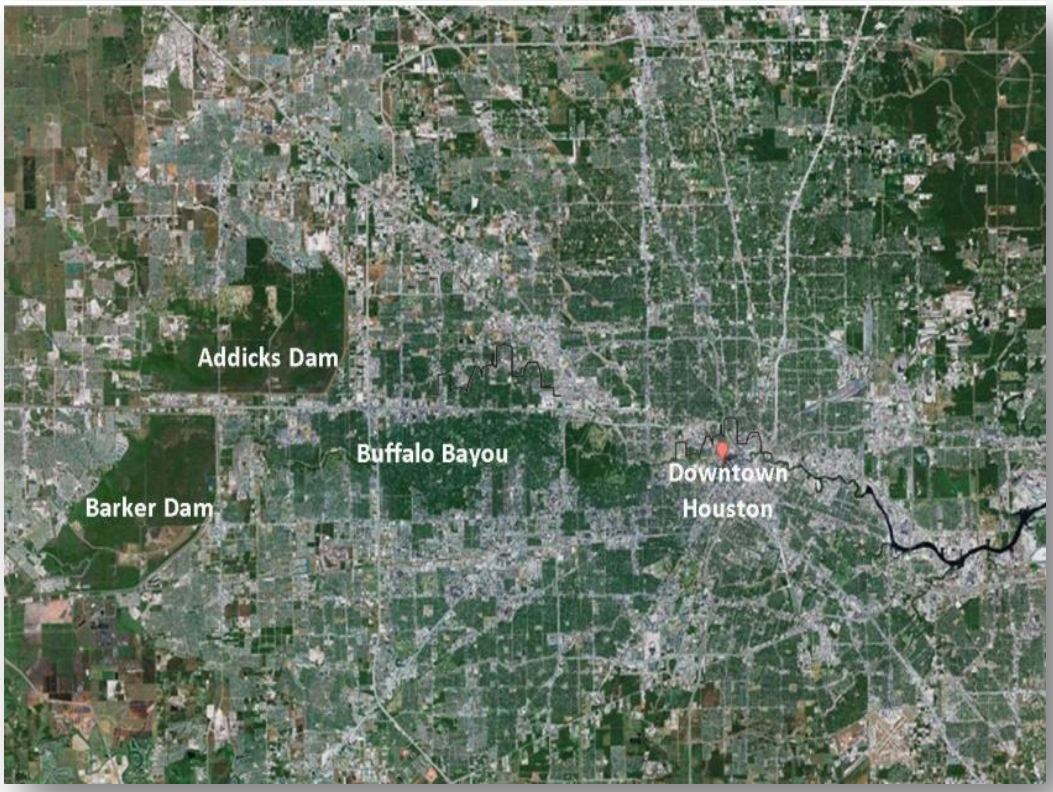
US Army Corps of Engineers ®

Addicks and Barker Dam Safety Program

REVIEW PLAN
FOR
ADDICKS AND BARKER DAMS

Pre-Construction, Engineering, and Design (PED) and Construction Activities



Project P2 Number: 145913
SWD Approval Date: November 8, 2013
SWG Revision Date:

Buffalo Bayou & Tributaries, Houston, Texas
Southwestern Division
Galveston District

REVIEW PLAN CHANGE MANAGEMENT

Significant modifications to the Review Plan are summarized in a brief change description and documented in the table below. This change management will commence once the September 2013 Review Plan is approved.

REVISION SERIAL #	SERIALIZED CHANGE DESCRIPTION TITLE	DATE REVISED	APPROVED BY

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1. PURPOSE AND REQUIREMENTS

1.1. Purpose.

This Review Plan (RP) defines the scope and level of quality management activities and peer review for the design and construction activities of the Buffalo Bayou and Tributaries, Houston, Texas, Addicks and Barker Dams, Dam Safety Project. This project is based on the approved Recommended Risk Management Plan which consists of Structural Alternative 2, Non-Structural Plan 3, and additional efforts by local governments to reduce potential consequences as contained in the Addicks and Barker Dam Safety Modification Report (DSMR) dated May 10, 2013.

The RP defines roles, responsibilities, and the accountability of the project team members for quality control. It addresses cooperative efforts of the project delivery team (PDT), District Quality Control (DQC), and the Agency Technical Review (ATR) team members for accomplishing seamless review throughout the product development phase. This plan also defines the process and requirements for Biddability, Constructability, Operability, Environmental and Sustainability (BCOES) Reviews, Independent External Peer Review (IEPR), Policy Compliance and Legal Review and Value Engineering (VE) Study. The Addicks and Barker DSMR was approved on June 10, 2013. The Finding of No Significant Impacts (FONSI) was signed on July17, 2013. The Addicks and Barker Dam Safety Project is currently in the early stages of pre-construction engineering and design (PED).This review plan covers design and construction activities related to the plans, specifications, and design documentation report (DDR) for the construction of the following planned Addicks and Barker Dams Modifications: a new outlet structure to include an intake tower, steel lined conduits, parabolic chute slab, stilling basin, cutoff wall, downstream filter, and abandoning the existing structure in place at Addicks and Barker Dams and an additional seepage cutoff element at Noble Road for the Barker Reservoir.

This Review Plan is a living document and will be updated as additional information becomes available.

1.2. References

1. ER 1110-2-1150, Engineering and Design for Civil Works Projects, 31 Aug 1999
2. ER 1110-1-12, Engineering and Design Quality Management, 30 Sep 2006
3. WRDA 2007 H. R. 1495 Public Law 110-114, 8 Nov 2007
4. ER 1110-2-1156, Safety of Dams – Policy and Procedures, Chapter 9, 28 Oct 2011
5. EC 1165-2-214, Civil Works Review Policy, 15 Dec 2012
6. ER 415-1-11, Engineering and Design Biddability, Constructability, Operability, Environmental and Sustainability (BCOES) Reviews, 1 January 2013

7. AR 15-1, Committee Management, 27 Nov 92 (Federal Advisory Committee Act Requirements)

8. National Academy of Sciences, Background Information and Confidential Conflict of Interest Disclosure, BI/COM FORM 3, May 2013.

1.3. Review Requirements.

This plan was developed in accordance with EC 1165-2-214, which establishes the procedures for ensuring the quality and credibility of US Army Corps of Engineers (USACE) decision and implementation documents through independent review. The RP describes in general the scope of review for the pre-construction, engineering, and design (PED), and construction for the Addicks and Barker Dams, Dam Safety Modification Project. All appropriate levels of review (DQC, ATR, BCOES, Type II IEPR, Policy Compliance and Legal Review, and VE) are addressed in this document. Any levels deemed inapplicable will require documentation in the RP of the risk-informed decision not to undertake that level of review. The RP identifies the most important skill sets needed in the reviews, the objective of the review and the specific advice sought, thus setting the appropriate scale and scope of review for each particular feature of the project.

The Risk Management Center (RMC) and Dam Safety Modification Mandatory Center of Expertise (DSMMCX) will fill a vital part of the overall Quality Assurance (QA) function for Headquarters (HQ) in this project. While the day-to-day execution of a project remains the responsibility of the Galveston District (SWG); the RMC and DSMMCX are able to bring an agency-wide perspective to the project to ensure uniformity and adoption of best practices from across the U.S. Army Corps of Engineers (USACE). Their early and continual involvement as part of the Project Delivery Team (PDT) is essential. Involving all elements from the inception of a project will ensure the failure modes are identified, the correct alternatives are evaluated, and that the best project solution is chosen.

The Review Management Organization (RMO) is responsible for managing the overall peer review effort described in this Review Plan. The RMO for decision documents is typically either a Planning Center of Expertise (PCX) or the Risk Management Center (RMC), depending on the primary purpose of the decision document. The USACE Risk Management Center (RMC) shall serve as the RMO for Dam Safety Modifications projects and Levee Safety Modification projects. The RMO for the peer review effort described in this Review Plan is the Risk Management Center.

The RMO will coordinate with the Cost Engineering Mandatory Center of Expertise (MCX) located in the Walla Walla District to ensure the appropriate expertise is included on the review teams to assess the adequacy of cost estimates, construction schedules and contingencies.

The RMC will be the review managing organization (RMO) on technical issues dealing with the review of scope and the ATR team composition. The ATR team will be comprised of individuals from outside the home district that have not been involved in the development of the decision document and will be chosen based on expertise, experience, and/or skills.

