MEMORANDUM FOR Commander, U.S. Army Corps of Engineers, Huntington District, 502 Eighth Street, Huntington, WV 25701-2070

SUBJECT: Review Plan for Bluestone Dam, Dam Safety Assurance (DSA)-Phase 5, Summers County, West Virginia – Great Lakes and Ohio River Division Commander (LRD) Approval

1. References:


2. The Risk Management Center (RMC) has reviewed the Review Plan (RP) for Bluestone DSA-Phase 5, dated August 2019, and concurs that this RP complies with the current peer review policy requirements outlined in EC 1165-2-217, Review Policy For Civil Works, 20 February 2018; and EC 1165-2-214, Review Policy For Civil Works, dated 15 December 2012.

3. I concur with the recommendations of the RMC and approve the enclosed RP for the subject Bluestone DSA which is located approximately one and a half miles upstream of the City of Hinton and a half mile upstream of the confluence of the New and Greenbrier Rivers. Bluestone Dam is located in southern West Virginia in Summers County within the New River Basin, which is a sub-basin of the Kanawha River Basin.

4. The District is authorized to post Review Plan on the Huntington District public website.

4. The point of contact for the MSC’s approval is Roscoe Bright; he can be reached at 513-684-3159 or at roscoe.c.bright@usace.army.mil.

Encl

STEPHEN G. DURRETT, P.E., SES
Regional Programs Director
Project Management Plan

APPENDIX 13 – Review Plan

BLUESTONE DAM

DAM SAFETY ASSURANCE (DSA) – PHASE 5
Bluestone Dam Safety Assurance Project (Dam NID: WV08902)  
Implementation Documents for Phases 4 and 5

Huntington District  
Great Lakes & Ohio River Division

PREPARED BY:

Digitally signed by
SMITH.AARON.OLIVER.1377053547
2019.09.06 07:35:29 -04'00'

Aaron Smith  
Huntington District  
Project Manager

ENDORSED BY:

Digitally signed by
CARLSON.DAVID.ERIC.1228954302
2019.09.06 08:02:36 -04'00'

David E. Carlson, P.E  
Chief, Eastern Division  
USACE, Risk Management Center

APPROVED BY:

Digitally signed by
JOS_MEV_112708
2019.09.06 07:52:26 -04'00'

Joseph M. Savage, P.E., PMP  
Regional Business Director  
USACE, Great Lakes and Ohio River Division

MSC Approval Date: TBD  
(Original Approval Date – February 2011)  
Last Revision Date: August 2019

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1. INTRODUCTION

The Bluestone Dam, Dam Safety Assurance (DSA) Project began in 1998 following completion of a Dam Safety Assurance report which identified a hydrologic deficiency. The DSA project has since been designated as a USACE Mega Project and will comply with established tenets according to Engineering and Construction Bulletin (ECB) 2014-14, issued 4 June 2014 as updated by ECB 2016-16, dated 26 May 2016. The Mega Project management controls require a governance structure to review progress, facilitate issue resolution, and generally improve integrated accountability and follow-through at all levels, from District offices to Major Subordinate Command (MSC) Project Executives to the Director of Civil Works. Mega Project management controls, periodic reporting, and Design-Construction Evaluation (DCE) Reviews will apply to the Bluestone Dam Safety Assurance Project. In 2018, $574,000 in Emergency Supplemental Funds appropriated by Public Law 115-123 were allocated to the DSA Project. In accordance with DPM CW 2018-19, the DSA project has taken the appropriate risk on project execution to realize this unprecedented opportunity to reduce life safety hazard and realize full benefits of the project much earlier than planned. The following update to an existing Review Plan is meant to capture efforts to re-plan project execution given receipt of near full funding.

2. PURPOSE AND REQUIREMENTS

a. Purpose. This Review Plan defines the scope and level of peer review associated with the implementation documents being prepared for the Dam Safety Assurance (DSA) Project at Bluestone Dam, which is located in Hinton, West Virginia. This Review Plan outlines the peer review requirement for the design and implementation of features approved by the Dam Safety Assurance (DSA) Evaluation Report completed in 1998 as well as features approved by the Supplemental Dam Safety Modification Report (SDSMR) approved in 2017. Given Phases 1, 2A, 2B, and 3 associated with the DSA Evaluation Report have been completed and Phase 4 is under construction, this Review Plan only addresses construction from FY 18 through completion of Phase 5. A detailed explanation of construction phases is contained in Section 3 of this Review Plan. In addition, there are associated documents, such as updates to the Bluestone Dam DSA Total Project Cost (TPC), Water Control Manual, as well as National Environmental Policy Act (NEPA) documents, which are also covered with this review plan.

b. References
   (1) EC 1165-2-217, Review Policy For Civil Works, 20 February 2018
   (2) ER 1110-1-12, Quality Management, 31 Mar 2011
   (3) ER 415-1-11, Biddability, Constructability, Operability, Environmental and Sustainability (BCOES) Reviews, 1 January, 2013
   (4) EC 1105-2-412, Assuring Quality of Planning Models, 31 Mar 2011
   (5) Engineering Regulation (ER) 1110-1-12, Quality Management, 30 Sep 2006
   (6) ER 1105-2-100, Planning Guidance Notebook, Appendix H, Policy Compliance Review and Approval of Decision Documents, Amendment #1, 20 Nov 2007
   (7) ER 1110-2-1150, Engineering and Design for Civil Works Projects, 31 August 1999
c. Requirements. This review plan was developed in accordance with EC 1165-2-217, which establishes an accountable, comprehensive, life-cycle review strategy for Civil Works products by providing a seamless process for review of all Civil Works projects from initial planning through design, construction, and operation, maintenance, repair, replacement and rehabilitation (OMRR&R). The EC outlines four general levels of review: District Quality Control/Quality Assurance (DQC), Agency Technical Review (ATR), Independent External Peer Review (IEPR), and Policy and Legal Compliance Review. In addition to these levels of review, decision documents are subject to cost engineering review and certification (per EC 1165-2-217), planning model certification/approval (per EC 1105-2-412), and Senior Oversight Group (SOG) review (per ER 1110-2-1156). Also covered are Biddable, Constructible, Operable, Environmental Compliance and Sustainable (BCOES) review and Real Estate certification prior to issuing requests for proposals (RFPs) or invitations for bid (IFBs) as well as required reviews by a Major Subordinate Command (MSC) and/or USACE Headquarters (USACEHQ).

3. REVIEW MANAGEMENT ORGANIZATION

The USACE Risk Management Center (RMC) is the Review Management Organization (RMO) for this project. Contents of this review plan have been coordinated with the RMC and the Great Lakes and Ohio River Division (LRD), the Major Subordinate Command (MSC). 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. Huntington District will assist the RMC with management of the ATR and IEPR reviews and development of the draft ATR and IEPR “charges.”

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

4. PROJECT BACKGROUND AND INFORMATION

Implementation documents covered within this Review Plan include Design Documentation Reports and plans and specifications for Phase 5 as well as other construction contracts for recreation and aquatic mitigation and other similar commitments. A Design Documentation Report (DDR) provides the technical basis for the plans and specifications and serves as a summary of the final design. According to ER 1110-2-1150, the approval level for a DDR is at the District Command. While DDRs are prepared in support of plans and specifications, this type of document cannot be completely finalized until plans and specifications and construction are completed.

