REVIEW PLAN

PRECONSTRUCTION ENGINEERING & DESIGN (PED) PHASE

FOR

TAINTER VALVE MACHINERY REHAB
SAULT STE. MARIE, MICHIGAN

Initial RMO Endorsement Date

26 FEB 2019

Initial MSC Approval Date

29 MAR 2019

Latest Revision Date

N/A

U.S. ARMY CORPS OF ENGINEERS
DETROIT DISTRICT

TABLE OF CONTENTS

REVIEW PLAN - PED PHASE
TAINTER VALVE MACHINERY REHAB
SAULT STE. MARIE, MICHIGAN

ATTACHMENTS

REVIEW PLAN – PED PHASE
TAINTER VALVE MACHINERY REHAB
SAULT STE. MARIE, MICHIGAN

I. OVERVIEW

A. PURPOSE

The Review Plan (RP) is the foundational document that presents the endorsed/approved documentation of accountability and the steps to produce a credible product, consistent with the requirements shown in EC 1165-2-217. The RP is also the basis for compliance with the Information Quality Act requirement to confirm and maximize the quality, objectivity, utility, and integrity of information (including statistical information) disseminated by the agency. To the extent practical, reviews should not extend the schedule but should be embedded in the development of the product. DQC reviewers (including Office of Counsel) must be involved at key decision points and should be included throughout project development. This RP describes the scope of review for the pre-construction, engineering and design phase and is a component of the Project Management Plan (PMP) or Program Management Plan (PgMP). This document also identifies the personnel that will be responsible for conducting the applicable reviews. A list of all acronyms can be found in Attachment 2.

B. PROJECT SCOPE & PRODUCTS

The MacArthur Lock has two sets of tainter valves and associated machinery on the downstream end (emptying valves) and two sets of valves and machinery on the upstream end of the lock (filling valves). The machinery is installed within the galleries of each lock wall and is accessible from both lock walls. The tainter valve machinery is original from 1943. The MacArthur Lock was constructed in 1943 and is 800 feet long by 80 feet wide and consists of direct connected, mechanical drive, reverse tainter gate culvert valves. The machinery is all mechanical drive with gearboxes and open gearing. The strut arm and strut (that actually drive the tainter valve) are on the wet-side within the tainter valve recess. The dividing line between wet-side components and dry side components is immediately after the sector gear. The tainter valve machinery consists of an electric motor connected to a series of parallel gear sets, open gears and an enclosed worm gear box which connects to a direct linkage to the reverse tainter valve. The machinery is directly connected with a strut arm and strut assembly. The strut assembly utilizes a spring set for shock absorption. The motors on the tainter valve machinery are variable speed (VFD). There is a holding brake (shoe brake) in the system. If the holding brake failed, the tainter valve could drop uncontrolled if it were in the raised position.

If one set of valve machinery failed on either the downstream end or the upstream end of the lock, the fill or empty times, respectively, would double. This would slow traffic but the lock could continue to operate. The lock could only be rendered inoperative if both sets of machinery on either the upper or downstream end failed (this would mean the lock could neither fill nor empty).

The economic analysis considered both full rehabilitation and the advanced maintenance strategy. An advance maintenance strategy reduces the cost and thus improves the benefit cost ratio. It is proposed to replace all the wet side components as part of this strategy. This will require the full dewatering of the lock.

It was necessary to evaluate structural modifications on the lock wall to simplify removal and installation of machinery from the machinery pit. An assumption will be made that a new mechanical drive system similar to existing will be installed. This includes:

- New strut and strut assembly and connection pins on all 4 sets of tainter valve machinery;
- New sector arms;
- New sector gear and pinion;
- New cross shaft and packing;
- New mechanical drive system to include new gear boxes and open gearing;
- Worm gear box;
- New electrical wiring and conduit as required;
- New lighting as required.

The projects resource loaded schedule with P2 activities for each review (including costs for each review) is included in ATTACHMENT 4. The estimated construction cost for the project is $5,182,000.

Engineering and design products that will be prepared and reviewed as part of this project include:

- Design Documentation Report (DDR)
- Plans and Specifications (P&S)
- Engineering Considerations and Instructions for Field Personnel (ECIFP)

C. REVIEW PLAN APPROVAL & UPDATES

The Review Management Office (RMO) is responsible to endorse and oversee the review effort described herein. For this project the RMO is the Inland Navigation Design Center (INDC). The RMO will develop the review charge and organize the necessary agency and independent external peer review teams.

