safety (FEMA 93) state: "The head of each Federal agency having responsibility for design, construction, operation, or regulation should establish a dam safety office (officer) which reports directly to the head of the agency or his designated representative."

FEMA 93 notes the duties of the dam safety office (officer) to include:

- Surveillance and evaluation of administrative and technical/regulatory practices related to dam safety
- Recommending improvements in the practices when deficiencies in the program are identified
- Maintaining an inventory of agency dams

The DSO at the Division and District levels has similar duties.

It is our understanding that the DSO has control of the decision-making process.

Given the roles and responsibilities of the DSO, the peer review team has the following questions for discussion with the DSO. In addition, it may be beneficial to have the DSPM participate in this discussion.

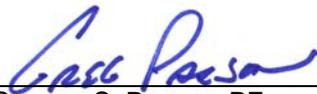
1. What is a good dam safety program?
2. What are your dam safety program priorities?
3. What are USACE's dam safety strong points?
4. What are the weaknesses?
5. What are your top concerns about the program?
6. What changes and improvements are planned?
7. Describe the current communication, cooperation, and collaboration between the vertical levels within USACE and the local Emergency Management Agencies with regard to notification and evacuation of downstream development which could be impacted by an emergency at a USACE dam.

IDIQ Contract W912QR-10-D-0021 LRL Task Order 0002
Assessment, Analysis and Evaluation of the USACE Dam Safety Program

8. Time-sensitive EAPs are EAPs where the downstream development is located so close to the dam that there is not enough time to warn or evacuate the people with normal USACE/local EMA coordination. How many time-sensitive EAPs do you have?
9. What input or control does the DSO have on funding at the District/Division levels? Are you satisfied with your level of input on budgeting processes to facilitate and promote dam safety activities, both for O&M and for project remedial activities?
10. Do you find that for a non-complex DSMS there are too many levels of reviews?
11. Do you have opinions regarding the organizational changes, notably the development of Dam Safety Modification Centers of Excellence?
12. What has been your experience with DSOG reviews?
13. Do you consider the current methods for determining the scorecard rankings to be adequate?
14. Does HQ solicit input in developing procedures, guidelines, etc., from the District/Division, i.e., bottom up feedback?
15. Do you have confidence in the downstream emergency responders?
16. Does your Public Affairs officer work with staff and the local communities in getting the right message out? Is open communication with the community encouraged?
17. Do you feel the right metrics are being measured in the scorecard system?
18. In the event of an incident at a dam, what authorities does the DSO or, in his absence, operations personnel at a dam site have to make critical time-sensitive decisions?

We appreciate your time and effort in coordinating the visit to SWD and SWT and look forward to meeting you and other USACE staff. Feel free to email me at gpaxson@schabel-eng.com or call me if you would like to discuss these topics.

SIGNED:



Gregory S. Paxson, PE
Principal

GSP:jlc

APPENDIX D

2001 ASDSO PEER REVIEW REPORT – EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

A Peer Review of the U. S. Army Corps of Engineers (Civil Works) Dam Safety Program was performed by a four-member team of the Association of State Dam Safety Officials (ASDSO). The Peer Review began with a project briefing at the General Headquarters office in Washington, D.C. on March 20, 2001. Thereafter, interviews of selected dam safety personnel and project visits were made between March 20, 2001 through June 22, 2001 covering the Headquarters and four Major Subordinate Commands (Divisions).

The Peer Review Team evaluated the practices, procedures and competence of the program relative to the generally accepted standards of practice of dam safety. There are seven areas of practice that were evaluated based on the ASDSO Manual. These seven areas are: (1) Organizational Management, (2) Management, (3) Emergency Management Procedures, (4) Technical Practice and Procedures, (5) Human Resources Management, (6) Financial Management, and (7) Public Relations Practices. Security at Corps of Engineers dams was added as an eighth area of practice. The Peer Review Team evaluated all of these areas. Additionally, the Corps requested specific areas for evaluation by the team. These specific areas cover (1) Budgetary Practices, Priorities and Needs, (2) Program Formulation and Execution, (3) Development, Maintenance, and Utilization of Technical Expertise, (4) Technical Practices and Standards Employed to Detect, Evaluate, Monitor and Correct Dam Safety Performance Concerns, (5) Dam Safety Decision-Making Authority and Procedures, and (6) Organization.