1.3.1. Project Delivery Team (PDT).

PDT reviews are performed by members of the PDT to ensure consistency and effective coordination across all project disciplines. Additionally, the PDT is responsible for a complete reading of any reports and accompanying appendices prepared by or for the PDT to assure the overall coherence and integrity of the report, technical appendices, and the recommendations before approval by the District Commander. In addition, the PDT is responsible for assuring work is performed in accordance to the District and Southwest Division Quality Manuals. The District Project Manager as part of the PDT will establish, coordinate, and oversee In-Progress Reviews (IPR). These reviews will serve as both information and decision-making forums.

1.3.2. District Quality Control (DQC).

DQC is an internal review process of basic science and engineering work products focused on fulfilling the project quality requirements defined in the Project Management Plan (PMP). The Biddability, Constructability, Operability, Environmental, and Sustainability (BCOES) review is a DQC process. The Galveston District shall manage DQC. Documentation of DQC activities is required and shall be in accordance with the Quality Manual of the Galveston District and the Southwestern Division. The DQC will be managed by the Galveston District in accordance with ER 1110-1-12, and the Southwestern Division /Galveston District Quality Management Plans. The DQC will be documented using DrChecks. The DQC requires several fields of expertise for review activities. The DQC roster is provided in Appendix E and includes the following disciplines; geotechnical, hydraulic design, civil/construction, structural/concrete materials, cost and mechanical/electrical.

1.3.3 Biddability, Constructability, Operability, Environmental, and Sustainability (BCOES) Review.

BCOES reviews are done during design for a project using the design-bid-build (D-B-B) method or during development of the request for proposal (RFP) for a design-build (D-B) project. The BCOES review results are to be incorporated into the procurement documents for all construction projects. The value of BCOES reviews is based on minimizing problems during the construction phase through effective checks performed by knowledgeable, experienced personnel prior to advertising for a contract. Biddability, constructability, operability, environmental, and sustainability requirements must be emphasized throughout the planning and design processes for all programs and projects, including during planning and design charrettes. This will help to ensure that the government's contract requirements are clear, executable, and readily understandable by private sector bidders or proposers. It will also help ensure that the construction may be done efficiently and in an environmentally sound manner,

and that the construction activities and projects are sufficiently sustainable. Finally, effective BCOES reviews of design and contract documents will reduce risks of cost and time growth, unnecessary changes and claims, as well as support safe, efficient, sustainable operations and maintenance by the facility users and maintenance organization after construction is complete.

The BCOES review will be documented using DrChecks. The BCOES reviewers will include facility operators and maintenance staff as well as construction, operations, and environmental staff to improve the BCOES aspects of designs. The BCOES roster is provided in Appendix F.

1.3.4. Agency Technical Review (ATR).

The purpose of the ATR is to ensure consistency with established criteria, guidance, procedures, and policy. The ATR will assess whether the analyses presented are technically correct and comply with published USACE guidance, and that the document explains the analyses and results in a reasonably clear manner for the public and decision makers. ATR is managed within USACE by the designated RMO and is conducted by a qualified team from outside the home district that is not involved in the day-to-day production of the project/product.

ATR teams will be comprised of senior USACE personnel and may be supplemented by outside experts as appropriate. The ATR team lead will be from outside the home MSC. The ATR roster is provided in Appendix C and includes the following disciplines: geotechnical, hydraulic design, civil/construction, structural/concrete materials, cost, mechanical/electrical, real estate, and NEPA/environmental.

1.3.5. Independent External Peer Review (IEPR).

IEPR may be required for decision documents under certain circumstances. IEPR is the most independent level of review, and is applied in cases that meet certain criteria where the risk and magnitude of the proposed project are such that a critical examination by a qualified team outside of USACE is warranted. A risk-informed decision, as described in EC 1165-2-214, is made as to whether an IEPR is appropriate. IEPR panels will consist of independent, recognized experts from outside of the USACE in the appropriate disciplines, representing a balance of areas of expertise suitable for the review being conducted. IEPR is divided into two types, Type I is generally for decision documents and Type II is generally for implementation documents. Type I IEPR is conducted on project studies. A Type II IEPR (SAR) shall be conducted on design and construction activities for any project where potential hazards pose a significant threat to human life (public safety). This applies to new projects and to the major repair, rehabilitation, replacement, or modification of existing facilities. A Type I IEPR of the DSMR was performed previously during the Dam Safety Modification Study. A Type II IEPR as described below is required for PED and Construction activities for the Addicks and Barker Dam Safety Project.

- **Type II IEPR.** Type II IEPR, or Safety Assurance Review (SAR), are managed outside the USACE and are conducted on design and construction activities for hurricane, storm, and flood risk management projects or other projects where existing and potential hazards pose a significant threat to human life. Type II IEPR panels will conduct reviews of the design and construction activities prior to initiation of physical construction and, until construction activities are completed, periodically thereafter on a regular schedule. The reviews shall consider the adequacy, appropriateness, and acceptability of the design and construction activities in assuring public health safety and welfare.

1.3.6. Value Engineering (VE).

A value engineering study is required during PED to include the risk-informed decision criteria, the tolerable risk guidelines, ALARP and essential engineering guidelines. The objective of the project will be the objectives of the dam safety modification study. Value Engineering shall be conducted in accordance to ER 11-1-321 Value Engineering.

1.4. Review Objectives.

The objective of the RP is to ensure the Addicks and Barker Dam Safety project is designed and constructed to the highest quality standards. The Corps is committed to the very highest standards of quality in engineering products and design services rendered. This commitment manifests itself in the attitude of the staff at all levels of project involvement. Achievement of quality control is a management attitude activated by the application of established procedures and standards. The procedures, standards and lists outlined in the RP are based on industry practices, Corps planning, engineering and construction policies, and regulations found to be conducive to good quality control.

The purpose of the RP is to define and achieve the following goals and objectives:

(1) Assure production of high quality engineering design and construction documents that comply with Corps requirements and meet or surpass USACE expectations all while remaining on schedule and within budget.

(2) Consistently provide high quality planning services and products on schedule and within budget that comply with regulations, policies, guidelines, procedures, and client needs. Whether produced by in-house staff or contractors, ensure that all personnel recognize applicable lessons-learned and see that these are incorporated into the process.

(3) Maintain and improve awareness by all planning, design and construction personnel of the need and responsibility for adhering to rigorous, upfront Quality Control (QC) procedures.

(4) Produce effective and coordinated documentation.

(5) Focus on doing the job effectively and efficiently, followed with a thorough yet efficient check and review system.

(6) Define the roles, responsibilities, and the accountability of project team members for quality control.

(7) Address cooperative efforts of Project Delivery Team (PDT) and Agency Technical Review (ATR) team members for accomplishing Seamless Review throughout the product development phase.

(8) Define interagency coordination with respect to quality control.

(9) Reduce construction cost growth by "acting" to control quality during the design phase rather than "reacting" to problems during construction.

(10) Promote safety and the well-being of the public.

The Agency Technical Review under the RP does not replace the need for conducting design checks or supervisory review of products, as required by District Quality Control (DQC).

1.5. Quality Guidelines.

Quality control is defined as the evaluation of technical products and processes to ensure they comply with applicable laws, and Corps planning, engineering, and construction regulations and policies. Quality control ensures the use of sound technical practices and that customer requirements and expectations are met. Addicks Dam and Barker Dam implementation documents and critical design features will receive a high level of technical quality verification by each discipline. Products will be reviewed to ensure that the following objectives are met:

- The plan is economically and technically feasible and environmentally acceptable; is compatible with existing projects; will be safe, functional, and meet the project authorized purpose.
- The engineering concepts, assumptions and methods are appropriate and valid, and analyses are correct.
- The design complies with engineering policy and accepted engineering practice both within the Corps and industry-wide.
- The cost estimate, including escalation and contingencies, is reasonable.
- The schedule, including contingencies, is reasonable and coordinated with the cost estimate.