After endorsement is received from the RMO, the RP will be routed for approval by the commander of the Great Lakes & Ohio River Division. The RP is a living document and may change as the work progresses and the District will be responsible for keeping the document updated. Minor changes can be made to the document without the need for re-approval. Re-approval of RPs by the MSC will be required when there are significant changes, such as in the level of review (i.e., if Type I or Type II IEPR is added to or deleted from the RP). Other situations requiring RMO re-endorsement and MSC re-approval should be very limited but could include significant changes in project scope (e.g., adding or subtracting a purpose, etc.). Changes to the review plan since the initial MSC Commander approval will be documented in ATTACHMENT 1.

D. REFERENCES

References. This review plan is prepared in accordance with regional business process QMS 08504 LRD. Additional references include:

- Engineering Regulation 415-1-11, Biddability, Constructability, Operability, Environmental and Sustainability (BCOES)
- Engineering Regulation (ER) 1110-1-12, Quality Management, 30 Sep 2006
- Engineering Circular (EC) 1165-2-217, Review Policy for Civil Works, 20 February 2018
- Regional Business Process 08504 LRD – QC/QA Procedures for Civil Works
- Project Management Plan, 13 December 2018

E. POINTS OF CONTACT

Any inquiries regarding this document can be directed to the Detroit District, RMO or MSC points of contacts outlined in ATTACHMENT 5.

II. PUBLIC INVOLVEMENT

After MSC approval is received the RP will be posted on the District's website for public review and input. Public comments received will be reviewed and incorporated, as appropriate, to this review plan. There is no expectation of obtaining support from personnel outside of USACE to conduct reviews.

III. COMPUTER CERTIFICATION & APPROVAL

The use of certified, validated, or agency approved engineering models is required for all activities to ensure the models are technically and theoretically sound, compliant with USACE policy, computationally accurate, and based on reasonable assumptions. 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. 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, BCOES, policy and legal review, and SAR (if required). Where such approvals have not

been completed, appropriate independent checks of critical calculations will be performed and documented. The following engineering models, software, and tools are anticipated to be used:

Model Name	Version	Software Application (e.g. how it will be used)
MCACES or MII	4	Cost estimating
Microsoft Office Suite	2013	Technical writing and computational analysis
STAAD.Pro V8i	V8i	Structural analysis and design
Autodesk Inventor	TBD	3D modeling
Microstation Power Inroads	Select Series 4	3D modeling

IV. IN-KIND CONTRIBUTIONS

N/A. Project has no Local Sponsor.

V. DOCUMENTATION OF ISSUES/RISK

Reliability Analysis

A Weibull analysis was utilized for the reliability analysis. If one set of valve machinery failed on either the downstream end or the upstream end of the lock, the fill or empty times, respectively, would double. This would slow traffic but the lock could continue to operate. The lock could only be rendered inoperative if both sets of machinery on either the upper or downstream end failed (this would mean the lock could not either fill or empty).

The economic analysis considered both full rehabilitation and the advanced maintenance strategy. An advance maintenance strategy reduces the cost and thus improves the benefit cost ratio. It is proposed to replace all the wet side components as part of this strategy. Again, the intent is to reduce the overall risk of failure and reduce the cost at the same time. A separate fault tree and hazard curve were also developed for this advance maintenance strategy.

Failure Mode Description

The current year (2015) overall probability of failure to operate one set of the tainter valve machinery is 4% (the unreliability of one machinery unit). The current year probability of failure for one machinery unit reduces to 2.6% if the proposed advance maintenance strategy is implemented. There are 4 sets of machinery units. Fixing one machine in the base condition will still result in 4% chance of failure since there are 4 machines that are equal in their risks. The event tree shows the different paths of failure for the machinery units. The critical thing to consider is whether a companion valve (a valve on the same end – upstream or downstream - of the lock) fails. That scenario will shut down the lock. A failure of just one machinery unit will slow the filling or emptying rate by half. Appendix A-1 of the MRER Main Report (Dec 2017) discusses in more depth the operational and maintenance concerns of the valve machinery. The OCA ratings of the machinery also reflect this. The major factor driving the “unreliability” is the mechanical components with the gearbox and open gearing the primary factors and also the wet-side components. The mechanical components on the wet-side of the system including the strut and pins have never been replaced or repaired.