Advance information about the Corps' Dam Safety Program together with completed questionnaires by Corps staff was provided and reviewed by the Peer Review Team prior to the start of staff interviews and the on-site visits to Headquarters and four selected Major Subordinate Commands (MSC). Additional information requested by the Peer Review Team was provided and is included in this report as Appendix A.

Based on the collective experience and judgment of the Peer Review Team, the Corps of Engineers in consideration of its available resources, is currently considered to have a minimally acceptable Dam Safety Program and any further reductions in their Program will endanger their dams and the lives and property they protect. The following findings are

based on the interviews of selected Corps personnel, review of materials submitted to the Peer Review Team, and comparison with the requirements of the Federal Guidelines for Dam Safety, including its supplemental guidelines prepared by the Interagency Committee on Dam Safety (ICODS) and reference to the ASDSO Peer Review Manual.

1. The Corps of Engineers has never experienced a dam safety incident that resulted in loss of life or significant economic damage. The Corps of Engineers has 609 dams in 49 states (Hawaii has no Corps dams). Seventy seven percent of those dams are classified as high hazard potential. High hazard potential means that should the dam fail there would be loss of human life and significant economic loss. The average age of these dams is 46 years, and in the last 20 years few new dams have been constructed. However, continued budget reductions, together with a continuing decrease of Corps-wide engineering expertise and institutional knowledge concurrent with the aging inventory of their existing dams, will create a major challenge for the Corps of Engineers to maintain a quality dam safety program.
2. Given the resources available, the Corps of Engineers dam safety managers, engineers, technicians, and mechanics at the Project Sites, District Offices, Major Subordinate Commands (Division Offices) and the Headquarters level are highly dedicated, satisfied, professional, thoroughly knowledgeable and competent, and are doing an excellent job.
3. The current Corps' Strategic Vision does not mention dam safety or the protection of public safety as an identified "business process" of the Corps of Engineers. More importantly, the Corps' dam safety program has no identifiable strategic plan, mission statement, goals, objectives, or program performance measurements. Within a matrix type of work process, management, clear goals and objectives, and performance measurements are considered essential to a consistent nationwide program.
4. The current organization specifies that the Dam Safety Officer at the Headquarters, Division, and District level is the Chief of the Military and Technical Directorate (formerly Engineering/Construction Directorate). The dam safety responsibility is only one of the many duties and responsibilities of a Directorate Chief or Chief of the Engineering/Construction Division. As the Chief of a major Directorate in the Corps, the Dam Safety Officer is fully tasked and able to devote only a small portion of their time to

dam safety (reported by DSOs to be 5-10% of their time). Further, in many cases, the DSO had limited dam safety experience or expertise and is only in their position for two or three years before transferring to another position. The DSOs, especially at the Headquarters and the Division level, are not involved in the day-to-day management of the dam safety program. While the ability to respond to emergencies and solve problems appears to be effectively managed, the Peer Review Team found little pro-active leadership and no substantial time or effort applied to planning and implementing program improvements.

5. The Dam Safety Program Managers are not readily identifiable in the organizational charts and have one to two layers of management between them and the Dam Safety Officer. In most cases, they were allowed to report directly to the Dam Safety Officer on dam safety issues. This is not reflected in the organizational charts, and problems could develop when the layers of management personnel fail to communicate.
6. The portion of the Emergency Action Plans (EAP) that describes the actions of the Corps staff when dealing with project emergencies is very thorough and well exercised, thereby ensuring that emergencies at the project structures would be effectively handled. There is, however, room for improvement in the portion of the EAP that provides for the safe evacuation of any affected downstream residents or upstream recreational users. Many managers and staff expressed concerns that in the event of an emergency the local Emergency Management Agencies (EMA), who are responsible for evacuations, may not know what to expect or how to respond to the emergency. This indicates that more coordination with the local EMA is required. There is no clear guidance describing the importance of necessary coordination between the USACE staff and the local EMA. Such guidance would assure evacuation procedures, if necessary, are effective and that the affected residents are safely evacuated by their local EMA.
7. A number of high and significant hazard potential dams have not been evaluated using the current hydrologic or seismic criteria. In addition, the evaluation guidance provided in ER 1110-2-8157, "Responsibility For Hydraulic Steel Structures," has not been implemented or accomplished uniformly across all Districts.