In addition, updates to the Water Control Manual are also covered by this Review Plan. These
updates must be approved by the MSC. However, as these updates have life-safety implications they will also be subject to ATR, public review and review by the Dam Safety community of practice.

Additional National Environmental Policy Act (NEPA) compliance documentation is required for certain features being implemented under the 2017 SDSMR, as described in a 2017 Supplemental Environmental Impact Statement (SDEIS) and Record of Decision (ROD).

a. Project Description.

BACKGROUND: Bluestone Dam is located in southern West Virginia in Summers County within the New River Basin, which is a sub-basin of the Kanawha River Basin. Bluestone Dam is located approximately one and a half miles upstream of the City of Hinton and a half mile upstream of the confluence of the New and Greenbrier Rivers. The project began operations in 1949 and controls an approximate 4,600 square mile drainage area upstream of the dam (Figure 1).

Bluestone Dam and reservoir was authorized by Executive Order 7183 in September 1935 and the Flood Control Acts of 1936 and 1938 for the purposes of flood control and power development. The stated purposes were later expanded under the Flood Control Act of 1944 to include recreation activities and under the Fish and Wildlife Coordination Act of 1958 to include fish and wildlife enhancement. Section 102(ff) of the Water Resource Development Act (WRDA) of 1992, as amended by Section 357 of WRDA 1996, further modified the original project authorization to address the accumulation and disposal of drift and debris at the project.

Bluestone Dam (Figure 2) was originally constructed at full Federal expense and was started in January 1942 and continued until March 1944. The War Production Board stopped the project construction for the duration of World War II. The project resumed construction in 1946 and was completed in December 1948. While the original authorization for Bluestone Dam provided for hydropower development, extensive electric power development during wartime resulted in a decision to defer hydropower development at the project and use all available storage for flood control. This lowered the elevation of the lake 80 feet from 1490 to 1410. Section 547 of Public Law 106-541 provides TriCities Power Authority with exclusive rights to develop hydropower at Bluestone Dam. Interest in developing a non-federal hydropower plant at Bluestone has been put on hold pending the completion of the DSA project designed to address significant life-safety risks.
Bluestone Dam is a straight, concrete gravity structure with an overall length of 2,060 feet and a maximum height of 165 feet above the streambed. Discharge capacity of the existing structure consists of gated sluices and a gated auxiliary spillway. The spillway section is 790 feet long and includes 21 bays with vertical lift gates. The total design discharge capacity of the dam is 430,000 cubic feet/second (cfs). Operation of the reservoir is by 16 gated sluices with a total
discharge capacity of 72,000 cfs (at pool elevation 1520.5 with no spillway crest flow).

1998 Dam Safety Assurance Project: During the planning of Bluestone Dam, a design flood was created by shifting the center of the hurricane storm of July 1916 to the New River drainage basin. This flood, the Spillway Design Flood, had an estimated peak inflow of 430,000 cfs. Since the completion of Bluestone Dam, the National Weather Service (NWS) has developed estimates of Probable Maximum Precipitation applicable to the New River Basin. Precipitation estimates were coupled with detailed terrain, soil, and runoff data and other information to develop a new design flood. The resultant flood – the Probable Maximum Flood (PMF) – has an estimated peak inflow of 1,086,000 cfs, which is more than double the peak of the original design inflow. In order to address this hydrologic deficiency, a Dam Safety Assurance (DSA) Evaluation Report and Environmental Impact Statement (EIS) was prepared and later approved in 1998.

The plan approved under the 1998 decision document is currently under construction. This plan modifies Bluestone Dam to safely pass the estimate peak inflow discussed above. Features of the approved plan include: modification of the six hydropower penstocks to supplement the discharge capacity; parapet wall on top of the dam; an additional gravity monolith on the east abutment; a floodgate closure across State Route 20 on the west abutment; removable closures at each end of the spillway; high-strength, multi-strand anchors; mass concrete thrust blocks against the downstream face of the dam; and scour protection downstream of the penstocks.

June 2005: A Screening Portfolio Risk Assessment (SPRA) was completed on Bluestone Dam. During this assessment, Bluestone Dam was classified as a Dam Safety Action Classification (DSAC) 2 project. Engineer Regulation (ER) 1110-2-1156 defines a DSAC 2 project as HIGH URGENCY and characterizes this class as FAILURE INITIATION FORESEEN or VERY HIGH INCREMENTAL RISK. Class 2 is assigned to dams where failure could begin during normal operations or be initiated by the consequence of an event.

July 2008: An Issue Evaluation Study was initiated by a risk assessment team comprised of members of the U.S. Bureau of Reclamation and the Corps Risk and Reliability Directorate of Expertise Cadre which performed a Potential Failure Mode Analysis (PFMA) and prepared a qualitative risk assessment. This assessment concluded that incremental risks upon the planned completion of DSA Evaluation Report approved features was unacceptable and expedited action was warranted. While ongoing design and construction efforts of features approved under the DSA Evaluation Report address many of the identified issues of concern and failure modes, the District was instructed to prepare a Dam Safety Modification Report Supplement (DSMRS) examining alternatives for reducing risk associated with the failure modes not covered by the 1998 decision document. These failure modes are predominately related to the spillway component of the dam.

July 2013: The District completed a 2013 Baseline Condition Risk Assessment (BCRA) using a baseline as the completion of any on-going construction. The findings of this report were presented in July 2013 to the Dam Safety Senior Oversight Group (DSOG) which agreed with the conclusions that risks were unacceptable and additional modification was likely required. The District was directed to completion of a Dam Safety Modification Report Supplement (DSMRS)
to the 1998 DSA report. SMRS.

September 2017: HQUSACE-DSO approved at SDSMR with an accompanying Supplemental Environmental Impact Statement (SEIS)

2018: In 2018, near funding to completion in Emergency Supplemental Funds appropriated by Public Law 115-123 were allocated to the DSA Project. In accordance with DPM CW 2018-19, the DSA project has taken the appropriate risk on project execution to realize this unprecedented opportunity to reduce life safety hazard and realize full benefits of the project much earlier than planned. The following update to the existing Review Plan is meant to capture efforts to re-plan project execution given receipt of near full funding.

SUMMARY OF CONSTRUCTION PHASES: Construction of the DSA project has been divided into phases, briefly described as follows. This was initially done because it was unlikely the entire DSA project would be able to be fully funded in one fiscal year. As it stands, it has provided phased implementation and an opportunity to adapt the project to the most recent engineering regulation, ER 1110-20-1156, Safety of Dams, for the final phase. Figure 3 provides an overview of completed and under contract dam safety construction.

Figure 3. Aerial View of Bluestone Dam Highlight Completed or Active Construction
Phase 1 contract was awarded in September 2000. Features of Phase 1 included construction of a temporary two-lane bailey type bridge built over the stilling basin and glory hole for construction traffic. In addition, a mass concrete thrust block was built on the downstream side of monoliths 15-21. Six penstocks were extended and three of the six sacrificial bulkheads were installed. Construction of Phase 1 was completed in November 2004.