Also, all the mechanical components for one machinery unit are essentially in series. This means it only takes one component to fail and the machine as a system is out of operation. This includes the worm gear box, multiple parallel gear sets, pinion gear, sector gear, strut, and strut arm. The strut arm and strut are connected by pins. The analysis includes all the machinery and components from the motor to the tainter valve itself. The structural portion of the tainter valve is not part of this analysis. The operating age (which factors in the yearly shutdowns) was used for the Weibull formula in order to complete reliability modeling.

Hazard Rates

A hazard curve was created for a single tainter gate machinery unit. The hazard curve was created from the Isograph Reliability Workbench program. Again, the age shown in the curve is overall age starting from 1943. The tainter valve machinery was modeled, however, assuming it was 54 years of age. This operating age simply shifts the point on the hazard curve. The hazard curve itself does not change. The

hazard rate indicates how the system degrades over time and was calculated from the output of the Isograph Reliability Workbench fault tree model. First, using Excel, a polynomial equation was developed for the reliability curve. This was done in Excel by using curve fit feature “Format Trendline”. A 6th order polynomial equation was developed in Excel to plot the hazard rate. The MRER Main Report (Dec 2017) Appendix A-1 provides more information.

Consequences and Event Tree

Once the hazard rate for the fix-as-fails condition (baseline condition) was calculated for the MacArthur tainter valve operating machinery system, a consequence event tree was developed. The baseline condition is the fix-as-fails condition. There is a base O&M cost if the old machinery fails or not. The baseline O&M condition was also included in the event tree and it was assumed $10,000 per year would be spent on operation and maintenance and monitoring under the baseline condition. Under the baseline condition, the machinery would continue to degrade over time.

The consequences vary depending on the type and level of failure and also how they impact navigation. The primary driver for the unreliability is the open gearing and the gearbox and the wet side components. Failure of one tainter valve machinery unit would double the filling or emptying rates. The failure of both sets of tainter valve machinery on upper or lower end would lead to an outage of the MacArthur Lock. The first node of the event tree was whether a failure occurred or not. With no failure, the baseline condition was assumed. Assuming a failure, three consequence levels were considered. These include:

Catastrophic Failure

The tainter valve connection pin or strut pin or strut itself fails when gate is in the upper position. This causes loss of valve function and significant damage (but repairable) to the tainter gate and damage to the strut and strut arms. It was assumed dewatering of the lock would be necessary to repair the damage to the strut, strut arm, pins, and valve body. This is primarily due to insufficient space in the tainter valve recess to conduct the work. Although bulkheads are now repaired for the tainter valve pit, it will still require a lock dewatering scheduled during the winter closure period to remove components and replace them through the lock chamber. The total time to repair was assumed to be 9 months. A dewatering cost of $100,000 was utilized. This duration was determined after discussions with Soo Locks operating staff. The event tree also considers whether a companion valve fails at the same time. Under this scenario, it was assumed that the lock would undergo an immediate-unscheduled shut down to swap parts to get at least one fill and one empty valve online. Such unscheduled closures, demonstrated of multiple failures, and cobbled together machines would be grounds for subsequent replacement of all tainter valve machinery as a consequence.

Major Failure

The valve machinery experiences a failure of one of the open gear sets or the worm gear drive reducer. Essentially a gear wears to the point it cannot operate any more. No damage is done to the valve body. Replacement of a gear train or gear set and worm gear reducer is necessary. Assume complete replacement (supply and install) of one gear set (including worm gear reducer) for a total cost of $500,000. Time to repair will be 9 months due to long lead time on custom made machinery. A scenario also considered was a companion valve failed at the same time.

The consequences analysis includes elevated consequences due to failure and repairs during ice conditions. For emergency dewatering, it is estimated that 10 days be added to the outage durations if the event occurs during the winter/ice season to account for potential delays in mobilizing floating plant, cranes placing bulkheads, dive support, etc.

Operational Failure

The valve machinery experiences a failure of a drive component, limit switch, or motor. This causes loss of valve function, but no damage would be done to the valve body. Repairs are minor and completed in one day by the lock staff.

The likelihood of these three outcomes was determined from the Isograph Reliability Workbench Fault Tree program. The current year probability of failure was utilized for the strut and pins (catastrophic) and a gear set (major) to determine their individual contribution to the machinery’s current-year system probability of failure. The ratio of the individual sub-component to that of the whole was used to determine the distribution among the outcomes.

