Review Plan
U.S. Army Corps of Engineers
Louisville District
Great Lakes and Ohio River Division

C.M. Harden Dam
Issue Evaluation Study

US Army Corps of Engineers®

11 January 2013

Contents

1. Introduction

a. Purpose

This Review Plan is intended to ensure a quality-engineering Dam Safety Issue Evaluation Study developed by the Corps of Engineers. ER 1110-2-1156, “Dam Safety Policy and Procedures” dated 28 Oct 2011, Chapter 8 describes the Issue Evaluation Study (IES) Plan development, review, and approval process. This Review Plan has been developed for C.M. Harden Dam. This Review Plan was prepared in accordance with EC 1165-2-214, “Civil Works Review Policy”, and covers the review process for the C.M. Harden Dam Phase 1 IES Report. The IES is a study that may lead to additional studies, modeling, or NEPA consultation. NEPA compliance would occur during the Dam Safety Modification Study Phase. Because the Phase 1 IES is used to justify a Phase 2 Issue Evaluation Studies and potentially Dam Safety Modification (DSM) studies, it is imperative that the vertical teaming efforts are proactive and well coordinated to assure collaboration of the report findings, conclusions, and recommendations, and that there is consensus at all levels of the organization with the recommended path forward.

b. Project Description and Information

C.M. Harden Lake Dam was screened by a national risk cadre as part of the FY 2009 Screening for Portfolio Risk Analysis (SPRA). Based on the results of this risk screening, the dam was categorized as Dam Safety Action Classification (DSAC) II (urgent or potentially unsafe). The potential failure modes identified in the SPRA report are: foundation seepage and piping of the main dam embankment; foundation seepage and piping failure of the dike; embankment erosion due to an overtopping event; and spillway erosion during a spillway event. In addition, a “modified” Periodic Assessment was held in August 2011 and drew on the initial PFMA session. The PFMA session identified 13 significant failure modes and are documented in the November 2010 “Draft” PFMA report.

The Louisville District will prepare for and support a risk analysis for C. M. Harden Dam. The risk assessment will be performed to confirm the current DSAC rating, gauge the effectiveness of interim risk reduction measures (IRRMs), and evaluate if additional data is necessary for a potential Dam Safety Modification Study. Preparation includes scanning documents, examining existing analyses and documentation, and loading all pertinent data into RADS II. Support entails providing District staff familiar with the project for participation in the PFMA session and subsequent risk analysis performed by the regional risk cadre assigned to the project. The District will be responsible for the overall management and execution of the study and the production of an IES Report

and any associated documents. The IES will determine the nature of a safety issue or concern, and the degree of urgency for action within the context of the USACE inventory of dams.

Preliminary risk assessment work was performed by a previous cadre. Potential Failure Modes Analysis (PFMA) and EOE sessions have been held. EOE did not result in consensus for risk estimate and revisions to the PFMA, event trees, and node probabilities were planned prior to work being stopped on this project.

A new cadre was assigned for FY13. The PDT will enhance the project data package as well as geologic drawings and instrumentation data. PFMA will be reviewed for completeness and thoroughness of PFM's. A site visit and semi Quantitative Risk Assessment will be held to evaluate PFM's and identify which ones will be carried forward for full quantitative risk assessment.

c. Levels of Review

IES Reviews shall include:

- District Quality Control (DQC)
- Agency Technical Review (ATR)
- RMC Reviews shall include:
- Quality Control and Consistency Review (RMC staff and/or external experts)

Independent External Peer Review (IEPR) is applied in cases that meet certain criteria. This IES is not a decision document and does not cover work requiring a Type I or Type II IEPR. Issue Evaluation Studies are used to justify Dam Safety Modification Studies. If this project requires a Dam Safety Modification Study, both Type I and Type II IEPR will be conducted.

d. Review Team

Review Management Office: The USACE Risk Management Center (RMC) is the Review Management Organization (RMO) for dam safety related work, including this IES. Contents of this review plan have been coordinated with the RMC and the Great Lakes and Ohio River Division, the Major Subordinate Command (MSC). Informal coordination with LRD will occur throughout the IES development, including briefings to the LRD Dam Safety Committee and Program Review Board updates. In-Progress Review (IPR) team meetings with the RMC, LRD, and HQ will be scheduled on an “as needed” basis to discuss programmatic, policy, and technical matters. The LRD Dam

Safety Program Manager will be the POC for vertical team coordination. This review plan will be updated for each new project phase.