1.5.1. Quality Management Policy Guidance.

This Technical Review will be conducted using guidance from the following documents:

1. Quality Management Plan for Galveston District

2. ER 1110-1-12, Engineering and Design Quality Management
3. ER 1110-1-8159, Engineering and Design DrChecks
4. ER 1110-2-1150, Engineering and Design for Civil Works Projects
5. ER 1105-2-100, Planning Guidance Notebook
6. EC 1165-2-203, Implementation of Technical Policy Compliance Review
7. ER 200-2-2, Procedures for Implementing NEPA
8. ER 1165-2-501, Civil Works Ecosystem Restoration Policy
9. ER 11-1-321, Value Engineering
10. ER 415-1-11, Biddability, Constructability, Operability, Environmental, and Sustainability (BCOES) Review
11. EC 1165-2-214, Civil Works Review Policy
12. ER 415-1-13, Design and Construction Evaluation (DCE)

2. PROJECT INFORMATION

2.1. Authority, Site Location, and Description.

Addicks and Barker Dams, floodwater detention structures, are significant features of the Buffalo Bayou and Tributaries, Texas Project. The Buffalo Bayou and Tributaries, Texas, Project, was authorized by the Rivers and Harbors Act of 1938, and modified by the Flood Control Acts of 1939 and 1954. These legislative actions authorized the improvement of Buffalo Bayou and its tributaries above the main turning basin of the Houston Ship Channel at Houston, Texas, to provide for the control of floods to protect the City of Houston from flood damages and the prevention of the deposition of silt in the turning basin of the Houston Ship Channel by means of detention reservoirs, enlargement and rectification of channels, the construction of control works, and any diversions which may be found advisable. Addicks and Barker Dams are located in southeast Texas in the San Jacinto River basin approximately 17 miles west of downtown Houston (Figure 1). The majority of both Addicks and Barker Reservoirs fall within Harris County; however, a small portion of Barker Reservoir crosses into Fort Bend County. Addicks Reservoir is located on the north side of Interstate Highway 10 (IH-10) with State Highway 6 (SH 6) bisecting the reservoir north to south. Barker Reservoir is located on the south side of IH-10, and west of SH 6. The dams are strategically located above the confluence of Buffalo Bayou and South Mayde Creek. Beyond this confluence, Buffalo Bayou continues east through downtown Houston, where it joins with White Oak Bayou, and eventually becomes the Houston Ship Channel, which flows into San Jacinto Bay, into Galveston Bay, and then into the Gulf of Mexico. The project was completed in 1948 and is operated 365 days a year. Both Addicks and Barker Reservoirs provide flood control only and do not maintain permanent pools.

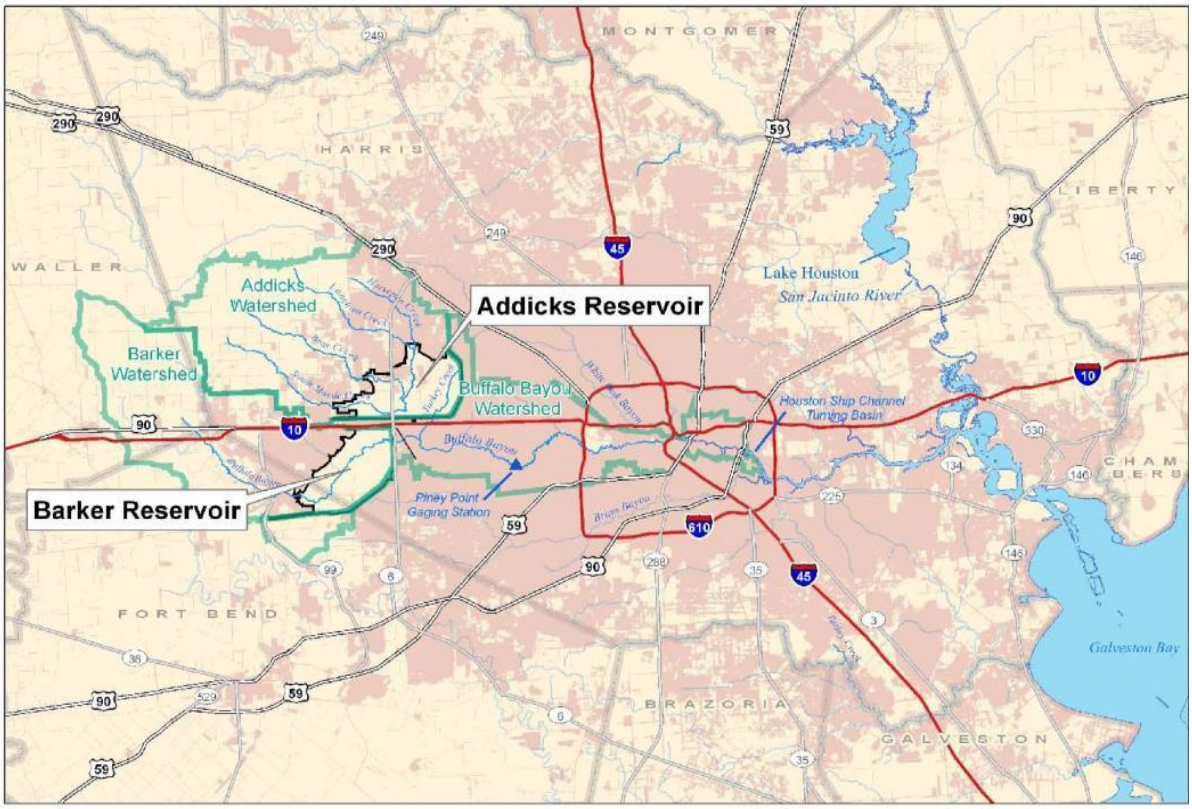

Figure 1 - Addicks and Barker Reservoirs, Project Location Map

2.1.1 Addicks Dam and Reservoir.

The Addicks Reservoir project features include an earthen dam, concrete outlet works, and roller compacted concrete (RCC) uncontrolled auxiliary spillways. The earthen dam consists of an unzoned, random fill embankment that is 61,166 feet long and 48.5 feet above the original streambed. The top of the dam elevation currently ranges from 117.4 to 121 feet and the crest is 12 feet wide. The crest elevations were raised in 1986 to comply with necessary freeboard requirements. The abutment, or existing ground, at either end of Addicks Dam is lower than the top of dam elevation. Existing ground at the north end of Addicks Dam is at elevation 108 feet and ties into the spillway crest at 112.5 feet. The existing ground at the south end is at elevation 111.0 feet and ties into the spillway crest at 115.5 feet The outlet works have five 8 feet by 6 feet concrete conduits controlled by six gates. One conduit was originally gated using 2 gates. The remaining conduits were gated by 1963. Both ends of the dam are armored with roller-compacted concrete that serve as uncontrolled spillways. Addicks Dam and Reservoir are shown in Plan View in Figure 2 with the southern segment of Addicks Dam shown in Figure 3.

Figure 2 – Plan View, Addicks Dam and Reservoir

Figure 3 – Addicks Dam looking toward downtown Houston

2.1.2. Barker Dam and Reservoir.

The Barker Dam and Reservoir project features include an earthen dam, concrete outlet works, and uncontrolled spillways. The earthen dam consists of an unzoned, random fill embankment that is 71,900 feet long with a maximum height of 42.9 feet at the outlet works. The top of the dam elevation currently ranges from 110.0 to 113.1 and the crest is 12 feet wide. The crest elevations were raised in 1986 to comply with necessary freeboard requirements. The abutment, or existing ground, at either end of Barker Dam is lower than the top of dam elevation. Existing ground at both ends of Barker Dam is at elevation 104.0 feet. The spillway crest at the north end is at elevation 105.5 feet and the south end is at 106.7 feet. The outlet works consist of five gated concrete conduits (9 feet by 7 feet) and 6 gates. Initially only one of the five conduits was gated. Two additional conduits were gated in 1948, and in 1963 the remaining two conduits were gated. Both ends of the dam are armored with roller-compacted concrete and serve as uncontrolled spillways. Barker Dam and Reservoir are shown in Plan View in Figure 4 with the outlet works segment of Barker Dam shown in Figure 5.

Figure 4 - Plan View, Barker Dam and Reservoir

Figure 5 - Barker Dam at Outlet Works during reservoir impoundment

2.2. Decision Documents

2.2.1. Potential Failure Modes.

Technical issues concerning the safety of Addicks and Barker Dams were examined and discussed by a PFMA team during a preliminary PFMA study conducted in August 2009. In May 2010, another risk cadre was assembled for the issues evaluation study (IES). Again the significant failure modes were further evaluated and examined. Additional modifications of the potential failure modes (PFMs) were developed for both Addicks and Barker Dams. The teams identified 22 and 23 PFMs for Addicks and Barker Dams, respectively. Following their more detailed examination and discussion, six PFMs at each dam were determined to be significant failure modes for both Addicks and Barker Dams. Four PFMs were identical and include:

PFM 1 – Seepage flow along or beneath the outlet works structure due to voids or low stress areas leads to headcut then backward erosion piping beneath the outlet works structure. This failure mode is possible from the recent observations conducted in 2008 and 2009 where voids were discovered beneath the conduits for both Addicks and Barker Dams.