8. It is not clear, logical, or appropriate that only two of the major dam failure modes are included in the Dam Safety Assurance Program and other perhaps more important and more likely failure modes, such as seepage (piping) situations and structural stability issues, are dealt with under the Construction General/Major Rehabilitation Funding program where decisions are made on an economic basis, and safety and loss of life are not addressed. The different funding avenues utilized for dam safety investigations and remediations add an unnecessary confusion to resolving dam safety issues and appear to be delaying necessary dam safety work.
9. Funding for dam safety work has been flat in recent years and actually decreasing in real dollars. An unfunded backlog exists in the Dam Safety Assurance work (seismic and hydraulic upgrading) of \$800 million, while in Major Rehabilitation work (modifications to extend the life, provide for new purposes, or correct dam deficiencies), it was \$1.2 billion.

A major problem is that there is no budget line item for dam safety work. While most of the work is identified and accomplished in the Engineering and Construction Division, the funding for the work is included in the Operation and Maintenance Division budget. Further, while the responsibility for dam safety is appropriately assigned to the engineering function, the funding mechanism is assigned to the Operations function. Therefore, dam safety funding must compete with all the other items in the Operations and Maintenance budget, such as recreation, navigation, dredging, environmental restoration, and others. A number of these budget items enjoy a higher public profile than dam safety work and receive considerably more local and political pressure to fund. Dam safety work does not produce a marketable product and can come up short in the budgeting process when compared to other higher profile items. There appear to be situations across the nationwide program where necessary dam safety work is being delayed due to other O&M priorities. The O&M budgeting mechanism diffuses responsibility for dam safety and works against funding dam safety issues.

10. There is not currently in place an effective nationwide management oversight procedure to prioritize dam safety deficiencies or required operation and maintenance across all Divisions to ensure that the projects that pose the greatest risk to the downstream public

are funded according to their appropriate urgency, regardless of Division or District O&M program needs.

11. The Corps, along with the entire dam safety profession in the United States, is facing a dwindling talent pool of experienced dam safety engineers since there is little new dam design or construction activity in the United States. Engineers with experience in dam design, construction, and operation and maintenance are quickly reaching retirement age. The Peer Review Team was told that 50% of the Corps staff with dam design and construction experience will be eligible for retirement in the next 5 years. As a major dam owner and operator, it is essential that the Corps maintain the experience necessary to maintain safe dams. It will require a major effort on the part of the Corps to train and mentor its younger engineers to develop the necessary expertise, attract new engineers, and transfer the important historical and institutional knowledge about their projects.

The Corps is transitioning all of its technical programs to a matrix management approach, including the dam safety program. Technical staff performing dam safety duties are distributed throughout the various Divisions, Branches, and Sections. While the matrix approach can be effectively applied to a dam safety program, it is important that a dam safety program identity be re-established and maintained. Presently there is no overall technical career path that will promote the re-establishment of necessary technical expertise in the dam safety related fields of engineering, such as geotechnical, structural, H&H and seismic engineering.

12. There is widespread dissatisfaction with centralization of the human resource function in terms of responsiveness and providing high quality candidates with the appropriate expertise. This is particularly critical in the hiring process for new entry-level engineers and technical personnel, where extremely tight hiring deadlines must be met to compete with other agencies and companies for best new talent.

The Peer Review Team recommends the following:

1. The Corps of Engineers should re-evaluate its commitment to dam safety and re-establish leadership for the dam safety program by:
 - Developing and implementing a strategic plan for the dam safety program. The strategic plan should include a clear mission statement, goals, objectives and include performance measurements that can be utilized to evaluate the accomplishment of program goals and objectives.
 - Developing a long-range plan (minimum 5-year time frame) for their Dam Safety Program.