Agency Technical Review Team:

Required ATR Team Expertise: The ATR team will be chosen based on each individual's qualifications and experience with similar projects.

ATR Lead: The ATR team is a senior professional with extensive experience in preparing Civil Works documents and conducting ATRs (or ITRs). The lead has the necessary skills and experience to lead a virtual team through the ATR process. The ATR lead may also serve as a reviewer for a specific discipline, e.g. Geotechnical Engineering.

Geotechnical Engineer - shall have experience in the field of geotechnical engineering, analysis, design, and construction of earthen dams. The geotechnical engineer shall have experience in subsurface investigations, rock and soil mechanics, internal erosion (seepage and piping), slope stability evaluations, erosion protection design, and earthwork construction. The geotechnical engineer shall have knowledge and experience in the forensic investigation of seepage, settlement, stability, and deformation problems associated with high head dams and appurtenances constructed on rock and soil foundations.

Engineering Geologist - shall have experience in assessing internal erosion (seepage and piping) beneath earthen dams constructed on bedrock formations. The engineering geologist shall be familiar with identification of geological hazards, exploration techniques, field and laboratory testing, and instrumentation. The engineering geologist shall be experienced in the design of grout curtains and must be knowledgeable in grout theology, concrete mix designs, and other materials used in foundation seepage barriers.

Hydraulic Engineer – shall have experience in the analysis and design of hydraulic structures related to dams including the design of hydraulic structures (e.g., spillways, outlet works, and stilling basins). The hydraulic engineer shall be knowledgeable and experienced with the routing of inflow hydrographs through multipurpose flood control reservoirs utilizing multiple discharge devices, Corps application of risk and uncertainty analyses in flood damage reduction studies, and standard Corps hydrologic and hydraulic computer models used in drawdown studies, dam break inundation studies, hydrologic modeling and analysis for dam safety investigations.

Structural Engineer – shall have experience and be proficient in performing stability analysis, finite element analysis, seismic time history studies, and external stability analysis including foundations on structural components of embankment dams. The structural engineer shall have specialized experience in the design, construction and analysis of embankment dams.

Economist (or Consequence Specialist) – shall be knowledgeable of policies and guidelines of ER 1110-2-1156 as well as experienced in analyzing flood risk management projects in accordance with ER 1105-2-100, the Planning Guidance Notebook. The economist shall be knowledgeable and experienced with standard Corps computer models and techniques used to estimate population at risk, life loss, and economic damages.

2. Requirements

a. Reviews

The review of all work products will be in accordance with the requirements of EC 1165-2-214 by following the guidelines established within this review plan. All engineering and design products will undergo District Quality Control Reviews.

i. District Quality Control (DQC)

DQC is the review of basic science and engineering work products focused on fulfilling the project quality requirements. DQC will be performed for all district engineering products by staff not involved in the work and/or study. Basic quality control tools include a plan providing for seamless review, quality checks and reviews, supervisory reviews, Project Delivery Team (PDT) reviews, etc.

ii. Agency Technical Review (ATR)

ATR is an in-depth review, managed within USACE, and conducted by a qualified team outside of the home district that is not involved in the day-to-day production of the project/product. The purpose of this review is to ensure the proper application of clearly established criteria, regulations, laws, codes, principles and professional practices. The ATR team reviews the various work products and assure that all the parts fit together as a coherent whole. ATR teams will be comprised of senior USACE personnel (Regional Technical Specialists, etc.), and may be supplemented by outside experts as appropriate. To assure independence, the leader of the ATR team shall be from outside the home Major Subordinate Command (MSC).

iii. Independent External Peer Review (IEPR)

IEPR is the most independent level of review, and is applied in cases that meet certain criteria. This IES is not a decision document and does not cover work requiring a Type I or Type II IEPR. Issue Evaluation Studies are used to justify Dam Safety Modification Studies. If this project requires a Dam Safety Modification Study, both Type I and Type II IEPR will be conducted.

iv. Policy and Legal Compliance Review

Policy and Legal Compliance Review is required for decision documents. Since this IES is not a decision document it does not require a Policy and Legal Compliance Review. If this project requires a Dam Safety Modification Study, a Policy and Legal Compliance Review will be conducted.

v. Peer Review of Sponsor In-Kind Contributions

There will be no in-kind contributions for this IES.