*PFM 5 – Loss of auxiliary spillway RCC slabs and breach of auxiliary spillway at high pools. Spillway embankments for both dams were covered with roller-compacted concrete (RCC) slabs. When flows over the spillway embankments occur as pool rises to above the spillway levels, the RCC slabs can be displaced because of high uplift pressures developed beneath the RCC slabs. The spillway embankment can then be eroded until breach occurs.

PFM 21 – Hydraulic pressure in the conduit exceeds pressure outside the conduit which leads to seepage through conduits joints and erosion along conduits.

PFM 22 (Addicks), PFM 23 (Barker) – Instability of the outlet works parabolic chute slab and stilling basin retaining walls due to uplift caused by excessive seepage and/or tailwater.

For Addicks Dam, the two separate significant PFM's; PFM 4a and PFM 6, were:
*PFM 4a – Erosion of embankment toe due to flow around the north end of the dam and over the RCC auxiliary spillway results in scour of the ditch at the embankment toe leading to slope failure of the embankment.

PFM 6 – Foundation seepage and piping through soils beneath conduit or within the window beside the conduit where there is no cutoff wall as the cutoff wall rises and goes over the conduit leading to backward piping and erosion.

For Barker Dam, the two separate significant PFMs; PFM 7 and PFM 8 were:

PFM 7 – Seepage and piping in the foundation at the old Buffalo Bayou channel beneath the existing cutoff wall and exiting at the end of the stilling basin.

PFM 8 – Seepage and piping in the foundation at the end of the cutoff trench at Noble Road.

**It should be noted that the Phase I Study documented in the approved DSMR did not address the loading conditions and subsequent damages associated with PFM 4a and PFM 5. The driving factors and hydraulic conditions that could lead to large consequences tied to PFM 4a and PFM 5 will be covered in a follow on Phase II Dam Safety Modification Study.*

2.2.2. Interim Risk Reduction Measures (IRRMs).
Various Interim Risk Reduction Measures (IRRM) have been instituted at the project site. Based on the preliminary PFMA study conducted in August of 2009, an interim risk reduction measures plan (IRRMP) was developed for the Addicks and Barker Dams. The initial IRRMP consisted of the following risk reduction measures for both dams:

(1) Emergency action plan coordination with local sponsors,

(2) Install reservoir regulator alarm system for stage and rainfall reporting,
(3) Installation of outlet conduit monitoring instrumentation,
(4) Installation of emergency generators and enhanced lighting,
(5) Conduct risk communications with public,
(6) Create interim reservoir control action plan,
(7) Update emergency action plan,
(8) Fill voids under conduits Phase I,
(9) Replacing a gate at Barker Dam,
(10) Painting the gates and steel structure at both Addicks and Barker Dams
(11) Fill voids under outlet conduits Phase II,
(12) Install granular filter to control any seepage along the conduit, and
(13) Install inspection plugs along the conduit bottom and parabolic chute slab.

From the May 2010 risk analysis study and the issues evaluation study, it was concluded that additional IRRMs were advised for reducing the immediate risk for better managing the dam safety in the short term. These additional recommended IRRMs included:

(1) Revise water control manual to prevent pressurization of conduit.
(2) Fill in borrow pit near upstream toe at Noble Road.
(3) Reduce 24-hr surveillance elevation for both projects
  - Addicks
    - Extend Watch elevation 87
    - Pool of Record elevation 97.6
    - 24 hour Watch elevation 99.9
  - Barker
    - Extend Watch elevation 85
    - Pool of Record elevation 93.6
    - 24 hour Watch elevation 94.7

(4) Anchor the parabolic chute slabs at both Addicks and Barker Dams.

The critical IRRM relative to the failure modes at Addicks and Barker Dams is the filling of voids beneath the outlet works conduits and parabolic chute slab. The other IRRMs include a partial conduit filter, additional instrumentation, and increased surveillance. Anchoring of the parabolic chute slabs is planned for award in August 2013. With the voids filled beneath the outlet works conduit, Addicks and Barker Dams are returned to their condition immediately following construction and are not provided with an adequate seepage barrier and filter to prevent a recurrence of erosion beneath the outlet works conduits. The filling of voids beneath the outlet works conduits was accomplished first with polyurethane grout followed

by Portland cement grout. These actions to fill the voids were temporary measures with every expectation that internal erosion will reoccur at some time in the future due to deterioration of the gout material, and because the seepage path has only been lowered within the foundation soils to just beneath the grouted voids. These IRRMs do not address problems with the conduit joints, seepage at the old Buffalo Bayou Channel, seepage at Noble Road, or the stability issues with the parabolic chute walls and are therefore unacceptable as a long term risk management plan.

2.2.3. Addicks and Barker Dam Safety Modification Study (DSMS).
A Dam Safety Modification Study (DSMS) of the Addicks and Barker Dams was conducted in accordance with ER 1110-2-1156 dated October 28, 2011. The purpose of the study was to address the significant potential failure modes that drove the DSAC I classification, to reduce the associated risk to meet tolerable risk guidelines, and to identify what measures would need to be undertaken so that the dams would meet essential USACE guidelines. Risk reduction measures were identified and incorporated into non-structural and structural risk reduction plans. The plans were compared against the baseline condition, and then against one another to select a final risk management plan as documented in the Dam Safety Modification Report dated May 2013 and approved on June 10, 2013.

2.2.4. Environmental Assessment (EA).
In accordance with the National Environmental Policy Act of 1969, including guidelines in the 33 Code of Federal Regulations, Part 230, the Galveston District completed an environmental assessment in May 2013. The assessment evaluated the effects of the interim risk reduction measures and implementation of the dam safety modifications at Addicks and Barker Dams respectively. The EA facilitated the decision process regarding the proposed action and alternatives with a finding of no significant impact (FONSI) which was signed on July 17, 2013.

2.3. Recommended Risk Management Plan.
The recommended risk management plan for Addicks and Barker includes Structural Alternative 2, Non-Structural Plan 3, and additional efforts by local governments to reduce potential consequences.

Alternative 2 (Replace Structure and Abandon Existing Structure) consists of construction of a new outlet structure to include an intake tower, steel lined conduits, parabolic chute slab, stilling basin, cutoff wall, downstream filter, and abandoning the existing structure in place at Addicks and Barker Dams. It also includes the additional seepage cutoff element at Noble Road for the Barker Reservoir. This risk management plan was selected for recommendation from among all alternative plans that were considered, including the no action plan. The criteria for selecting Alternative 2 were based on the ranking of tolerable risk guidelines, ALARP considerations, and

essential USACE guidelines. ALARP Justification, as described in ER 1110-2-1156, is very strong due to Disproportionality Ratio of zero. Alternative 2 will consist of common construction techniques that can easily be assessed using proper quality control/assurance. This will provide for lower construction and long term operational risk. Operational and structural redundancy will be assured with the construction of a modern outlet work structure. Robust design results in no alteration or loss of functionality across the entire range of operational conditions. Alternative 2 would maintain full operability throughout construction (i.e. no requirement for care of water due to use of existing outlet works). Overall, Alternative 2 also provides the highest certainty of success in the implementation of the dam safety modification.

Non-Structural Plan 3 includes communication and coordination between USACE and local emergency management. Harris County and the City of Houston, Texas emergency warning systems are considered to be highly effective in communicating emergency information to the public. However, continued frequent communication between USACE and local emergency management coupled with daily to hourly communication during unusual and extreme events, is considered the most effective measure for reducing the loss of life during significant discharge events or failure of either Addicks or Barker Dam. The cost of implementing is included in the Operations and Maintenance costs of the recommended structural alternative plan.

It is also recommended that Harris County and the City of Houston develop plans to include identification of critical infrastructure, hospitals, nursing homes, schools, etc; evacuation locations and evacuation routes for areas subject to inundation during extreme events or breach of the Addicks or Barker Dams. The plans should be communicated and exercised with local emergency officials and the public.

It is recommended that the local floodplain managers such as the Harris County Flood Control District, Fort Bend County Drainage District, Brookshire-Katy Drainage District and other local entities ensure that any future development along Buffalo Bayou and its tributaries be regulated to avoid impacts during project operations and poor performance and not jeopardize the safety of persons downstream of the dams.

2.4. Non-Federal Sponsor.

The Addicks and Barker Dam Safety Project is a federally funded project. The Federal government is responsible for all associated costs related to actual experienced operation and maintenance (O&M) and reconstruction, rehabilitation and replacement (RR&R) costs, and dam safety program costs.