Phase 2A contract was awarded in May 2004. Work included installing swing gate closure across State Route 20, upgrading the access roadway to stilling basin, installing a new handicap fisherman pier on the west abutment, adding an east abutment gravity wall and relocating primary power and telephone lines. Construction of Phase 2A was completed in February 2007.

Phase 2B contract was awarded in May 2005. Phase 2B consisted of the installation of 216 high capacity anchors in critical monoliths and the installation of sacrificial bulkheads on the three remaining penstocks. Construction of Phase 2B was completed in November 2011.

Phase 2C was intended to complete all remaining actions necessary to carry out the 1998 DSA Evaluation Report. Following the risk assessment conducted in 2008, this nomenclature was abandoned and replaced with Phases 3, 4, 5 and 6.

Phase 3 contract was awarded in September 2010. The purpose of this phase is to reduce the risk of scour and threat to the stability of the dam in the event the penstocks are used to increase discharge capacity. Work includes the installation of a scour pad immediately downstream of the penstock extension, construction of two training walls adjacent to each side of the scour pad, addition of five divider walls and two partial divider walls designed to separate flow of the penstock discharge, and the incorporation of an ogee section and baffle blocks with an end sill into the scour pad. The project was completed in February of 2017.

Phase 4 contract was awarded in September 2012 and includes installing approximately 278 high strength steel strand anchors in the spillway and non-overflow monoliths. The contract is expected to be completed in October 2019.

Phase 5 has been determined by the 2017 DSMR. The DSMRS selected Risk Management Plan (RMP) 6 (also referred to as Super Baffle plan in historical and technical documents), the modified stilling basin with the super-cavitating baffles, as the recommended plan. RMP 6 is the most efficient plan at reducing incremental risk based on screening level cost estimates with the least amount of environmental risk and impacts. RMP 6 consists of structural measures working in unison to reduce risk and achieve the primary objectives of reducing the incremental risk of life loss. RMP 6 effectively reduces the incremental risk of life loss to below tolerable risk guidelines for Bluestone Dam.

The purpose of RMP 6 is to reduce the incremental risk associated with spillway monolith instability. The spillway design accomplishes incremental risk reduction by modifying the first stage stilling basin to prevent rock scour, reinforcing the second stage basin to minimize scour, and addressing scour concerns with overtopping of the training walls. These design features will be stabilized with bar and strand anchors, and uplift design loads will be reduced with new drains.
Planning, Engineering and Design of Phase 5 began in FY 18 and is scheduled to be completed in FY 2020 with construction continuing into the 2029. The project received funding to completion from the Bipartisan Budget Act of 2018 and has taken appropriate risk on execution to attempt to advance this important life-safety investment. Specifically, Phase 5 scope has been broken out into multiple contracts to advance this work. Originally, Phase 5 was scheduled to be awarded in August of 2022. Since last fall, project has awarded 5 major contracts to deliver the project ahead of schedule. This work has included making all 21 crest gates remote operable, installing a critical path coffer dam which allows the next contractor to unwater more efficiently to begin work in the stilling basin, as well as installing required fishing access to mitigate for the loss of fishing during implementation Phase 5. Concurrently, the design package for the actual stilling basin is being finalized for award in 2020.

Included in the scope is procurement of the stilling basin coffer dam to be constructed prior to, and provided to as Government furnished material, to the stilling basin work.

Included in the scope of designing and implementing Phase 5 is achieving and maintaining all environmental permits, conducting required environmental monitoring for invasive species, and National Environmental Policy Act (NEPA) documents to define final locations for disposal of excavated material and construction debris, as well as the final scope of required recreational and aquatic mitigation, as documented in a 1998 Environmental Impact Statement and 2017 Supplemental Environmental Impact Statement (SEIS). The implementation of required recreational mitigation and aquatic mitigation/monitoring is also included within the scope, cost, and schedule of Phase 5. Refer to the 2017 SEIS for details.
Included in the scope and design of the project are an Operational Risk Optimization concerning the care and diversion of water during Phase 5 construction is also covered by this Review Plan.

Included in the scope of designing and implementing Phase is a Post Implementation Estimate (PIE) on the residual risk the project presents to the public following physical completion Phase 5. This will be the only PIE for the entire DSA and will estimate the effectiveness of all Phases of construction to risk reduction goals. Prior to the initiation of the PIE, this review plan will be updated to reflect the PIE specific reviews or a separate review plan will be developed.

b. Factors Affecting the Scope and Level of Review. Design and construction of projects where potential hazards pose a significant threat to human life require a high level of review. The remainder of this section will present information regarding the factors affecting the appropriate scope and level of review for the design and implementation documents for Phases 4 and 5 as well as accompanying documents.

- Bluestone Dam has unacceptable risks of failure, and a threshold pool currently well below design level. Bluestone Dam also has a threshold discharge well below design level in the primary spillway. Discharges above this level may cause hydraulic features within the stilling basin to fail which could possibly lead to dam breach. The penstocks have been retrofitted with sacrificial bulkheads to provide additional discharge capacity for the dam. In the event the penstocks must be used to increase discharge capacity to reduce the possibility of breaching or exceeding the threshold pool or discharge from the primary spillway, control of the dam cannot be regained until the pool reaches the invert of the penstock at elevation 1410. Without modification of the spillway to address scour and cavitation concerns, the probability of utilizing the penstocks is unacceptably high.
- Failure of Bluestone Dam would have significant economic, environmental, and social effects. During a PMF event, dam failure is estimated to have significant loss of life associated with a population at risk of approximately 165,000. Approximately $20B in critical facilities and infrastructure located downstream would also be impacted. Impacts associated with inundation at chemical facilities would have devastating effects both economically and to health and human safety.
- According to the US Fish and Wildlife Service, the tailwater area is designated as a Resource Category 1. Habitats of this nature are considered of high value for evaluation species and are unique and irreplaceable on a national basis. Modification of the spillway during Phase 5 will impact New River, an invaluable resource and thus avoidance, minimization and mitigation measures are required.
- Operation of the project during the construction of Phase 5 will be challenging, as only half of the primary spillway will be operational during the period of construction, estimated to be 8-10 years, increasing the probability of penstock operation.
- Experience gained from 20 years in planning, design, and construction of the Bluestone DSA project have not proven controversial to the public except with certain very local issues primarily concerning construction traffic and similar effects. As a result, significant public regarding the plan recommended within the DSMRS is not anticipated.
Throughout the implementation of the approved plan within the DSA Evaluation Report and DSMRS interagency interests have been typical of any water resource project (e.g. fish and wildlife, recreation, etc.) with the exception of emergency service agencies. Given the risk associated with the dam, emergency services agencies have been more involved and are continually apprised of the project.

It is not anticipated that a peer review by independent experts will be requested by the Governor of West Virginia or the head of a Federal or State agency.

Additional congressional authorization is not necessary to implement Phases 4 and 5.

Pre-construction, engineering, and design of Phase 5, updates to the Water Control Manual and environmental documents will use models and methods common to USACE practices and will not require influential scientific information.

Type 2 Safety Assurance Reviews will be required for Phases 4 and 5.

c. **Project Sponsor.** Products and analyses provided by non-Federal sponsors as in-kind services are subject to DQC, ATR, and IEPR. Given Bluestone Dam was constructed prior to the enactment of cost sharing provisions and did not require a non-Federal sponsor, all work under the dam safety project will be completed at full Federal expense and will not be subject to in-kind contributions.