b. Approvals

i. Review Plan Approval and Updates

The MSC for this IES is the Great Lakes and Ohio River Division. The MSC Commander is responsible for approving this Review Plan. The Commander's approval reflects vertical team input (involving the Louisville District, MSC, RMC and HQUSACE members) as to the appropriate scope and level of review for the study and endorsement by the RMC. Like the PMP, the Review Plan is a living document and may change as the study progresses. The District is responsible for keeping the Review Plan up to date. Minor changes to the review plan since the last MSC Commander approval will be documented in an Attachment to this plan. Significant changes to the Review Plan (such as changes to the scope and/or level of review) should be re-endorsed by the RMC and re-approved by the MSC Commander following the process used for initially approving the plan. The latest version of the Review Plan, along with the Commanders' approval memorandum, will be posted on the District's webpage and linked to the HQUSACE webpage.

ii. IES Report

The IES Report shall undergo a DQC and formal ATR. After the ATR, the PDT will present the IES to the Quality Control and Consistency (QCC) Panel for review. The district and the risk assessment cadre present the IES risk assessment, IES findings, conclusions, and recommendations for review. After the QCC meeting, the Risk Cadre and RMC will certify that the risk estimate was completed in accordance with the Corps' current guidelines and risk management best practices. The IES will then be presented to the Senior Oversight Group (SOG). The SOG generally consists of the following

members: Special Assistant for Dam Safety (Chair); CoP & Regional Representatives to include Geotechnical and Materials CoP Leader, Structural CoP Leader, and Hydraulics and Hydrologic CoP Leader; Regional representatives determined by Special Assistant for Dam Safety; Corps Business Line & Program Representatives to include DSPM, Flood Damage Reduction, Navigation, Programs, and Director, Risk Management Center; and any other Representatives determined by the Special Assistant for Dam Safety. The District Dam Safety Officer (DSO), the MSC DSO, and the SOG Chairman will jointly approve the final IES after all comments are resolved.

3. Guidance and Policy References

- ER 5-1-11, USACE Business Process
- EC 1165-2-214, Civil Works Review, 15 Dec 2012
- ER 1110-2-1156, Safety of Dams – Policy and Procedure, 28 Oct 2011
- ER 1110-1-12, Quality Management, 31 Mar 2011

4. Summary of Required Levels of Review

The dam safety program follows the policy review process described in EC1165-2-214, Civil Works Review Policy. The RMC will be the review management office for the ATR, and the RMC must certify that the risk assessment was completed in accordance with the USACE current guidelines and best risk management practices. A Quality Control and Consistency (QCC) review will be conducted including the district, MSC, and RMC. The district and the risk assessment cadre will present the IES risk assessment, IES findings, conclusions, and recommendations for review. After resolution of QCC review comments, the MSC and HQUSACE will complete quality assurance and policy compliance review.

5. Models

a. General

The use of certified or approved models for all planning activities is required by EC 1105-2-407. The EC defines planning models as any models and analytical tools that planners use to define water resources management problems and opportunities, to formulate potential alternatives to address the problems and take advantage of the opportunities, to evaluate potential effects of alternatives, and to support decision-making. The EC does not cover engineering models. Engineering software is being addressed under the Engineering and Construction (E&C) Science and Engineering Technology (SET) initiative. Until an appropriate process that documents the quality of

commonly used engineering software is developed through the SET initiative, engineering type models will not be reviewed for certification and approval. The responsible use of well-known and proven USACE developed and commercial engineering software will continue and the professional practice of documenting the application of the software and modeling results will be followed.

b. List

Model	Status
N/A **	N/A

** HEC-FIA Version 2.2 will be used on this project. The HEC-FIA program estimates total damages (structure damage, content damage, and vehicle) for a range of events (both dam failure and non-dam failure). This is considered an engineering model but it is currently being certified as a corporate software under the Planning Center guidelines anyway. HEC-FIA 2.2 and HEC-FIA 2.1 are already certified as engineering models.