3. REVIEWS

The scope of this RP includes the plans, specifications and Design Documentation Report being developed for the Addicks and Barker Dam Safety Project. The levels of peer review required are DQC (District Quality Control), IPR (In-Progress Reviews), ATR (Agency Technical Review), Type II IEPR (also known as Safety Assurance Review (SAR)), Constructability Review (BCOES), Value Engineering (VE) study, and Policy/Legal Reviews.

DQC is an internal review process of basic science and engineering work products focused on fulfilling the project quality requirements defined in the Project Management Plan (PMP). ATR is undertaken to "ensure the quality and credibility of the government's scientific information" in accordance with EC 1165-2-209 (dated 31 Jan 2012). The Type II IEPR (SAR) is conducted to examine resiliency, robustness, and redundancy of the project and to "consider the adequacy, appropriateness, and acceptability of the design and construction activities in assuring public health, safety, and welfare."

3.1. On-Board Reviews.

On-board reviews require that the PDT and Review Team hold a review conference with all applicable PDT and Review Team members present. Reviews should be independently facilitated in order to focus both the project team and the review team(s) for the specific review. Reviews will be coordinated and scheduled between the Project Manager, Engineering Lead, and Review Team Lead. Duration and scope of the review conference should be commensurate with the scale of scope of the material being reviewed.

Review dates will be specifically identified as milestones in the Project Master Schedule. The Engineering Lead will coordinate a review package and distribute it to the Review Team Lead/Team two weeks prior to the scheduled review.

The purpose of the on-board review is to facilitate a rapid exchange of information between the PDT and the Review Team. PDT members will prepare presentations relative to their disciplines for presentation at the on-board review. Review Team members should be prepared with questions and look for resolution on outstanding issues directly from PDT members. At the conclusion of the on-board review, the Review Team Lead should ensure that formal comments are added to the Dr. Checks system for evaluation and closure. Significant comments that were resolved during the on-board review should be noted in the Final Review Report prepared by the Review Team Lead. On-board reviews for multiple required reviews such as ATR and SAR may be held concurrently in order to maximize efficiency so long as each review panel is independently led, understands its distinct review charge, and provides an independent report of findings related to its review charge.

3.2. Project Quality Evaluations

PQE's (formerly Design and Construction Evaluations) will be conducted in accord with draft ER 415-1-13 to independently ascertain quality of project execution. PQE teams will be organized by HQUSACE and assigned the task to perform reviews of selected mega-projects. The PQE teams will be multi-discipline and will evaluate procurement, engineering, construction, and project management processes for compliance with USACE policy and their effectiveness in achieving desired project outcomes. PQE teams will meet with the appropriate customer, prime contractor(s) and stakeholder(s) to obtain a 360 degree perspective of the project. For mega-projects, these PQEs will be conducted at a minimum on a twice a year basis, and are intended to provide regional and HQUSACE senior staff with a second "line of sight" for critical project decisions, and ensuring that USACE products and services are technically excellent, on schedule and within budget . PQEs will also be planned in advance of critical project milestones, such as:

- 6 months in advance of any design or construction contract award
- Semi-annually after award of any major construction contract, until substantial completion is achieved
- During the formative stages of any request for funding or schedule increase

While restoring a dam to a fully functional condition so that it can meet its intended purpose is the ultimate goal, the more fundamental premise is that any modification undertaken must first do no additional harm to a structure (thereby increasing risks of failure). The PDT should never lose sight of the unique risks that might be present during the construction period and should remain diligent in monitoring and mitigating those risks. This will be assured through frequent instrumentation reading/analysis and on-site inspections throughout construction – particularly during high water periods. This will be accomplished using a combination of design, construction and/or operations personnel. Particular care and oversight will be given to activities such as dewatering; spillway/gate/outlet works modifications; excavating; drilling; and grouting. Analysis of the instrumentation data and inspection results as it relates to the expected behavior of the dam will be done by the DSM Lead Engineer or his designated PDT representative throughout the construction period.

3.3. In-Progress Reviews (IPRs).

The Project Senior Executive will establish the format and timing and will chair IPRs. These reviews will serve as both information and decision-making forums. Meeting minutes will be provided to the Director of Civil Works after each CW mega-project IPR respectively. PQE team input, if it exists, will also be briefed at these reviews. IPRs will be conducted on a quarterly basis at a minimum or on an "As Needed" basis.

3.4. District Quality Control (DQC) Review.

All work products, reports, evaluations, and assessments shall undergo the necessary and appropriate District Quality Control/Quality Assurance (DQC). This review is managed by the home district in accordance with the Major Subordinate Command (MSC) and district Quality Management Plans. The DQC includes seamless quality checks and reviews, supervisory reviews, and Project Delivery Team (PDT) reviews. To ensure specific discipline efforts are on target with regard to compliance with policy and criteria and an acceptable level of quality, sub-products will be technically coordinated and reviewed before they are integrated into the overall project. DQC will be conducted prior to the 35%, 65%, 95% review periods for each feature. In addition, DQC will be conducted prior to ATR and BCOES reviews. QA review will be administered by the appropriate discipline section chiefs.

3.4.1. DQC and BCOES Review Products, Schedule and Cost.

The products that will undergo DQC review consists of the design documentation report (DDR), plans and specifications, and the cost estimate. The schedule and estimated cost for the DQC reviews are contained in the following table.

DQC Review Schedule		
Task (Products to be Reviewed)	**Completion Date**	**Estimated Cost**
35% Design DQC Review (DDR, P&S, Cost Estimate)	23 Sep 2013	$30,000
65% Design DQC Review (DDR, P&S, Cost Estimate)	14 Feb 2014	$30,000
95% Design DQC Review & Back Check (DDR, P&S, Cost Estimate)	5 Sep 2014	$30,000

The products that will undergo BCOES Review consist of the plans and specifications and cost estimates for the Addicks and Barker dams. The schedule and estimated cost for the BCOES reviews are contained in the following table.

BCOES Review Schedule		
Task (Products to be Reviewed)	**Date of Completion**	**Estimated Cost**
35% Design BCOES Review (P&S and Cost Estimate)	23 Sep 2013	$60,000
65% Design BCOES Review (P&S and Cost Estimate)	7 Apr 2014	$60,000
95% Design BCOES Review, Back Check & Certification (P&S and Cost Estimate)	3 Dec 2014	$60,000

3.5. Agency Technical Review

According to EC 1165-2-214, Agency Technical Review (ATR) is mandatory for all decision and implementation documents and is undertaken to "ensure the quality and credibility of the government's scientific information." Plans and specifications are implementation documents; therefore ATR is required for this project. Consistency checks between planning, environmental and engineering concerns/documents will be included in all reviews by the ATR and will be a responsibility of the review members. The ATR will examine relevant DQC records and provide written comment on the adequacy of the DQC effort. The ATR is also responsible for conducting a Constructability Evaluation (CE) to ensure dam safety risks are adequately addressed by the designs and all construction-related risks are fully identified and mitigated to an acceptable level.

CE is an ATR process. The CE process will utilize ATR members often from outside the geographic district. A CE will be performed at the 65% design during PED. CE reviews the risks posed by construction alternatives. CE can provide input into other efforts to include the VE process and Engineering Considerations and Instructions to Field Personnel (ECIFP). To ensure dam safety risks are adequately addressed by the designs and that all construction-related risks are fully identified and mitigated to an acceptable level, the ATR team will evaluate the constructability, the schedule, and the cost estimate at the 65 percent design during PED. A construction risk assessment involving event tree preparation and risk estimation may be required if potential failure modes introduced by construction activities are perceived to introduce significant risk. If a construction risk assessment is required, it would be performed as a part of the constructability evaluation. The DSM Lead Engineer/PDT may need to brief the ATR team on the potential failure modes mitigated by construction and on potential failure modes that may be present during construction activities. The following constructability issues should be evaluated and discussed, if applicable, by the ATR:

- Borrow, staging, and processing area locations, sizes, ownerships, and accesses
- Borrow, staging, and processing areas with respect to flooding
- Borrow materials characteristics in relation to processing requirements
- In situ moisture conditions
- Dewatering and care of water requirements
- Foundation characteristics in relation to excavation and drilling operations
- Waste and stockpile issues
- Zoning
- Protection of work from flooding and inundation from reservoir
- Reservoir operations/restrictions during construction
- Specialized Quality Control/Quality Assurance requirements

- Instrumentation monitoring and associated restrictions on Construction
- Reservoir operations and associated construction constraints
- Availability of equipment and materials, delivery times, and their sources
- User deliveries and special needs
- Climatic effects on construction schedules
- Available right of way
- Expected acquisition times
- Road relocations
- Material utilization

3.5.1. ATR Products, Schedule and Cost.

The ATR teams will review the VE Study Report, DDR, plans and specifications and cost estimates, for the Addicks and Barker Dams. The schedule and estimated cost for the ATR reviews are contained in the following table.