5. **DISTRICT QUALITY CONTROL (DQC)**

a. **Requirements.** All work products and reports, evaluations, and assessments shall undergo 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 home district, Huntington District, shall manage DQC. Documentation of DQC activities is required and should be in accordance with the Quality Manual of the District and the home Major Subordinate Command (MSC); in this case the Great Lakes & Ohio River Division. A schedule of major milestone DQCs can be found in Table 5.

b. **Implementation Documents.** Throughout the development of implementation documents DQC will be handled in the following manner:

   (1) **Field Investigations.** The PDT will conduct a thorough examination of the project site and the collected data documenting the existing conditions (including structures and other features, topographic surveys, geotechnical data, utility information, and environmental conditions) to accurately develop the products.

   (2) **Coordination.** The PDT will conduct periodic coordination meetings to review status, product development matters, upcoming reviews, and conformity with quality objectives. PDT members will communicate regularly to coordinate interfaces among the design disciplines and product components. The goal is to avoid design and construction coordination issues. PDT members will continuously share information relating to their progress and matters which affect product development.
(3) **Quality Checks and Reviews.**

**(a) PDT Reviews.** All PDT members will be knowledgeable about the critical project elements of all their PDT counterparts and will understand how their assigned project elements and work relate and affect those requirements. PDT members will also be knowledgeable of the customer objectives and will understand how their work relates to and affects them. The PDT will review products to insure consistency and effective coordination across disciplines and verify the correct application of methods, validity of assumptions, adequacy of data, correctness of calculations, completeness of documentation, and compliance with guidance, standards, and customer objectives.

**(b) Plan-in-Hand Review.** At the end of product development, the PDT will conduct a final plan-in-hand review to verify all quality and customer objectives have been met. This review will be done to verify the correct application of methods, validity of assumptions, completeness of documentation, and compliance with guidance, standards, and customer objectives.

**(c) Quality Control (QC) Reviews.** Informal technical checks and reviews will be performed during product development. These reviews will include checking basic assumptions and calculations. DQC reviews will be performed by qualified personnel from each technical discipline involved with the work. Quality checks may be performed by staff responsible for the work, such as supervisors, work leaders, team leaders, designated individuals from the senior staff, or other qualified personnel. All design computations will be checked in accordance with QMS 08504.02 LRH Design Quality Control.

**(d) Biddability, Constructability, Operability, Environmental and Sustainability Review (BCOES).** BCOES reviews will be performed in accordance with QMS 08520 LRD Biddability, Constructability, Operability, Environmental, and Sustainability (BCOES) Reviews and QMS 08520 LRH Conducting BCOES Review Work Instruction. BCOES reviews will be conducted after ATR is completed and prior to advertisement. A BCOES backcheck will also be performed to verify that comments have been resolved. BCOES review certification will be presented in the format shown in QMS 08520 LRH Conducting BCOES Review Work Instruction. The BCOES review team will consist of experienced personnel qualified to review each of the BCOES areas.

(4) **Documentation of DQC.** Historically, DQC has been accomplished through a series of “red-dot” reviews during which engineering counterparts perform design checks. According to local ISO procedures, a design check is a detailed evaluation of the engineering analysis and contract documents prepared by each engineering discipline as an extension of the design process. All checked drawings, computations, quantity estimates, and analyses are annotated to show the initials of the designer and the checker and the date of action. The scientific and technical information will undergo
a quality control peer review that will be documented memorandum for record that will be copied furnished to pertinent PDT and lead engineer.

(5) **Products to Undergo DQC.** DQC has been completed for the plans and specifications for Phase 4. The only remaining product requiring DQC is the DDR, Plans and Specifications and NEPA documents prepared for all the scope included Phases 5 and all other associated documents (mitigation contracts, operational risk optimizations).

(6) **Required DQC Expertise.** All design team members are expected to perform a comprehensive review of documents prior to ATR. In addition, design team counterparts with journeyman or senior level of experience will also be asked to review their counterparts’ respective sections of the products undergoing review. Counterparts should be selected from outside the PDT. The disciplines represented on the DQC team will reflect the significant disciplines involved in the engineering and design effort. These disciplines will be tailored to each product, but will likely include environmental, geotechnical, geology, structures, hydrology and hydraulics, cost engineering, civil design, electrical and mechanical, and construction.

6. **AGENCY TECHNICAL REVIEW (ATR)**

a. **Requirements.** ATR is mandatory for all decision and implementation documents (including supporting data, analyses, environmental compliance documents, etc.). The objective of 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. The ATR team will also examine DQC records and provide written comment in the ATR Report as to the apparent adequacy of the DQC effort for the associated product. 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. When required or considered appropriate, site visits by the ATR team or teammates shall be scheduled. A schedule of ATRs can be found in Table 5.

b. **Implementation Documents.** The Agency Technical Review (ATR) will be performed according to procedures outlined in EC 1165-2-217 Review Policy for Works. The ATR will be conducted by a qualified USACE team outside the district, drawing appropriate discipline for reviews from the members listed below and will be performed in accordance with the project’s Review Plan. ATR Completion and Certification forms are found in [QMS 08504 LRD - QC / QA Procedures for Civil Works Engineering and Design Products](#).

c. **Products to Undergo ATR.** ATR has been completed for the DDR and Plans and Specifications for Phase 4. The only remaining products requiring ATR are the components of the Phase 5
APPENDIX 13 – REVIEW PLAN

DDR, Phase 5 Plans and Specifications and Post Implementation Estimate (PIE) that address dam safety issues. Operational Risk Optimization efforts and the NEPA documents will also be subject to ATR. In addition, a constructability review will be conducted during the design of Phase 5. The ATR of the annual update to the total project cost estimate, construction schedules, and contingencies will be coordinated with the Cost Engineering MCX.

d. **Required ATR Team Expertise.** The ATR team will be comprised of senior USACE personnel (e.g. Regional Technical Specialists (RTS), or Subject Matter Experts (SME), etc.), and may be supplemented by outside experts as appropriate. The disciplines represented on the ATR team will reflect the significant disciplines involved in the planning and engineering and design effort. These disciplines include, environmental, geotechnical, geology, structures, hydrology and hydraulics, cost engineering, civil design, and construction. To assure independence, a leader will be chosen from a division other than LRD while the remaining ATR members will be selected from a district outside LRH. A list of the ATR members, disciplines and required expertise will be provided once identified by the RMO. The chief criterion for being a member of the ATR team is knowledge of the technical discipline and relevant experience. While the ATR Lead should have at least 15 years of experience, all remaining ATR team members should have a minimum of 10 years of experience.