VI. REVIEW REQUIREMENTS

A. DISTRICT QUALITY CONTROL

District Quality Control is the backbone of the Corps of Engineers' quality process. All work products and reports, evaluations, and assessments will undergo necessary, robust, and appropriate District Quality Control (DQC). It is an internal review process on the basic science and engineering work products focused on fulfilling the project quality requirements defined in the PMP. The DQC of products and reports will also cover any necessary National Environmental Policy Act (NEPA) documents and other environmental compliance products and any in-kind services provided by local sponsors. DQC efforts will include the necessary expertise to address compliance with current USACE policy and procedures. When policy and/or legal concerns arise during DQC efforts between the PDT and the DQC reviewers that are not readily and mutually resolved by the DQC Review Lead, the district leadership/Counsel will try to resolve, then seek issue resolution support from the MSC, RMO, and HQUSACE according to the procedures outlined in Engineer Regulation (ER) 1105-2-100, Appendix H, Amendment #1, or other appropriate guidance. The total estimated cost for DQC is $14k.

Each step of the DQC process will be documented and stored in Projectwise. The DQC certification provided in ATTACHMENT 6 shall be finalized after successful completion of DQC, as outlined in this RP.

1. DEVELOPING THE DISTRICT QUALITY CONTROL (DQC) REVIEW TEAM

The Chief, Engineering & Construction Office will assign a DQC Review Lead to each project who is responsible for ensuring that a formal DQC review is performed by all members who have been assigned to the DQC Review Team. The DQC Review Lead ensures coordination and interaction of team members, completeness of reviews, quality of review comments, and comment closeout and DQC Certification. The DQC Review Lead will be a qualified senior staff member (Supervisor, Regional Technical Specialist, Lead Planner, Engineering Technical Lead, or PM) who has no production role in the study/project. Note, for small projects the DQC Review Lead may be the only reviewer. The DQC Review Lead ensures adequate DQC time and budget are identified in the RP, support Districts' risk identification and assessment, and leads in coordination of risk assessment with District management and the vertical team. As a minimum, the requirements provided in EC 1165-2-217 will be followed, beyond which the home district and MSC can require more stringent DQC. The DQC Review Lead is responsible for coordinating ATR that is triggered by key risk-informed decisions and high risk items/features that warrant additional evaluation. The designated DQC Review Lead for this project is provided in ATTACHMENT 5.

The resource providers (e.g. branch supervisors) and DQC Review Lead will be responsible for assigning DQC Review members. Each DQC Review member and there function/discipline is provided in ATTACHMENT 5.

2. QUALITY ASSURANCE (QA)

To verify performance of DQC (including QA) the RMOs may conduct audits as necessary. MSC quality manuals will prescribe specific procedures for the selection of DQC team members and the conduct of DQC including documentation requirements that require inclusion of comments and responses, and maintenance of associated records for internal audits to check for proper DQC implementation. MSCs are responsible for evaluating and recommending changes to subordinate districts' QC processes. The MSC has the responsibility to ensure vertical and lateral integration of organizational capabilities, to include resource sharing, technical expertise, project management, and project delivery to broaden and enhance the range of services and quality within its region. In addition to their oversight role in assuring the PDT is technically qualified, the MSC is also responsible for assuring the adequacy and capability of the DQC teams and supplementing the team members from outside the district when necessary. The MSC's QA process will verify that the QC for each project is appropriate.

3. QUALITY REVIEW (SUPERVISORY REVIEW)

Quality Reviews are rigorous independent reviews that occur throughout the development process and are carried out seamlessly as a routine management practice. Quality Reviews are performed by staff responsible for the work, such as supervisors, work leaders, team leaders, designated individuals from the senior staff, or other qualified personnel. However, they should not be performed by the same people who produced the original work. If required expertise is not available within the district, the district should coordinate with the MSC to consider qualified personnel from other districts or A-Es to supplement the DQC team.

Prior to submission of the package to Contracting, a supervisory review will also be conducted to ensure that the package is ready to be labeled “Certified Final – Ready to Advertise” (e.g. E&C Chief’s Brief, Final Signature Meeting). The review team is comprised of the supervisor of each of the PDT members. The review will confirm that all reviews have been properly completed, all files are properly labeled as dictated by project milestones and filed in ProjectWise, and that the package is ready for advertisement. Once the “Certified Final” package has been reviewed by all supervisors and the Chief, Engineering & Technical Services has signed the Memorandum for Record provided in ATTACHMENT 6, the documents will be labeled “Certified Final - Ready to Advertise”.