ATR Review Schedule		
Task (Products to be Reviewed)	**Date of Completion**	**Estimated Cost**
35% Design ATR (VE Study Report, DDR, P&S, Cost Estimate)	12 Nov 2013	$80,000
65% Design ATR (DDR, P&S, Cost Estimate)	11 Apr 2014	$80,000
95% Design ATR, Back Check & Certification (DDR, P&S, Cost Estimate)	3 Dec 2014	$80,000
ATR Midpoint Construction Site Visit	Oct 2016	$80,000
ATR Prior to Final Inspection Site Visit	Mar 2018	$80,000
ATR Risk Reduction - Post Construction Site Visit	Sep 2018	$80,000

3.6 Type II Independent External Peer Review.

EC 1165-2-214 requires that a Type II IEPR (also known as a Safety Assurance Review (SAR)) shall be conducted on design and construction activities for any project where potential hazards pose a significant threat to human life (public safety). The SAR team is an independent external panel that conducts reviews at various work phases, and is to be reviewed by the Review Management Organization (RMO), which is currently the Risk Management Center (RMC), and the final approval authority is the SWD Commander. The SAR shall consider the adequacy, appropriateness, and acceptability of the design and construction activities in assuring public health, safety, and welfare.

Factors to consider for conducting a Type II IEPR of a project or components of a project are:

1. The project involves the use of innovative materials or techniques where the engineering is based on novel methods, presents complex challenges for interpretations, contains precedent-setting methods or models, or presents conclusions that are likely to change prevailing practices.
2. The project design requires redundancy, resiliency, and robustness.
3. Redundancy is the duplication of critical components of a system with the intention of increasing reliability of the system, usually in the case of a backup or failsafe.
4. Resiliency is the ability to avoid, minimize, withstand, and recover from the effects of adversity, whether natural or manmade, under all circumstances of use.
5. Robustness is the ability of a system to continue to operate correctly across a wide range of operational conditions (the wider the range of conditions, the more robust the system), with minimal damage, alteration or loss of functionality, and to fail gracefully outside of that range.
6. The project has unique construction sequencing or a reduced or overlapping design construction schedule; for example, significant project features accomplished using the Design-Build or Early Contractor Involvement (ECI) delivery systems.

The Galveston District Chief of Engineering and Construction, and Director of the Dam Safety Production Center are responsible for coordinating with the RMO, attending SAR review panel meetings, communicating with the agency or contractor that is selecting panel members, and for coordinating the approval of the final report with the MSC Chief of Business Technical Division.

After receiving the report from the peer review panel, the District Chief of Engineering and Construction, and Director of the Dam Safety Production Center, with full coordination with the Chiefs of Construction and Operations, shall consider all comments contained in the report and prepare a written response for all comments and note concurrence and subsequent action or non-concurrence with an explanation. The panel's report and the District's/DSPC responses shall be submitted to the MSC for final MSC Commander's approval. The report and responses will be made available to the public on the District's website.

A SAR will be conducted for all the features that are associated with Life Safety. The SAR panel will review the 95% DDR, plans and specifications and cost estimate; conduct a review of the 100% plans and specifications and conduct site visits at the midpoint of construction and prior to final inspection and review the as-built plans and completion report and conduct a post construction site visit. If any critical design or construction decisions occur, the most recent activities with assumptions and preliminary conclusions will be presented to the SAR for review and comment. These reviews will be conducted as "on-board" reviews. Reviews shall be

cumulative with each subsequent review focusing on the new information presented rather than a complete review of the project.

3.6.1. Type II IEPR (SAR) Products, Schedule and Cost.

The Type II IEPR (SAR) team will review the DDR, plans and specifications, cost estimate, as-built drawings and completion report and conduct construction site visits for the Addicks and Barker Dams. The schedule and estimated cost for the Type II IEPR (SAR) reviews are contained in the following table.

Type II IEPR (SAR) Schedule		
Task (Products to be Reviewed)	**Completion Date**	**Estimated Costs**
95% Design Type II IEPR (SAR) (DDR, P&S, Cost Estimate)	4 Nov 2014	$190,000
Type II IEPR (SAR) Midpoint Construction Site Visit & 100% P&S Review	Oct 2016	$50,000
Type II IEPR (SAR) Prior to Final Inspection Site Visit	Mar 2018	$50,000
Type II IEPR (SAR) Risk Reduction - Post Construction Site Visit & As-built Drawings and Completion Report Review	Sep 2018	$50,000

3.7. Policy Compliance and Legal Review

The Addicks and Barker Dam Safety Modification Project plans and specifications will be reviewed for compliance with law and policy by the Corps legal team.

3.8 Quality Assurance

Dams with safety deficiencies have a high potential for loss of life, a risk of significant property damage, potential significant costs to the Government, and negative political impacts. Therefore, the Addicks and Barker dam safety project is considered of such critical nature that, to the extent practicable, quality assurance shall be performed directly by USACE forces. This includes, but is not limited to, performing inspection of all contract-related construction operations, materials testing, equipment factory inspection, survey control, and foundation testing. Inspection or testing by private consultants should be utilized only in situations where it is impractical for USACE to perform the inspection or testing, or the work is of such a specialized nature that USACE is not capable of performing it. Use of third parties to provide quality assurance should be limited to noncritical items/features. All quality assurance processes shall be in accordance with ER 1180-1-6.

Engineering representatives from RMC, DSMMCX, and MSC office are an integral part of the vertical team and thus should be continually advised of construction progress in order to permit

participation by personnel from those offices in field inspections at critical construction stages in accordance with the requirements of ER 1110-2-112. This involvement, along with Project Quality Evaluation inspections, is a vital part of the QA role associated with MSC/HQ on dam safety modification projects. This includes their participation in the latter stages of construction (prior to final acceptance). This shall be accomplished through a regular project update prepared by the Project Manager and distributed to the entire vertical/horizontal team. This project update shall include updates on construction progress to include charts, photographs, graphs that depict current status, progress for the current month, issues (both funding and technical), and a 30 to 90 day look-ahead. Summaries of field tests, trials, and status of IRRM shall be included. The frequency of the project update will be agreed upon at the time of initiation of construction.

3.9. Value Engineering.

Value engineering (VE) studies will be conducted on the project as required by ER 11-1-321. The VE studies will be completed for the 35% Design as shown in the table below.

VE Study Schedule		
Task	**Completion Date**	**Estimated Costs**
VE Study of 35% Design	26 Nov 2013	$200,000

4. Review Teams

4.1. Project Management and Project Delivery Teams (PDT).

The Project Management Team is provided in Appendix A. The Project Delivery Team is provided in Appendix B. The PDT lead engineer, in consultation with the project manager and design leads, is ultimately responsible for any engineering/design scopes of work. The planning coordinator, in consultation with the project manager, will be responsible for any planning scopes of work.

4.2. Peer and Seamless Reviews

During project development, seamless review by the ATR is encouraged for all aspects of the project. The PDT members will initiate seamless reviews at appropriate times in order to reach a common understanding with their ATR counterparts, thereby minimizing significant comments/impacts during final ATR. Although several of the technical disciplines working on the Addicks and Barker Dam Safety Modification Project are assigned to other projects, the Section Chiefs representing each of the technical disciplines will provide in-progress design checks, advice, and supervisory review (as well as Quality Assurance) of the products.

4.3. Agency Technical Review.

The Agency Technical Review (ATR) team members are listed in Appendix C. Engineering Circular 1165-2-214 states, "ATR teams will be comprised of senior USACE personnel, preferably recognized subject matter experts with the appropriate technical expertise such as regional technical specialists, and may be supplemented by outside experts as appropriate. ATR will be conducted by a qualified team outside of the home district that is not involved in the day-to-day production of a project/product." Therefore, the ATR will be coordinated outside the Galveston District. ATR members will be selected from outside the Galveston District and will represent disciplines that have a major part in the design of the project features. DrChecks will be used for managing and documenting the ATR comments, evaluations, and back checks as well as the resolution of controversial comments, if any.