<table>
<thead>
<tr>
<th>ATR Team Members/Disciplines</th>
<th>Expertise Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>ATR Lead</td>
<td>The ATR lead should be a senior professional with extensive experience in preparing Civil Works design documents and conducting ATR. The lead should also have 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 (such as structural or geotechnical, etc.). The ATR lead should also have a minimum of 15 years of experience.</td>
</tr>
<tr>
<td>Environmental / NEPA Compliance</td>
<td>The Environmental / NEPA Compliance reviewer should have a strong background in inland riverine ecosystems (e.g. riparian, aquatic, wetland), NEPA and other State and Federal environmental laws and regulations. The reviewer should also have extensive experience in performing incremental cost analysis, developing appropriate mitigation measures, and evaluating environmental impacts and other social effects. The Environmental / NEPA Compliance reviewer should have received environmental compliance ATR certification.</td>
</tr>
<tr>
<td>Civil Design</td>
<td>The Civil Design reviewer should be a senior level, professionally registered civil engineer with extensive experience with civil site layout and dam safety projects. The Civil Design reviewer should also have a minimum of 10 years of experience.</td>
</tr>
<tr>
<td>Geotechnical Engineering</td>
<td>The Geotechnical reviewer should be a professionally registered engineer with extensive experience in subsurface investigations, soil mechanics, retaining wall design, erosion protection, and earthwork construction. The reviewer should also have a working knowledge of all applicable Corps of Engineers geotechnical design criteria and dam safety guidance. The Geotechnical reviewer should also have a minimum of 10 years of experience.</td>
</tr>
<tr>
<td>Engineering Geology</td>
<td>The reviewer should be a senior-level, professionally registered geologist with extensive experience in dam safety analysis. The reviewer should be proficient in assessing rock strengths and performing stability analyses. The reviewer should be experienced in the design of high strength anchors used to stabilize mass concrete gravity dams and structures. The reviewer should also have a working knowledge of all applicable Corps of Engineers design criteria and dam safety guidance. The Geologist reviewer should have a minimum of 10 years of experience.</td>
</tr>
<tr>
<td>ATR Team Members/Disciplines</td>
<td>Expertise Required</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>--------------------</td>
</tr>
<tr>
<td>Hydraulic Engineering</td>
<td>The H&amp;H reviewer should be a professionally registered engineer with experience with engineering analysis related to flood risk management and dam safety projects. This reviewer should be familiar with standard Corps hydrologic and hydraulic computer models (HEC-RAS, HEC-HMS, &amp; HEC-ResSim), and have experience with unsteady flow dam failure analysis modeling. The H&amp;H reviewer should also be experienced in the analysis and design of hydraulic structures including spillways, outlet works, and stilling basins related to flood control reservoirs, and have knowledge and experience with the routing of inflow hydrographs through multipurpose flood control reservoirs utilizing multiple discharge devices, including gated sluiceways, and gated spillways. The H&amp;H reviewer should possess knowledge and experience with physical modeling and the application of data from physical model testing to the design of stilling basins and scour protection. The H&amp;H reviewer should also have a minimum of 10 years of experience.</td>
</tr>
<tr>
<td>Structural Engineering</td>
<td>The Structural Engineer reviewer should be a senior level, professionally registered engineer with extensive experience with dam safety projects. The reviewer should be proficient in performing stability analyses and designing high strength anchors to stabilize mass concrete gravity dams and structures. The review should also have a working knowledge of all applicable Corps of Engineers design criteria and dam safety guidance. The Structural Engineer reviewer should have a minimum of 10 years of experience.</td>
</tr>
<tr>
<td>Cost Engineering</td>
<td>ATR of the project cost estimate is performed by the Walla Walla District Cost Center of Expertise. The Cost reviewer should have a minimum of 10 years of experience.</td>
</tr>
<tr>
<td>Materials</td>
<td>The Materials reviewer should be a senior level, professionally registered engineer, or geologist. This reviewer should have extensive knowledge in mix designs and materials for mass concrete placement. This reviewer should also have experience in preparing plans and specifications and field applications of mass concrete placement. The Materials reviewer should have a minimum of 10 years of experience.</td>
</tr>
<tr>
<td>Engineering Construction</td>
<td>Reviewer should be a senior level, professionally registered engineer with extensive experience in the engineering construction field with particular emphasis on dam safety projects. The Construction reviewer should have a minimum of 10 years of experience.</td>
</tr>
</tbody>
</table>

e. **Documentation of ATR.** DrChecks review software will be used to document all ATR comments, responses and associated resolutions accomplished throughout the review process. Comments should be limited to those that are required to ensure adequacy of the product. The four key parts of a quality 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 be 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; and
4. The probable specific action needed to resolve the concern – identify the action(s) that the reporting officers 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
team coordination (the vertical team includes the district, RMO, MSC, and HQUSACE), and the agreed upon resolution. When policy and/or legal concerns arise during ATR efforts that are not readily and mutually resolved by the PDT and the reviewers, the district will seek issue resolution support from the MSC and HQUSACE in accordance with the procedures outlined in ER 1105-2-100 (Appendix H), or other appropriate guidance. The responses and the ensuing discussion are to seek resolution of the ATR concerns to the mutual satisfaction of the PDT and the ATR team. When resolution is not readily achievable, the RMO should engage the PCX or MSC subject matter experts to help facilitate resolutions, and they in turn may choose to engage HQUSACE SMEs. Unresolved comments involving disagreement between the ATR team and the PDT shall be closed with the notation that the comment has been elevated to the appropriate community of practice (CoP) for resolution. Any such issues shall be explicitly listed on the ATR certification form prior to signature.

At the conclusion of each ATR effort, the ATR team will prepare a Review Report summarizing the review. Review Reports will be considered an integral part of the ATR documentation and shall:

- Identify the document(s) reviewed and the purpose of the review;
- Disclose the names of the reviewers, their organizational affiliations, and include a short paragraph on both the credentials and relevant experiences of each reviewer;
- Include the charge to the reviewers;
- Describe the nature of their review and their findings and conclusions;
- Identify and summarize each unresolved issue (if any); and
- Include a verbatim copy of each reviewer's comments (either with or without specific attributions), or represent the views of the group as a whole, including any disparate and dissenting views.

ATR may be certified when all ATR concerns are either resolved or referred to the appropriate community of practice for resolution and the ATR documentation is complete. The ATR Lead will prepare a Statement of Technical Review certifying that the issues raised by the ATR team have been resolved. A Statement of Technical Review should be completed, based on work reviewed to date.

7. **INDEPENDENT EXTERNAL PEER REVIEW (IEPR) TYPE II**

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 1165-2-217, is made as to whether 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. For Bluestone Dam DSA, Type II IEPRs, commonly referred to as a Safety Assurance Review (SAR) are scheduled (Table 5).
The 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. SAR 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.

a. Implementation Documents. Throughout the implementation of Phases 4 and 5, SAR will be handled in the following manner:

(1) Decision on SAR. In accordance with EC 1165-2-217, a SAR shall be conducted on design and construction activities for hurricane and storm risk management and flood risk management projects, as well as other projects where potential hazards pose a significant threat to human life. Given failure of Bluestone Dam would pose a significant threat to human life and would have considerable economic, environmental, and social effects, SARs will be integrated throughout the development of Phases 4 and 5 will include periodic site visits for the SAR team.

(2) Products to Undergo SAR. SAR reviews shall occur near the completion of construction of Phase 4, during design (DDR and Plans & Specs) and during several key times during the construction of Phase 5.

(3) Required SAR Panel Expertise. Expert reviewers should have experience in design and construction of projects similar in scope to the Bluestone Dam project. A Master’s degree in engineering is preferable, but not required, as hands-on relevant engineering experience in the listed disciplines is more important. The following table provides an estimate of the number of SAR panel members required and the respective level of expertise required. All SAR panel members should have a minimum of 15 years of experience and be recognized as an expert in their field. Table 2 outlines the expertise sought for the SAR Panel for design. Expertise needed for construction will also draw from this list, but maybe reduced.