6. Review Schedule

Project Phase / Submittal	Review Start	Review Complete
DQC Review	**July 2013**	**September 2013**
ATR Review	**September 2013**	**October 2013**
Report Revisions and Backcheck	**October 2013**	**November 2013**
Submit Report to QCC	**November 2013**	**November 2013**
QCC Review	**November 2013**	**December 2013**
Report Revisions	**December 2013**	**January 2014**
Submit Report to SOG	**January 2014**	**January 2014**
SOG Review	**January 2014**	**January 2014**
Report Revisions	**January 2014**	**February 2014**

7. Public Participation

Public participation will not take place until the IES phase is completed. Public and stakeholder coordination has been performed to inform interested parties about the DSAC II rating and ongoing IES. Findings of the Final IES will also be shared with appropriate stakeholders. If this project results in a Dam Safety Modification Study (DSMS), future public coordination will occur for NEPA compliance.

8. Cost Estimate

Task Description	Review Start	Review Cost
DQC Review	**December 2012**	**$33,000**
ATR Review	**September 2013**	**$70,000**
QCC Review	**November 2013**	**$90,000**
SOG Review	**January 2014**	**$30,000**

9. Execution Plan

a. District Quality Control

i. General

DQC will be conducted after completion of the final draft IES. DQC requires both supervisory oversight and District technical experts. The district will conduct a robust DQC in accordance with EC 1165-2-214, Civil Works Review Policy, the District's Quality Management Plan, and ER 1110-2-12, Quality Management. Documentation of DQC activities is required and will be in accordance with the District and MSC Quality manuals. The DQC and ATR will be concurrent. Comments and responses from DQC will be available for the ATR team to review through ProjNet DrChecks.

ii. DQC Review and Control

The District DSAC Project Manager will schedule DQC review meetings. The in progress review meetings should include PDT members from Geotechnical, Dam Safety, Hydrology & Hydraulics, Structures, Mechanical, General Engineering, Cost Engineering, Project Management, Planning, and Operations as applicable. DQC Review will be conducted on the completed final draft IES including all Sections and Appendixes and will include comments, backcheck and IES revisions. ProjNet DrChecks review software will be used to document reviewer comments, responses and associated resolutions. Comments should be limited to those that are required to ensure the adequacy of the product.

b. Agency Technical Review

i. General

Draft ER 1110-2-1156, Chapter 8 describes the purpose, process, roles and responsibilities for an IES in addition to the submittal, review, and approval process. The Risk Management Center (RMC) is responsible for coordinating and managing agency technical review of the IES Report in accordance with EC 1165-2-214. The ATR Lead will be an RMC team member unless otherwise approved by the RMC Director.

The ATR Lead in cooperation with the PDT, MSC, and vertical team will determine the final make-up of the ATR team.

ii. ATR Review and Control

Reviews will be conducted in a fashion which promotes dialogue regarding the quality and adequacy of the IES and baseline risk assessment necessary to achieve the purposes of the IES. The ATR team will review the IES report which includes supporting risk and stability analysis documentation. A QCC of the baseline risk estimate and supporting documentation will be performed under the leadership of the RMC. Therefore, the level of effort for each ATR reviewer is expected to be between 16 and 32 hours. DrChecks review software will be used to document reviewer comments, responses and associated resolutions. Comments should be limited to those that are required to ensure the adequacy of the product. The RMC in conjunction with the MSC, will prepare the charge to the reviewers, containing instructions regarding the objective of the review and the specific advice sought. A kick off meeting will be held with the ATR team to familiarize reviewers with the details of the project.

The four key parts of a review comment will normally include:

(1) The review concern – identify the product's information deficiency or incorrect application of policy, guidance, or procedures.

(2) The basis for the concern – cite the appropriate law, policy, guidance, or procedure that has not been properly followed.

(3) The significance of the concern – indicate the importance of the concern with regard to its potential impact on the plan selection, recommended plan components, efficiency (cost), effectiveness (function/outputs), implementation responsibilities, safety, Federal interest, or public acceptability.

(4) The probable specific action needed to resolve the concern – identify the action(s) that the PDT must take to resolve the concern.

In some situations, especially addressing incomplete or unclear information, comments may seek clarification in order to then assess whether further specific concerns may exist. The ATR documentation in DrChecks will include the text of each ATR concern, the PDT response, a brief summary of the pertinent points in any discussion, including any vertical coordination, and lastly the agreed upon resolution. The ATR team will prepare a Review Report which includes a summary of each unresolved issue; each unresolved issue will be raised to the vertical team for resolution. Review Reports will be considered an integral part of the ATR documentation and shall also:

(1) Disclose the names of the reviewers, their organizational affiliations, and include a short paragraph on both the credentials and relevant experiences of each reviewer.