4.3.1. Review Team Members.

The ATR reviewers must have a minimum of ten years of experience in the discipline, have a professional license or equivalent qualifying experience, and not be involved in the design or supervision of the project. For the disciplines that play a crucial part in the project, Subject Matter Experts (SMEs) are preferred for filling the ATR roster. The following disciplines will be represented on the ATR: geotechnical, geology, concrete materials, civil, hydraulic, structural, construction, mechanical, electrical and cost engineering. The ATR roster is provided in Appendix C and will be updated, if necessary, to reflect any changes.

1. Geotechnical or geological engineering specialist(s) will possess a minimum 15 years of experience in design, inspection and construction of dam projects. The member(s) shall be registered Professional Engineers (PE) and preferably a registered Geotechnical Engineers (GE), or equivalent qualifying experience, with a minimum of 2 completed dam projects.
2. Civil/construction engineer(s) with significant experience with civil works construction quality assurance and control with a minimum 10 years of experience in flood control projects, including dams. The member(s) shall have significant experience in the construction and/or remediation of dams. The member shall be a registered Professional Engineer (PE) or equivalent qualifying experience.
3. Hydraulic engineering specialist(s) with a minimum 10 years of experience in designing spillways and hydraulic structures for flood control projects on major river systems. The member(s) shall be a registered Professional Engineer (PE) or equivalent qualifying experience.
4. Structural engineering and concrete materials specialist(s) with a minimum 15 years of experience in complex and hydraulic structures, including dynamic modeling and evaluating and developing materials for heavy civil projects, with a minimum of 3

completed dam projects. The member(s) shall be a registered Professional Engineer (PE) or equivalent qualifying experience.

5. Mechanical/Electrical engineer(s) with a minimum 10 years experience in designing gates and controls for flood control projects, including dams. The member(s) shall be a registered Professional Engineer (PE) or equivalent qualifying experience.
6. Cost Engineering specialist(s) with 10 years experience in an appropriate field. The position should be accustom to estimating complex, phased costing of multi-year civil construction projects and using the MII cost estimating software used by USACE. The member should have direct experience estimating hydraulic retention structures. The member(s) shall be a registered Professional Engineer (PE) or equivalent qualifying experience.

4.3.2. Review Team Leader.

1. The ATR team leader is responsible for assembling the team – which will be exclusive of SWG and may include AE contractors for specific disciplines or tasks, as necessary – as well as coordinating all activities of the review. The review team leader will communicate with the ATR team members to make sure they know their responsibilities and objectives.
2. The ATR team leader will monitor the products and ATR comments, the PDT responses, and the reviewer's back-check of responses. The ATR team leader will eliminate any conflicting comments and will consolidate similar or related comments. In the event of a disagreement on a comment or issue that cannot be resolved between the reviewer and the designer, the ATR team leader and the PDT design lead will review the situation and determine the fate of the comment.
3. The ATR Team Leader will prepare the ATR report for each phase of review and submit it to the PM, Technical Lead, and Review Management Organization (RMO) for approval and inclusion in the official record. A current template for the ATR Report can be obtained from the RMO.
4. The ATR Team Leader will participate in bi-weekly PDT meetings via conference call or in person in order to stay current on project status and challenges and better ensure seamless review of the project.
5. The ATR Team is provided in Appendix C.

4.4. Type II Independent External Peer Review Team.

The Type II IEPR (SAR) Team will be established, in consultation with the RMC, through one of the four Type II IEPR IDIQ contracts maintained by the Louisville District.

The appropriateness, in composition and scope, of the Type II IEPR ultimately falls under the Review Management Organization (RMO). The review team will be selected based on their

technical qualifications and experience. Once the team is selected Appendix D will be updated to include the names of the SAR team.

The Lead Engineer will coordinate the input of all the SAR team member's comments into Dr. Checks after the review conference.

The SAR team shall be composed of licensed engineers with experience in dam design and large construction projects. The members will represent the following disciplines (at a minimum). The final make-up, in size and composition, will be established by the contractor.

1. Geotechnical or geological engineering specialist(s) will possess a minimum 15 years of experience in design, inspection and construction of levee or dam projects. The member(s) shall be registered Professional Engineers (PE) and preferably a registered Geotechnical Engineers (GE), or equivalent qualifying experience, with a minimum of 3 completed dam projects.
2. Civil/construction engineer(s) with significant experience with civil works construction quality assurance and control with a minimum 15 years of experience in flood control projects, including dams or levees. The member(s) shall have significant experience in the construction and/or remediation of dams. The member shall be a registered Professional Engineer (PE) or equivalent qualifying experience.
3. Hydraulic engineering specialist(s) with a minimum 10 years of experience in hydraulic and hydrological modeling for flood control projects on major river systems. The member(s) shall be a registered Professional Engineer (PE) or equivalent qualifying experience.
4. Structural engineering and concrete specialist(s) with a minimum 15 years of experience in complex and hydraulic structures, including dynamic modeling and evaluating and developing materials for heavy civil projects, with a minimum of 3 completed dam projects. The member(s) shall be a registered Professional Engineer (PE) or equivalent qualifying experience.
5. Mechanical/Electrical engineer(s) with a minimum 10 years experience in designing gates and controls for flood control projects, including dams. The member(s) shall be a registered Professional Engineer (PE) or equivalent qualifying experience.

4.5. District Quality Control and BCOES Review Teams.

The District Quality Control (DQC) Team is provided in Appendix E and the BCOES Team is provided in Appendix F. The BCOES review team is an independent review to minimize potential change orders and schedule delays during construction by improving the constructability, biddability and efficiency of the proposed construction. These reviews focus on

large strategic issues to affect a more efficient construction process and shorter construction duration.

4.6. Vertical Review Team

The Vertical Review Team consists of the RMC, Regional Integration Team (RIT) at HQUSACE and the District Support Team at SWD. The vertical team supports, schedules, and conducts PQE (formerly DCE) and IPRs. A list of the team members is attached as Appendix G.

5.0. PUBLIC COMMENT.

To ensure that the peer review approach is responsive to the wide array of stakeholders and customers, both within and outside the Federal Government, this Review Plan will be published on the district's public internet site following approval by SWD at http://www.swg.usace.army.mil/. The opportunity for public comment remains open as there is no formal comment period and no set closure date at this time. If and when comments are received, the PDT will consider them and decide if revisions to the review plan are necessary. The public is invited to review and submit comments on the plan as described on the web site.

6.0. REVIEW DOCUMENTATION.

The work products will be reviewed using an interdisciplinary team approach. The products will be reviewed for scope and adequate level of detail; compliance with guidelines, policy, and customer needs; and consistency, accuracy, and comprehensiveness. Review comments will be identified with author and affiliation, and are expected to be constructive and relevant to the product. Review comments will contain the following elements: (a) a clear statement of the concern, (b) the basis for the concern, (c) the significance of the concern, and (d) the specific actions needed to resolve the concern. Reviewers must identify any significant deficiency; however, comments should be limited to those required to ensure adequacy of the product in meeting the stated objectives. Typographic errors and other minor stylistic changes should not be part of the formal technical review comments. Such comments will be provided separately to the PDT for their use and to the ATR team leader. A partial checklist for reviewers to consider is as follows:

1) Constructability versus actual site conditions;
2) Maintainability by USACE;
3) Accuracy and reasonableness test of computations;
4) Compliance with governing policies, criteria, and project requirements;
5) Seamless review (discussions and agreements with PDT counterparts); and
6) Product review comment/response/actions taken are documented in DrChecks.

6.1. Comment Resolution.

Review comments do not necessarily have to be complied with, but each comment must be addressed and resolved. If a PDT member disagrees with a comment, the PDT member will try to resolve the comment through discussions with the Review team member. The Review team leader will help facilitate those discussions as needed. When this does not result in resolution, the issue will be elevated through the PDT member's chain of command as necessary. If this level of interaction does not resolve the issue, the responsible Functional Chief will make the final decision. The Functional Chief may consult with the Branch Chief, SWD (Corps of Engineers Southwestern Division) staff, SMEs, or other appropriate sources. Resolution of disputes will be documented in DrChecks as appropriate.

6.2. Technical and Policy Issue Resolution.

Issues involving technical and policy interpretation shall be brought to the attention of the Chief of the functional element for resolution. In some cases the Chief of the responsible functional element may request that CESWD hold an issue resolution conference to resolve major policy or technical issues. CESWD may also arrange for HQUSACE participation in the issue resolution conference.