Comments submitted during the Quality Reviews and their resolution should be clearly documented and stored in Projectwise.

The designated quality reviewers for this project are provided in ATTACHMENT 5.

4. PDT REVIEWS

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. There will not be a formal design stop for this review effort, however, each PDT member is responsible for ensuring that they complete the review before the design documents are sent out for 95% BCOES/ATR/IEPR Review.

The PDT members for this project are provided in ATTACHMENT 5.

5. COMPUTATION CHECKS

All computations will undergo a rigorous independent check during DQC (including cost estimates). The computations will be appropriately annotated by the designer with annotations that include, but are not limited to: all assumptions, loadings, design parameters, constraints, equations, model inputs, quantities, and references (including edition and page number) used to complete the design and/or analysis. A narrative will explain the conclusions drawn from the computations. Annotation will be thorough enough that the checker can follow the computation process independently. For engineering products/documents and construction products/documents, for example, the author performing the computations will initial and date each computation sheet. A qualified reviewer/checker with experience and a thorough understanding of the computation will perform a quality check to assure all computations, calculations, assumptions, and models used are correct. The reviewer/checker will highlight (e.g., place a “red dot”) on each annotation and number on a computation sheet indicating concurrence with the correctness of the information shown and then initial and date each and every computation sheet being reviewed/checked. Since this is for verification of agreement by the reviewer/checker, typed initials are not allowed on the computations; however, an electronic PDF signature is acceptable. A PDF of the final checked computation sheets shall be stored in Projectwise in the District Quality Control Review folder.

The computation checker(s) for this project is provided in ATTACHMENT 5.

6. GRAPHIC/PLAN CHECKS

All graphics/plans will undergo a rigorous independent check as part of the DQC process. The plans, drawings, sketches, charts, diagrams, maps, profiles, or other graphical information will clearly illustrate the design intent and will satisfy the latest version of the A/E/C CADD Standard. The person designing the graphic will initial and date each graphic/plan. A qualified reviewer/checker with experience and a thorough understanding of the design intent and A/E/C CADD Standards will perform a "quality check" to assure all graphical information is correct. The reviewer/checker will place a highlight—e.g., "red dot"—on critical graphic/plan elements, e.g., dimension/elevation, note, or reference, showing concurrence with the correctness of the information shown and then initial and date each and every graphic/plan being reviewed/checked. Since this is for verification of agreement by the reviewer/checker, typed initials are not allowed on the graphics/plans; however, an electronic PDF signature is acceptable. A PDF of the final checked graphics/plans shall be stored in Projectwise in the District Quality Control Review folder.

The graphic/plan checker(s) for this project is provided in ATTACHMENT 5.

B. BIDDABILITY, CONSTRUCTABILITY, OPERABILITY, ENVIRONMENT & SUSTAINABILITY (BCOES) REVIEW

BCOES Reviews assure solicitation documents are readily understood; the product can be bid, built, operated and maintained efficiently; environmental concerns are protected, and sustainability is addressed. For this project, a 35% BCOES, 65% BCOES, 95% BCOES and 95% BCOES Backcheck review will be completed for a total anticipated cost of $42k. BCOES reviewers and PDT members will conduct the BCOES reviews utilizing DrChecks. Each comment will be within the scope of the review and will be flagged in accordance with the review that it is being submitted under (e.g. biddability review, constructability review, etc.). All DrChecks comments must be resolved and closed out by the reviewer.

Each step of the BCOES Review process will be documented and stored in Projectwise.

1. DEVELOPING THE BCOES REVIEW TEAM

The accomplishment of a quality design or development of an effective RFP package requires the effective involvement of the entire PDT. The Technical Lead will work with resource providers (e.g. branch chiefs) to develop the BCOES Review Team. The review team will include the customer (if applicable), construction, contracting, engineering, project management, real estate, operations, and environmental staff. Resource providers will ensure that the reviewers are familiar with the project's location, project site conditions, potential site-related problems, and plans and requirements for post-construction operations and maintenance. These reviewers should have extensive knowledge of the construction market place, site and access constraints, local regulations, site operations plans and constraints, environmental conditions and requirements, as well as experience in management of construction projects, determining construction durations, scheduling construction trades and activities, and experience in the operations-maintenance of project sites. The BCOES reviewers also should understand any unique problems and the application of design assumptions, principles, and specifications during construction and operation. Temporary assignment of construction or operations staff to the project design work prior to their assignment at the project site during construction will benefit both the design and the construction phases of the project.