<table>
<thead>
<tr>
<th>SAR Panel Members/Disciplines</th>
<th>Design Review Expertise Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geotechnical Engineer</td>
<td>Senior-level person with extensive experience in the type of work being performed. The Geotechnical Engineer should be proficient in design and construction of the following: earthen and cellular cofferdams, dewatering and groundwater control, disposal fills, slope stability, scour protection, retaining structures, earthwork/excavation, construction monitoring, soil testing, and material characterization. Specific working experience with soils of Appalachia is desired. The Geotechnical Engineer should have a working knowledge of all applicable Corps of Engineers design criteria, and be a licensed Professional Engineer with a minimum of 15 years of experience.</td>
</tr>
<tr>
<td>Structural Engineer</td>
<td>Senior-level person with extensive experience in the type of work being performed. The Structural Engineer should be proficient in performing stability analysis using limit equilibrium analysis and in the design of post tensioned high strength steel anchors to stabilize mass concrete gravity dams and structures. The Structural Engineer should be experienced in the stability analysis and structural analysis.</td>
</tr>
</tbody>
</table>
SAR Panel Members/Disciplines | Design Review Expertise Required
--- | ---
 | design of mass concrete scour protection and stilling features including the design of baffles, endsills, and training walls. The Structural Engineer should have a working knowledge of all applicable Corps of Engineers design criteria. The Structure Engineer should also be a licensed Professional Engineer with a minimum of 15 years of experience.
Hydraulic Engineer | Extensive experience in the analysis and design of hydraulic structures related to flood control reservoirs. The Hydraulic Engineer must have performed extensive work in design of hydraulic structures including spillways, outlet works, and stilling basins. The Hydraulic Engineer must demonstrate knowledge and experience with the application of numeric and physical modeling to the design of stilling basins and overtopping protection. The Hydraulic Engineer must have a wide breadth of experience related to fundamental concepts of hydraulic structures design and experience on cross-discipline design teams. The Hydraulic Engineer should be a licensed professional engineer and have a minimum of 15 years of experience related specifically to hydraulic structures design.
Engineering Geologist | Senior-level person with extensive experience in the type of work being performed. The Engineering Geologist should be proficient in assessing rock strengths and evaluating uplift for performing stability analyses using limit equilibrium. The Engineering Geologist should be experienced in the design of post-tensioned high strength steel anchors to stabilize mass concrete gravity dams and structures. The Engineering Geologist should have a working knowledge of all applicable Corps of Engineers design criteria and should be a licensed Professional Geologist with a minimum of 15 years of experience.
Civil Engineer (including Construction) | Reviewer should be a senior level, professionally registered engineer with extensive experience in the engineering construction field with particular emphasis on dam safety projects. The Construction reviewer should have a minimum of 15 years of experience. Extensive experience in the design, layout, and construction of flood control structures including dams and levees. Demonstrated knowledge regarding hydraulic structures, erosion control, earthwork, concrete placement, design of access roads, and relocation of underground utilities. The Civil Engineer should be a licensed Professional Engineer, familiar with USACE regulations and industry building codes.
Materials | Registered professional engineer or professional geologist with a minimum of Master’s Degree in Materials Engineering. The Materials Engineer must have extensive knowledge in mix designs and materials for mass concrete placements. He should also have experience in preparing plans and specifications and field applications of mass concrete placements. The Materials reviewer should also have a minimum of 15 years of experience.
Instrumentation | Senior-level person with extensive experience in the design and monitoring of structural and geotechnical features for the type of work being performed. The Instrumentation Specialist should be proficient in the design and operation of Automated Data Acquisition Systems (ADAS) as well as manually monitored instruments for the following: earthen and cellular cofferdams, rigid concrete structures, slope stability, retaining structures and construction monitoring. The Instrumentation Specialist should also be proficient in the reduction and evaluation of data collected by the instrumentation system(s). The Instrumentation Specialist should have a working knowledge of all applicable Corps of Engineers design criteria with a minimum of 10 years of experience.

(4) Documentation of SAR. The SAR panel is responsible for preparing a review report. All review panel comments shall be entered as team comments representing the group not a specific individual. The team lead is to seek consensus, but where there is a lack of consensus, note the non-concurrence and why. A suggested report outline includes the following:

- Introduction;
- Composition of the review team;
- Summary of the review during design;
- Summary of the review during construction;
- Lessons learned in both the process and/or design and construction; and
Appendices for conflict of disclosure forms and for comments to include any appendices for support analyses and assessments of the adequacy and acceptability of the methods, models, and analyses used.

All comments in the report will be finalized by the panel prior to their release to the District for each SAR review milestone.

The District’s Chief of Engineering is responsible for coordinating with the RMO, for attending review meetings with the SAR panel, communicating with the agency or contractor selecting the panel members, and for coordinating the approval of the final complete SAR with the MSC Chief of Business Technical Division.

After receiving a report on a project from the peer review panel, the District Chief of Engineering, 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 District’s Chief of Engineering shall submit the panel’s report and the District’s responses to the MSC Chief of Business Technical Division for final review and concurrence. The final report is then presented to the MSC Commander for approval. After MSC Commander approval, the report and responses shall be made available to the public on the District’s website.

8. SENIOR OVERSIGHT GROUP (SOG) REVIEW

Following technical review, the SOG will review the Post Implementation Estimate (PIE) and related documentation and recommend approval of the reports following resolution of all comments. The PIE will be updated prior to the initiation of the review. Interim SOG reviews will also occur as deemed necessary. However, it is important to note implementation documents are not subject to SOG review. The MSC shall review and endorse any products to be reviewed by the SOG prior to submission to the SOG.

Based on ER 1110-2-1156, the SOG generally consists of the following members: Special Assistant for Dam and Levee Safety (Chair); Headquarter Dam Safety Program Manager (DSPM); Community of Practice (CoP) & Regional Representatives to include Geotechnical and Materials CoP Leader, Structural CoP Leader, Hydraulics and Hydrologic CoP Leader, Planning CoP Leader, and Construction CoP Leader; Regional representatives determined by Special Assistant for Dam and Levee Safety; Corps Business Line & Program Representatives to include Flood Damage Reduction and Navigation; Programs Integration Representative, Director, Risk Management Center; Dam Safety Modification Mandatory Center or Expertise; and any other Representatives determined by the Special Assistant for Dam and Levee Safety.

9. COST ENGINEERING MANDATORY CENTER OF EXPERTISE (MCX) REVIEW AND CERTIFICATION
According to EC 1165-2-217, all total project cost updates shall be coordinated with the Cost Engineering MCX, located in the Walla Walla District. The MCX will assist in determining the expertise needed on the ATR team and SAR team (if required) and in the development of the review charge(s). The MCX will also provide the Cost Engineering MCX certification. The RMO is responsible for coordination with the Cost Engineering MCX.