There is at present a large capital investment in their facilities with an equally large backlog of needed maintenance and major rehabilitation, but there exists no single entity responsible for overseeing the expenditures of funds at existing projects. Likewise, there is no single entity in the position of assuring compliance with federal dam safety standards.

2. There are many challenges for the Corps of Engineers to maintain a high quality dam safety program. As a self-regulating agency, the Corps must maintain the public trust. To maintain this trust, it is recommended that the Corps establish a Center for Dam Safety Expertise at Headquarters. The Center should be directed by a full-time GS-15 level position. The Director shall be a registered professional engineer with extensive dam safety related experience and a record of effective advocacy for dam safety issues. The Center should have adequate and experienced staff to provide proper leadership and oversight of the Corps' dam safety program, practices, procedures, and performance. The Director should represent the Corps on both the Interagency Committee on Dam Safety (ICODS) and on the National Dam Safety Review Board (NDSRB) and be capable of identifying funding to support the Dam Safety Program.
3. The Center for Dam Safety Expertise should complete a comprehensive assessment of all Dam Safety roles and responsibilities at all levels of the Corps. This will enable the Corps to establish clear lines of communications and responsibilities for the Dam Safety

Program. Upon completion of this assessment, the Corps' decision-making policy for the Dam Safety Program should be issued and disseminated through all levels of the agency.

4. In the authorization and funding of dam safety work:
 - All dam safety related work items should be placed in a separate, identifiable budget line item under the control of the Center for Dam Safety Expertise.
 - The Dam Safety Assurance Program, where safety related decisions are made, should be revised to include all possible failure modes including seepage (piping) situations and structural stability issues.
 - Nationwide and Corps-wide risk reduction, risk assessment and risk management procedures should be developed for prioritizing the funding and allocation of resources for the dam safety program.
5. The Corps should establish a dual career path in the dam safety area, consisting of management and technical specialists. As a minimum, the technical specialist (non-supervisory) in the dam safety area at the District should be at least a GS-13 level. At the MSC and Headquarters level, the GS level for a dam safety technical expert would increase to the GS-14 and GS-15 levels, respectively. To develop full time workload requirements and a career path for a dam safety technical position, it may be necessary for those Districts with few dams to shift their program to other Districts. Alternatively, it may be advantageous to develop regional technical centers for dam safety expertise. Districts could request assistance on dam safety issues from the regional centers on an as-needed basis. This approach would create career path opportunities for those engineers with technical interest in dam safety. They would not have to shift into the management area to have opportunities for career advancement.
6. The Corps should continue to provide funding for their research and development program and update pertinent manuals and technical standards related to dam safety. The Corps is recognized as the leader and provider of technical standards for dam safety.
7. A Corps-wide initiative should be implemented to increase the effectiveness of the Emergency Action Plan (EAP) by raising the awareness of the importance of close coordination between the dam owner and the downstream local Emergency Management

Agencies (EMA). The initiative should (1) require close annual coordination and collaboration with the local EMA to ensure the EMA will understand what to expect during a dam related emergency, and be provided the information they need to plan the appropriate evacuation procedures, (2) provide Division and District staff with effective strategies for assisting the local EMA in developing evacuation procedures, and (3) develop an effective performance measurement and monitoring system to assure procedures are in place for the safe evacuation of downstream residents and upstream recreational users in the event of a dam safety emergency.