6.3. Certification.

6.3.1. DQC Certification.

For final products, a certification will be signed stating that issues raised by the DQC team have been resolved. The DQC certification will be signed by the AE, Architect Engineer Contractor (if appropriate), PDT Discipline Lead, DQC Reviewer Lead and SWD DSPC Lead Engineer. Standard Corps certification forms will be used.

6.3.2. ATR Certification.

For final products, a certification will be signed stating that issues raised by the ATR team have been resolved. The ATR certification will be signed by: the ATR team leader, the Project Manager (PDT Leader), the Review Management Office Representative (Risk Management Center) and the District Dam Safety Officer. A sample ATR Certification is provided in Appendix H.

6.3.3. IEPR/SAR Certification.

The review team will prepare a review report. All review panel comments shall be entered as team comments that represent the group and be non-attributable to individuals. All comments in the report will be finalized by the panel prior to their release to USACE for each review plan milestone. After receiving a report on a project from the review team, the Galveston District Chief of Engineering and Construction, with full coordination with the Chief of Operations, shall

consider all comments contained in the report and prepare a written response for all comments and note concurrence and subsequent action or non-concurrence with an explanation. The Galveston District Chief of Engineering and Construction shall submit the panel's report and the Galveston District's responses to the SWD Chief of Business Technical Division for final review and concurrence. The final report is then presented to the SWD Commander for approval. After approval by the SWD Commander, the report and responses shall be made available to the public on the Galveston District's website.

6.3.4. VE Certification.

In order to ensure compliance with applicable statutory requirements a statement that appropriate VE actions have been completed shall accompany the BCOES Certification. The statement shall be signed by the PM and the VE Officer and read as follows:

"I, (the PM), certify that the Value Engineering process as required by ER 11-1-321, Army Programs Value Engineering has been completed for this procurement action. I certify compliance with Public Law 99-662 (3 3 USC 2288) and OMB Circular A -131. A VE study was completed on (date) by the appropriate authority. All rejected VE proposals indicating potential savings of over $1,000,000 have been resolved with approval of the MSC Commander."

6.3.5. BCOES Certification.

Sample BCOES Certification as per ER 415-1-11 is included as Appendix I.

7.0. SCHEDULE AND COSTS.

7.1. Scheduled Review Periods and Costs.

The DQC, BCOES, ATR and SAR teams will review the plans, specifications, cost estimate and DDR for the Addicks and Barker Dams. Major design review milestones, the tentative associated schedule, and estimated costs, are listed in the following table. Funds have been budgeted for DQC, BCOES, ATR and SAR review activities as outlined below.

Task	Completion Date	Cost
35% Design		
DQC Review	23 Sep 2013	$30,000
BCOES Review	23 Sep 2013	$60,000
ATR Review	12 Nov 2013	$80,000
VE Study	26 Nov 2013	$200,000
65% Design		
DQC Review	14 Feb 2014	$30,000
BCOES Review	7 Apr 2014	$60,000
ATR Review	11 Apr 2014	$80,000
95% Design		
DQC Review	5 Sep 2014	$30,000
BCOES Review	3 Dec 2014	$60,000
ATR Review	3 Dec 2014	$80,000
SAR Review	4 Nov 2014	$190,000
Midpoint of Construction		
ATR Review	Oct 2016	$80,000
SAR Review	Oct 2016	$50,000
Prior to Final Inspection		
ATR Review	Mar 2018	$80,000
SAR Review	Mar 2018	$50,000
Risk Reduction (Post Construction)		
ATR Review	Sep 2018	$80,000
SAR Review	Sep 2018	$50,000

7.2. Constraints on the Process.

The schedule is ambitious however achievable. Means for tracking progress and enhancing communication, coordination, and documentation are in place for the project. If unforeseeable

events occur that are significant enough to jeopardize meeting schedules, this review plan will be amended in accordance with the Change Management plan outlined in the PMP.

8.0. POINTS OF CONTACT.

9.0. REVIEW PLAN APPROVAL.

The Galveston District requests that the Risk Management Center (RMC) endorse the above recommendations described in this Review Plan and as described in Appendix B of EC 1165-2-214. The approval from the Southwestern Division is also requested once the RMC endorsement is received.

10. POST CONSTRUCTION PHASE

Many important lessons, both positive and negative can be learned from dam safety projects. Near the end of construction (or as each phase of work is completed), the PDT (including all vertical and horizontal members) shall assemble and conduct a brainstorming session in order to capture lessons learned from both the design and construction phases of the project. The DSM Lead Engineer and Resident Engineer shall ensure these lessons learned are officially entered into DrChecks, the Dam Safety CoP site on the Technical Excellence Network (TEN), or another accepted forum. These lessons should then be built into the official design/construction checklists (typically part of a Design Quality Management Plan) so that future projects can reap the benefits. The district shall organize and facilitate such brainstorming sessions. Typical subjects of discussion can be found in ER 1110-2-1156, Chapter 22, Section 22.4.1.

As required in ER 1110-1-1901, the Project Geotechnical and Concrete Materials Completion Report for Major USACE Projects, requires documentation of the as-constructed geologic,

geotechnical and concrete materials aspects of all major, complex and unique engineered projects constructed by USACE, including all subsequent modifications. It is imperative that the report be all encompassing and records the geologic conditions encountered, solutions of problems, methods used, and experiences gained. It is imperative that data such as observations, notes, and photographs be collected and maintained during construction, describing procedures, conditions encountered, and the results of each major operation. This is particularly important for features representing departures from the anticipated conditions. This report shall be identified, scheduled, and resourced in the Project Management Plan (PMP). The information and data in this document shall be presented and discussed with the Reservoir Manager and his staff. The report provides significant information potentially needed by the USACE technical staff, and other team members to become familiar with the project. The report shall facilitate accurate, timely inspections and performance assessments, and serve as the basis for developing and implementing appropriate and effective modifications, and emergency and/or remedial actions to prevent flood damage, or required as a result of unanticipated conditions or unsatisfactory performance. The report will be written by a qualified USACE professional engineer or engineering geologist that was involved with the construction or modification of the dam.

A Post Implementation Risk Assessment is required once construction is complete. A team from the District and RMC will review and update the DSM study risk assessment after implementation of the risk management remedial measures are in place. The dam will be evaluated to determine if the risk management objectives were achieved.

Appendix A
Project Management Team

Appendix B
Project Delivery Team
(PDT)

Appendix C
Agency Technical Review (ATR) Team

Appendix D
Safety Assurance Review (SAR) Team

Appendix E
DQC Review Team

Appendix F
BCOES Review Team

Appendix G
Vertical Team

Appendix H
ATR Certification

ATR Certification Template

COMPLETION OF AGENCY TECHNICAL REVIEW

The Agency Technical Review (ATR) has been completed for the Dam Safety Modification Project for Addicks & Barker Dams, Houston, Texas. The ATR was conducted as defined in the project's Review Plan to comply with the requirements of EC 1165-2-209. 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].

_____ _____

ATR Team Leader Date

_____ _____

Project Manager Date

_____ _____

Lead Engineer Date

_____ _____

Director, Risk Management Center Date

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.

_____ _____

Date

Dam Safety Officer
US Army Engineer District, Galveston

Appendix I
BCOES Certification

Sample BCOES Certification

Name of Project/Project Number: _____/_____

Phase or Type of Project: _____

Certification Date: _____

"I, (the PM), certify that the Value Engineering process as required by ER 11-1-321, Army Programs Value Engineering has been completed for this procurement action. I certify compliance with Public Law 99-662 (3 3 USC 2288) and OMB Circular A -131. A VE study was completed on (date) by the appropriate authority. All rejected VE proposals indicating potential savings of over $1,000,000 have been resolved with approval of the MSC Commander."

_____ _____

Assigned Project Manager (dd/mm/yr) Value Engineering Officer (dd/mm/yr)

The Bid or RFP Package has been reviewed for Biddability, Constructability, Operability, Environmental, and Sustainability (BCOES) requirements in accord with ER 415-1-11. The undersigned certify that all appropriate BCOES review comments have either been incorporated into the Bid or RFP Package or otherwise satisfactorily resolved. Comments, evaluations, and backchecks are documented in DrChecks.

_____ _____

Chief, Engineering (dd/mm/yr) Chief, Construction (dd/mm/yr)

_____ _____

Chief, Planning (when appropriate) Chief, Operations (when appropriate)

_____

Chief, Real Estate (when appropriate)