10. MODEL 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. As part of the USACE Scientific and Engineering Technology (SET) Initiative, many engineering models have been identified as preferred or acceptable for use on Corps studies and these models should be used whenever appropriate. The selection and application of the model and the input and output data is still the responsibility of the users and is subject to DQC, ATR, and IEPR (if required).

a. Planning Models. The following planning models are anticipated to be used in the development of the decision and implementation documents:

<table>
<thead>
<tr>
<th>Model Name and Version</th>
<th>Brief Description of the Model and How It Will Be Applied in the Study</th>
<th>Certification / Approval Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>HEC-FIA Version 2.2</td>
<td>GIS-based software program that estimates direct damages (structure damage, content damage, and car damage), population at risk, and loss of life (daytime and nighttime) for a range of events (both dam failure and non-failure). The program uses inundation depth grids, river cross sections, and hydrographs to estimate flood depths and arrival times for each individual structure. Damage and population estimates are then determined using depth-damage curves, Census data, and the LifeSim methodology developed by the Utah State University's Institute for Dam Safety Risk Management. The program is currently under development by the Corps of Engineers Hydraulic Engineering Center.</td>
<td>Certified</td>
</tr>
<tr>
<td>Habitat Evaluation Procedure (HEP) &amp; Habitat Suitability Indices (HSI)</td>
<td>The purpose of HEP/HSI is to document the quality and quantity of available habitat for selected wildlife species. HEP and HSI may be used to evaluate direct in-stream impacts that would occur should an alternative be considered that would directly impact the New River (e.g. construct weir downstream of current stilling weir).</td>
<td>Approved for Use</td>
</tr>
<tr>
<td>IWR Planning Suite 2.0</td>
<td>IWR Planning Suite assists with plan formulation by combining user-defined solutions to planning problems and calculating the effects of each combination, or &quot;plan.” The program can assist with plan comparison by conducting cost effectiveness and incremental cost analyses, identifying the plans which are best financial investments, and displaying the effects of each on a range of decision variables. This model expands Version 1.0.11.0 by adding an &quot;annualizer&quot; module.</td>
<td>Certified</td>
</tr>
</tbody>
</table>

b. Engineering Models. The following engineering models are anticipated to be used in the development of the decision and implementation documents:
### Table 4. Engineering Models

<table>
<thead>
<tr>
<th>Model Name and Version</th>
<th>Brief Description of the Model and How It Will Be Applied in the Study</th>
<th>Approval Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>HEC-RAS 5.0 (River Analysis System)</td>
<td>The Hydrologic Engineering Center’s River Analysis System (HEC-RAS) program provides the capability to perform one-dimensional steady and unsteady flow river hydraulics calculations. The program will be used for steady flow analysis to evaluate the future without- and with-project conditions along the New River and its tributaries.</td>
<td>HH&amp;C CoP Preferred Model</td>
</tr>
<tr>
<td>HEC-ResSIM 3.1</td>
<td>The Hydrologic Engineering Center’s Reservoir Simulation program provides the capability to route flood hydrographs through a reservoir to determine resulting peak pool elevations and discharges. The program will be used to route historical hydrographs, PMF hydrograph and percentage PMF hydrographs through the Bluestone reservoir to update the Frequency of Filling curve.</td>
<td>HH&amp;C CoP Preferred Model</td>
</tr>
<tr>
<td>MCACES 2nd Generation (MII) Version V4.3 Build 7</td>
<td>Developed by Project Time and Cost, Inc. (PT&amp;C), MII is a detailed cost estimating application used by the USACE and its A-E contractors for military, civil works and hazardous, toxic and radioactive waste (HTRW) projects. MII was first released in June 2003 and replaced the MCACES and MCACES for Windows programs.</td>
<td>Cost Engineering Mandatory Center of Expertise (MCX) Preferred Model</td>
</tr>
<tr>
<td>Crystal Ball Fusion Edition, Release 11.1.2.4.600 Build 11.1.4512.0</td>
<td>Developed by Oracle, this Excel add-in is used to perform a risk analysis based on the Monte-Carlo principles. It involves selecting a distribution type for an identified risk, determining the input parameters to fit the selected distribution, completing the correlation matrix, running the simulation, allocating the risk dollars back to the appropriate line items, and running final reports on the analysis. The forecasts that result from these simulations help quantify areas of risk so decision-makers can have as much information as possible to support wise decisions.</td>
<td>Cost Engineering Mandatory Center of Expertise (MCX) Preferred Model</td>
</tr>
<tr>
<td>DAMRAE (DAM safety Risk Analysis Engine)</td>
<td>DAMRAE (Dam safety Risk Analysis Engine) is a software tool developed by Utah State University’s Institute for Dam Safety Risk Management for performing event tree risk model computations for dam safety risk analysis. DAMRAE includes a graphical user interface for developing and populating event tree inputs and functionalities for calculating and post-processing results. It provides estimates of the probabilities of various failure modes and their associated consequences for an existing dam. The post processing step allows the user to combine results for various loading types (e.g. flood and earthquake) and to make comparisons against USACE tolerable risk guidelines. It can be applied to analyze structural and non-structural risk reduction measures, considered as alternatives or staged measures, including obtaining estimates of the risk reduction and the cost effectiveness of risk reduction. The effects of changes in the event tree structure or changes to probability, state function relationships or consequences inputs on risk estimates and evaluations can be explored using a sensitivity analysis functionality incorporated in DAMRAE.</td>
<td>RMC Preferred Model</td>
</tr>
<tr>
<td>Physical Model – Spillway Sectional Model 1:36</td>
<td>The sectional physical model for Phase 5 consists of a 114-ft-wide section through the spillway section of the dam (three full spillway gate bays, two full piers and sluices, and two half piers and sluices), a 1,200-ft reach of the tailrace and a 1,000-ft reach of the upper pool at an undistorted linear 1:36 scale. The model is constructed of sheet metal, aluminum, acrylic, plastic, and wood. The left side of the flume was made of acrylic to allow for flow visualization. The model was initially designed and used with a fixed bed channel bottom for earlier Phases of the DSA project to provide measurement of pressures on the upstream and downstream faces of the baffle blocks and upstream and downstream of the end sills for both basins. Pressures were measured in the channel bottom between the upper basin and the stilling weir and downstream of the lower basin. Pressures were also measured at the toe of the spillway and on the stilling weir. The fixed channel bottom...</td>
<td>PDT Preferred Model</td>
</tr>
</tbody>
</table>
APPENDIX 13 – REVIEW PLAN

<table>
<thead>
<tr>
<th>Model Name and Version</th>
<th>Brief Description of the Model and How It Will Be Applied in the Study</th>
<th>Approval Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical Model – General Model 1:65</td>
<td>Downstream of the upper end sill was removed and then replaced with erodible material to demonstrate scour potential. For Phase 5, the same sectional physical model is being used to evaluate alternatives for preventing scour of the bedrock downstream of the spillway section of the dam to ensure that the stability of the structure is not compromised.</td>
<td>PDT Preferred Model</td>
</tr>
<tr>
<td>Primavera Project Management (P5)</td>
<td>Developed by Primavera Systems, Inc., P5 is a comprehensive planning application built on Oracle and Microsoft SQL Server relational databases. P5 was used to develop a detailed, resource-loaded construction schedule from the MII estimate as a basis construction duration and fully-funding.</td>
<td>USACE Preferred Model</td>
</tr>
</tbody>
</table>

11. REVIEW SCHEDULES AND COSTS

a. Implementation Documents. Listed below are anticipated schedule dates and costs associated with the remaining peer reviews of the implementation documents for Phase 5.