8. Provide adequate funds to update all inundation maps used for Emergency Action Plans to reflect current information on downstream flooding limits, downstream developments, and topographic features. It is recommended that fair weather or “sunny-day” event be added to the inundation maps.
9. The Dam Safety Officer and Dam Safety Coordinator/Program Manager at all levels of the Corps should be a Registered Professional Engineer. The Dam Safety Coordinator/Program Manager should be added as a voting member of the District Dam Safety Committee at all levels.
10. The MSC should perform the Quality Assurance of the District dam safety program. This could be accomplished by participation in the Periodic Inspection (PI) of District dams and monitoring to assure that Districts have processes and mechanisms in place that comply with established criteria, methods and policies, and that competent resources are applied by the District in their execution of their Dam Safety Program.
11. The Periodic Inspection is the cornerstone of the Corps of Engineers Dam Safety Program. The Corps is a self-regulating agency and must assure the safety of their projects for the public trust. The Periodic Inspection Report should be signed by all members of the Inspection Team including the District Dam Safety Program Manager/Coordinator (a registered professional engineer). The Report should include a statement regarding the status of the project’s ability to continue acceptable and safe operation.
12. The scope of the Periodic Inspection should be expanded to include a review of the project design to identify changes in the loading conditions, the condition of the project

structures, and current engineering criteria. The current requirements for re-assessment of Corps dams using current hydrologic and seismic criteria and the assessment requirements of the Hydraulic Steel Structures (HSS) program should be uniformly incorporated into the Periodic Inspection program.

13. A registered professional engineer should be designated as the Team Leader for the District Independent Technical Review (ITR), and the ITR Report should be signed by all members of the Review Team. Further, the Report should list a summary of the Team's comments and the actions taken to resolve all of the comments. The findings of the ITR are to be certified by the District Dam Safety Officer (a registered professional engineer) in signing the transmittal letter to the MSC indicating that the Report has been reviewed and is technically adequate. Finally, the MSC should retain approval responsibility for the Periodic Inspection so that they can support the Districts in prioritizing and funding maintenance projects and future studies.
14. The Corps of Engineers Dam Safety Program should be covered by an ER (Engineer Regulation). There is no need for an EP (Engineer Pamphlet) unless it is included as an Appendix to the ER as appropriate.
15. Provide adequate funding to complete the development and implementation of the Dam Safety Program Performance Measures (DSPPM) and Dam Safety Program Management Tools (DSPMT) for the Dam Safety Program Corps-wide. To evaluate their performance against the above Measures (Goals), each District should prepare an annual Dam Safety Status Report covering all aspects of each dam in their District. This Report should be submitted to the appropriate MSC Dam Safety Officer for Program Quality Assurance Review and forwarded to the Center for Dam Safety Expertise at Headquarters.
16. Directives from Headquarters that give high priority to the Corps Dam Safety Program should be more effectively communicated, funded, and demonstrated so that it is understood at all levels of the Corps.
17. Develop a 5-year plan to deal with the "brain drain" situation in order to maintain the necessary technical expertise, from the perspective of all disciplines, institutional knowledge, and geographical distribution. The plan should include delegating hiring authority to the District level to speed up the hiring process.

Post-Script

Dam safety programs are usually examined for one of two reasons. Number one is following a dam failure. Number two is during a peer review that is requested by the agency or dam owner. Of the two reasons, a peer review requested by the agency is a far better situation. It is an insightful manager who considers the recommendations from the peer review as seriously as ones from a post failure review.

The Peer Review Team members, as well as the Corps of Engineers representatives reviewing this Report, share a common philosophy that a world-class Dam Safety Program cannot be evaluated by a cost/benefit type analysis in which the Agency becomes a Contracting Organization with their Engineers in a support role (i.e., Project Management is the most important function). Therefore, we are encouraged that the Campaign Plan for the 50th Chief of Engineers incorporates an agenda to restore the core competency of the Agency – its dedicated staff of Engineering expertise.

APPENDIX E

2013 USACE SURVEY QUESTIONNAIRE

USACE Dam Safety Program Peer Review Survey Questionnaire

Organization (e.g. HQ, MSC, District,
Other): _____

References:

- a. ER 1110-2-1156, "Safety of Dams, Policy and Procedures" dated 28 Oct. 2011
- b. FEMA Publication 93, "Federal Guidelines for Dam Safety" dated June 1979
- c. EC 1165-2-214, "Water Resources Policies and Authorities, Civil Works Review" dated 15 December 2012

I. Questions for Narrative Responses:

1. Is the overall dam safety program adequate to manage the USACE portfolio? If not, what are the weaknesses?

2. Is there anything significant that needs improvement with how the program is managed? If yes, provide examples and suggestions for improvement.