(2) Include the charge to the reviewers prepared by the RMC in accordance with EC 1165-2-214, 7c.

(3) Describe the nature of their review and their findings and conclusions.

(4) Include a verbatim copy of each reviewer's comments and the PDT's responses.

ATR may be certified when all ATR concerns are either resolved or referred to HQUSACE for resolution and the ATR documentation is complete. Certification of ATR should be completed, based on work reviewed to date, for the final report. A draft certification is included in Attachment 1.

10. Review Plan Points of Contact

Name/Title	Organization	Email/Phone
Project Manager	CELRL-PM-C	
LRD Dam Safety Program Manager	CELRD-RBT	
Review Manager	CEIWR-RMC	

ATTACHMENT 1

COMPLETION OF AGENCY TECHNICAL REVIEW

The Agency Technical Review (ATR) has been completed for the Issue Evaluation Study for the CM Harden Dam in Indiana. The ATR was conducted as defined in the project's Review Plan to comply with the requirements of EC 1165-2-214. During the ATR, compliance with established policy principles and procedures, utilizing justified and valid assumptions, was verified. This included review of: assumptions, methods, procedures, and material used in analyses, alternatives evaluated, the appropriateness of data used and level obtained, and reasonableness of the results, including whether the product meets the customer's needs consistent with law and existing US Army Corps of Engineers policy. The ATR also assessed the District Quality Control (DQC) documentation and made the determination that the DQC activities employed appear to be appropriate and effective. All comments resulting from the ATR have been resolved and the comments have been closed in DrChecks[sm].

SIGNATURE _____ _____

Name Date
ATR Team Leader
Office Symbol/Company

SIGNATURE _____ _____

Date

Project Manager (Louisville District)
CELRL-PM-C

SIGNATURE _____ _____

Date

CEIWR-RMC

CERTIFICATION OF AGENCY TECHNICAL REVIEW

Significant concerns and the explanation of the resolution are as follows: *Describe the major technical concerns and their resolution.* As noted above, all concerns resulting from the ATR of the project have been fully resolved.

SIGNATURE _____ _____

Name Date
Chief, Engineering Division Louisville District)
Office Symbol

SIGNATURE _____ _____

Name Date
Dam Safety Officer[2] (Louisville District)

Office Symbol

[1] Only needed if some portion of the ATR was contracted
[2] Only needed if different from the Chief, Engineering Division.

ATTACHMENT 2: TEAM ROSTERS

See the following tables for the rosters for the current PDT, Risk Cadre, DQC team, ATR team, vertical team and RMC points of contact.

TABLE 1: Project Delivery Team (PDT)		
Functional Area	**Name**	**Office**
Project Manager		CELRL-PM-C
Project Engineer/Geotechnical		CELRL-ED-T-G
Geologist		CELRL-ED-T-G
Hydrology and Hydraulics		CELRL-ED-T-H
Structural		CELRL-ED-D-N
Water Management		CELRL-ED-T-H
Economics/Consequences		CELRL-PM-P
Environmental		CELRL-PM-P
Operations Lake Manager		CELRL-OP-MW-H

TABLE 2: Risk Cadre Team		
Functional Area	**Name**	**Office**
Risk Cadre Lead		CEMVS-EC-GD
Hydrology and Hydraulics		CEMVS-EC-HW
Structural		CEMVS-EC-DA
Geotechnical		CEMVS-EC-GD
Geotechnical		CEMVS-EC-GT
Geologist		CEMVS-EC-GT
Economics/Consequences		CESWL-PE

TABLE 3: District Quality Control (DQC) Team		
Functional Area	**Name**	**Office**
Project Engineer/Geotechnical		CELRL-ED-T-G
Geologist		CELRL-ED-T-G
Hydrology and Hydraulics		CELRL-ED-T-H
Structural		CELRL-ED-D-N
Economics/Consequences		CELRL-PM-P

TABLE 4: Agency Technical Review (ATR) Team		
Functional Area	**Name**	**Office**
ATR Lead	TBD	
Geotechnical	TBD	
Geologist	TBD	
Hydrology and Hydraulics	TBD	
Structural	TBD	
Economics/Consequences	TBD	

TABLE 5: Vertical Team	
Name	**Office**
	HQ
	HQ

	HQ
	RMC
	RMC
	LRD
	LRL Dam Safety Officer

TABLE 6: Risk Management Center (RMC) POC's	
Name	**Office**
	RMC
	RMC