(1) DQC Schedule and Cost. Although DQC is always seamless, the following milestone reviews are in Table 5. The cost for the DQC is approximately $605,000.

(2) ATR Schedule and Cost. ATR team participation will be seamless throughout the development of implementation documents (see Table 5). All ATR efforts including participation in vertical team coordination, reviews of all products, and development of comment responses are anticipated to cost $50,000 to $150,000 per review (depending on the size of the review); including funding for the work provided by the ATR team members and for the development of comment responses by the PDT.

(3) SAR Schedule and Cost. The SAR’s will be performed in accordance with EC 1165-2-217. SAR reviews will occur at the milestones shown in Table 5. The actual cost of the SAR during design was $253,000. The estimated costs for the SAR #1 during construction is $450,000 and SAR #2 during construction is $150,000. These estimates will be refined when the Scope of Work for the SAR task order is completed.

(4) Model Certification/Approval Schedule and Cost. Not applicable, considering all planning models to be used during the development of the implementation are certified, approved for use, or pending certification.

b. Review Schedule Summary and Key Project Milestones. Listed below (Table 5) are key dates associated with the development of the decision and implementation documents including a summary of anticipated reviews. All dates are based on the current version of the project schedule and are subject to change. It should be noted that for Phase 5 design...
implementation products (DDR and Plans and Specifications), the BCOES Review, Agency Technical Review (ATR), and Type II IEPR Safety Assurance Reviews (SAR) will be executed concurrently. The review of the DDR will commence one month prior to the P&S review. Concurrence with this strategy from Huntington District, the Great Lakes and Ohio River Division and the Risk Management Center has been obtained at prior to development of this Review Plans.

Table 5. List of Anticipated Reviews

<table>
<thead>
<tr>
<th>Activity</th>
<th>Approximate Dates</th>
<th>Start</th>
<th>Finish</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Document Review</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Project Oversight</td>
<td></td>
<td>FY 2026</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Annual Total Project Cost ATR Review</td>
<td>FY 2019</td>
<td>FY 2028</td>
<td>30-Aug-19</td>
<td></td>
</tr>
<tr>
<td>Operational Update #1 - District Quality Control (DQC) Preferred Plan</td>
<td>FY 2019</td>
<td>FY 2019</td>
<td>Completed</td>
<td></td>
</tr>
<tr>
<td>Operational Update #1 - LRH Magnt Endorsement of Preferred Plan</td>
<td>FY 2019</td>
<td>FY 2019</td>
<td>In-Progress</td>
<td></td>
</tr>
<tr>
<td>Operational Update #1 - ATR Certification</td>
<td>FY 2019</td>
<td>FY 2019</td>
<td>In-Progress</td>
<td></td>
</tr>
<tr>
<td>Operational Update #1 - MSC Review of Preferred Plan</td>
<td>FY 2020</td>
<td>FY 2020</td>
<td>Scheduled</td>
<td></td>
</tr>
<tr>
<td>Operational Update #1 - MSC Review Water Control Update #1</td>
<td>FY 2020</td>
<td>FY 2020</td>
<td>Scheduled</td>
<td></td>
</tr>
<tr>
<td>Operational Update #2 - District Quality Control Updated FY 2025</td>
<td>FY 2025</td>
<td>FY 2025</td>
<td>Scheduled</td>
<td></td>
</tr>
<tr>
<td>Operational Update #2 - LRH Magnt Endorsement of Preferred Plan</td>
<td>FY 2025</td>
<td>FY 2025</td>
<td>Scheduled</td>
<td></td>
</tr>
<tr>
<td>Operational Update #2 - MSC Review of Preferred Plan</td>
<td>FY 2025</td>
<td>FY 2025</td>
<td>Scheduled</td>
<td></td>
</tr>
<tr>
<td>Operational Update #2 - MSC Review Water Control Update #2</td>
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### APPENDIX 13 – REVIEW PLAN

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<td>Phase 5 - Post Implementation Evaluation (PIE) - DQC Review</td>
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### 12. PUBLIC POSTING OF REVIEW PLAN

The nature of risk identified and associated with the Bluestone Dam has required public meetings throughout the basin on a regular basis. The District has been proactive in keeping the public and stakeholders informed and involved. Given the continued risk to life and safety until the completion of the DSA project, regular public meetings will continue to be held.

Throughout the development of the project several opportunities for public comment will be provided. In compliance with NEPA, formal public review of all NEPA documents shall occur.

As required by EC 1165-2-217, the approved Review Plan will be posted on the District public website ([http://www.lrh.usace.army.mil/Missions/Civil-Works/Current-Projects/Bluestone-DSA/](http://www.lrh.usace.army.mil/Missions/Civil-Works/Current-Projects/Bluestone-DSA/) and [http://www.lrh.usace.army.mil/Missions/Public-Review/](http://www.lrh.usace.army.mil/Missions/Public-Review/)). The public will have 30 days to provide comments on the documents; after all comments have been submitted, the comments will be provided to the technical reviewers. This is not a formal comment period and there is no set timeframe for the opportunity for public comment. If and when comments are received, the PDT will consider them and decide if revisions to the review plan are necessary. This engagement will ensure that the peer review approach is responsive to the wide array of stakeholders and customers, both within and outside the federal government.
13. REVIEW PLAN APPROVAL AND UPDATES

The Great Lakes and Ohio River Division Commander is responsible for approving this Review Plan. The Commander’s approval reflects vertical team input (involving district, MSC, RMO, and HQUSACE members) as to the appropriate scope and level of review for the decision and implementation documents. Like the PMP, the Review Plan is a living document and may change as the study progresses. The home district is responsible for keeping the Review Plan up to date. Minor changes to the review plan since the last MSC Commander approval are documented in Attachment 3. Significant changes to the Review Plan (such as changes to the scope and/or level of review) should be 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, should be posted on the Home District’s webpage. The latest Review Plan should also be provided to the RMO and home MSC. As each major work product becomes ready to be reviewed in the future this RP, will be updated to reflect the review requirements of each work product.

14. REVIEW PLAN POINTS OF CONTACT

Public questions and/or comments on this review plan can be directed to the following points of contact:

- Aaron Smith, Huntington District, Project Manager, 304-399-5720
- Nancy McIntosh, Huntington District, Lead Engineer, 304-399-5035
- Troy O’Neal, Great Lakes and Ohio River Division, Dam Safety Program Manager, 513-684-3804
- John Clarkson, Risk Management Center, Senior Review Manager, 304-399-5217
### ATTACHMENT 3: REVIEW PLAN REVISIONS

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<tr>
<th>Revision Date</th>
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<td>First Developed</td>
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<td>July 2013</td>
<td>Updated to include completion of DSMRS</td>
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<td>December 2017</td>
<td>Updated to include scope approved by DSMRS in 2017</td>
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<td>March 2018</td>
<td>Updated to include revised understanding of review based on issuance of EC 1165-2-217</td>
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<td>January 2019</td>
<td>Updated to reflect advancement of schedule due to receipt of supplemental funding</td>
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<td>August 2019</td>
<td>Updated to reflect current status</td>
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*Table 13. Review Plan Revisions*