3. Are the QA/QC processes adequate to ensure quality work is being done within USACE? If not, list the processes and suggestions for improvement.

4. Have the significant changes to the program over the last 5 years improved the management of the program? Provide examples or explanation of your response.

5. Are products being produced in a timely fashion? If not, provide examples and/or explanation.

6. Are risks being reduced in a timely fashion? If not, provide examples and/or explanation.

7. Are there are specific parts of the program that warrant more attention? If yes, describe them and why.

8. Have the significant changes to the program over the last 5 years provided opportunity for professional growth? Provide examples or explanation of your response.

9. Is the USACE Dam Safety Program aligned with the agency Strategic Vision and Campaign Plan?

II. Rate the overall program performance from 1 to 5 (5 being the best) in the following categories:

Place an "X" in the most appropriate rating.

A. Organization and Management:

1 2 3 4 5

B. Management of Technical Activities:

1 2 3 4 5

C. Technical Competency:

1 2 3 4 5

D. Additional Questions:

Question	Yes	No
Do organizational structures, policies, practices and relationships facilitate effective dam safety practices and accomplishments?		
Are staffing levels adequate?		
Are procedures and practices adequately effective, efficient, and comprehensive?		
Is the communication and coordination of objectives, goals and needs effective?		
Is the record keeping appropriate?		
Do the Corps policies and procedures define decision making authorities and ensure an appropriate balance between public safety and Federal expenditures?		
Are decisions made in an appropriate timeframe?		
Are budgets sufficient and given the appropriate priority?		
Are funds managed wisely and expended appropriately for optimum risk reduction?		
Are practices reliable and credible and do they represent appropriate state-of-the-art techniques?		
Are external and internal technical review practices adequate?		
Are there adequate technical resources available in-house, such as a library?		
Are the agency's design standards up-to-date, well documented, and easily accessible?		
Are adequate programs and practices in place that allows the Corps to maintain expertise in inspection, analyses, design, and construction management?		
Are there procedures for training and continuing professional development of employees?		
Are employees with the potential encouraged to become registered?		
Do the non-Federal cost sharing policies associated with Operations and Maintenance practices impede prudent actions related to dam safety?		

APPENDIX F

IEPR TEAM BIOS

2013 INDEPENDENT EXTERNAL PEER REVIEW (IEPR) OF THE USACE DAM SAFETY PROGRAM – IEPR TEAM BIOGRAPHIES

IEPR Four-Member Panel

Randall (Randy) Bass, PE
Principal
Schnabel Engineering

Randy Bass has been extensively involved with the dam safety community since 1978 when he started work with the newly formed Georgia Safe Dams Program (Program). Mr. Bass worked for the Program for six years, where for the last four of those years he was the manager. This Program was started from scratch with a staff of five and had to immediately ramp up to identify which of the over 5,000 dams in the state were high hazard and then develop a process of identifying the deficiencies. Processes had to be developed to prepare Phase I inspections with reports, notification of deficiencies to dam owners, and review of subsequent consultants' designs. Mr. Bass's experience in developing and managing a regulator dam safety program along with all the processes required to implement such a program, including training staff, educating dam owners, interfacing with the legal department, and developing fair and legally defensible criteria for determining hazard classification, and developing design review guidelines would be a benefit in carrying out the tasks as outlined in the USACE RFP for reviewing District Dam Safety Programs. Since leaving the Program, Mr. Bass has been a private consultant working in the dam inspection and design field and as a contractor building dams. He was the national water resources engineer for the Portland Cement Association where he interfaced extensively with various USACE district offices on the technical issues of RCC and soil cement.

David (Dave) Campbell, PE
Director of Dam Engineering
Schnabel Engineering

Dave Campbell has been involved with dam engineering for 37 years. Early activities included the analysis, rock anchor strengthening design, and resident services for the 127-foot high Hoopes Dam, and the Phase I Inspection of more than 100 dams under the USACE National Dam Inspection Program plus independent review of a large number of Phase I Inspection Reports prepared by other firms (USACE Philadelphia District contract).

By 1985, Dave was Manager of Dam Engineering service for his former employer. He was a lead designer and project manager for the 157-foot high, 2,200-foot long Monksville RCC Dam, the 2nd RCC dam constructed (after the USACE's Willow Creek Dam). Dave pushed for physical hydraulic modeling of a stepped spillway for the dam, which led to a seminal research paper (Sorensen, 1985).

In 1994, Dave joined Schnabel to build a dam engineering practice for the firm. Since that time, Dave has been involved with the design of more than 15 new dams up to 185 feet high, more than 100 dam rehabilitation projects, and a full array of dam engineering support services. Dave Campbell now oversees the work of more than 70 people focused on dam engineering practice.

Daniel (Dan) Mahoney
Consultant
FERC Director (retired)

Dan Mahoney has nearly 40 years of dam engineering experience. He started his career at the Baltimore District of the USACE. In 1981, he joined FERC, where he eventually rose to the role of Director. In this role, Dan supervised 130 engineers and support staff in the Washington office and 5 regional offices nationwide. He served as program leader and supervised all dam safety matters, including the day-to-day operation of the FERC dam safety program, the management and supervision of the Regional Offices, the dam safety inspection program, all engineering analyses and evaluations, the emergency action program, the dam site security program, and the need for remedial dam safety improvements and repairs.

Dan has also served on numerous independent review panels to evaluate dam safety programs, including the panel that performed the 2001 Peer Review of the USACE Dam Safety Program. Most recently, he served on the Independent Review Panel to conduct independent reviews of the Bureau of Reclamation dam safety program for the years 2012 and 2013.

Dan received the ASDSO National Award of Merit in 2009 and the Joseph J. Ellam Presidential Award in 2011.

Martin (Marty) W. McCann, Jr., PhD
President
Jack R. Benjamin and Associates, Inc.

Martin McCann, PhD, has been involved with dam engineering and risk analysis for dams for more than 30 years. Following publication of the Federal Guideline for Dam Safety, Marty and colleagues at Stanford University developed early methods for performing portfolio risk analyses and detailed risk analysis for dams. Following this project, the Stanford group held risk analysis training classes around the country for state, federal and private sector professionals (mid-1980s). Marty has worked on numerous dam risk analyses and potential failure modes analysis projects. As part of his work at Stanford, Marty developed the first probabilistic method for using historical data and expert assessments to estimate the frequency of dam failure associated with 'sunny-day' failures such as seepage and piping, etc.

He has been an invited lecturer on applications of dam and levee safety risk analysis methods for over 30 years. Marty continues to participate in and offer risk analysis training courses for dams and levee systems and teaches a course on risk management for critical infrastructure at Stanford University. He is also the Director and founder of the National Performance of Dams Program at Stanford University. Currently, Marty is working on several dam risk analysis projects. These include development and implementation of risk-informed approaches for hydropower projects. He is also working with a dam owner to evaluate the seismic risk of multiple dam failures that may simultaneously be impacted by a single large magnitude earthquake. As part of these studies, Marty is working with the owner's engineering staff and consultants to implement the risk analysis solutions.

IEPR Project Manager

Gregory (Greg) Paxson, PE

Principal

Schnabel Engineering

Mr. Paxson has experience in analysis and design for dam engineering projects, for both evaluation and upgrading of existing dams and design of new dams. Specific experience includes hydrologic and hydraulic (H&H) analyses, gravity dam stability, labyrinth spillways, roller compacted concrete (RCC), and slope stability and seepage analyses for earth dams. He has served as project manager, lead designer, or senior reviewer for more than 30 dam rehabilitation or new dam projects. He has also served as project manager for Type II Independent External Peer Reviews for USACE projects. He is a licensed professional engineer in seven states.

Mr. Paxson has authored or co-authored more than 20 technical papers in the US and internationally, primarily related to dam rehabilitation, and H&H. In addition, Mr. Paxson currently serves on ASDSO's Affiliate Member Advisory Committee and the USSD Committee on Hydraulics of Dams.