The BCOES Reviewers for this project are provided in ATTACHMENT 5.

2. BCOES REVIEW PROCESS

The BCOES Review process includes a check on whether the VE requirements have been satisfied. Prior to the Kickoff Meeting, the Project Manager will coordinate with the Value Engineering (VE) Officer to develop a plan for VE on the project. VE requirements shall be

completed in accordance with ER 11-1-321, 01 Jan 2011, change 1 and ER 1110-2-1150, Para. 14.7, 31Aug 99.

The Technical Lead will upload the review documents into the appropriate folder in Projectwise and will distribute the review documents to the reviewers by sending an email that, at a minimum, contains the following:

- Link to the appropriate Projectwise folder which contains the review documents (external to USACE reviewers should be provided the review documents via email or other approved file transfer system)
- Whether the review documents were prepared in-house, by an A-E or both
- Start and end dates for the Review
- Project Review Name in DrChecks

The Engineering & Construction Office Administrative Assistant will also send out a meeting invitation for the BCOES conference that includes a webinar and teleconference number along with the template BCOES agenda.

The BCOES Review Team will then complete the review in accordance with the following guidance:

- Biddability Review. All biddability reviews will analyze the completeness, correctness, compatibility, clarity, and consistency of the collection of plans, specifications, clauses, forms, bid schedule, and other documents and references that comprise the total solicitation package and the planned contract. The government is responsible for determining its requirements, and the solicitation package should be prepared to help bidders or proposers understand clearly the government's requirements and to allow the submission of a competitive bid or proposal that is responsive to the government's requirements. The biddability review will also include an evaluation of the soundness of the evaluation criteria that are planned for negotiated acquisitions.

  The Construction Administration PDT Member will be responsible for the biddability review and will ensure that all comments are appropriate and within scope.

- Constructability Review. In general, the constructability review includes checking the compatibility of the design/contract documents with site conditions, materials, equipment, schedules, utility connections, government estimates, and construction methods relevant to the planned construction. It also includes evaluation of safety considerations and other planned project and contract features for their ease of successful, safe execution.

  All constructability reviews will include a Plan-In-Hand site visit and review by appropriate engineering (e.g. designers) and construction staff to ensure all visible and known existing characteristics of the site described in the project design and acquisition documents are included, accurate, and supportive of the project's successful acquisition and construction. Contractor office and storage areas will be among the items checked. A trip report will be prepared to document the Plan-In-Hand site visit. Ideally, the Plan-In-Hand site visit will be completed early in the design process and can be conducted (if desired) concurrently with a BCOES/ATR Review. If the PDT decides not to conduct the Plan-In-Hand Review, the Plan-In-Hand waiver which is part of the BCOES Certification, must be completed prior to the BCOES Review and signed by the Chief, Engineering & Technical Services.

  For projects involving acquisition of any real estate interest, coordination will be made with the applicable Chief of Real Estate to ensure all necessary real estate interests to accommodate all aspects of the planned work are available.

  All constructability reviews will also specifically review the planned construction phasing,

sequencing, and period of performance for the contract to ensure that an adequate construction period is specified. While many designers may initially develop this construction duration, the final evaluation of the adequacy of the specified period properly rests with the construction Area/Resident Engineer to review and concur with the period of performance or to determine if accelerated efforts will be required for a contractor to achieve an aggressive construction schedule. The planned contract's requirements for scheduling systems and quality control also will be checked as part of the constructability review.

The constructability review also needs to evaluate if the procedures used for development of the bid schedule and independent government estimate (IGE) comply with policies, and account for items such as accelerated construction, pre-priced contract line items, and other constructability impacts on the estimated cost for the construction. Additionally, the constructability review will include a review of the basis for calculating any liquidated damages for the project, including validation of any projected estimated additional expenses that would be incurred by the facility customer-user.

The Construction PDT Member will be responsible for the constructability review and will ensure that all comments are appropriate and within scope.

- Operability Review. Review of the operability of the site(s) to be constructed must include a good understanding and detailed consideration of the customer's-owner's operations and maintenance requirements, needs, practices, and capabilities after construction completion and turnover. The Area/Resident Engineer staff should jointly conduct an operability review with the project site's planned user(s) and maintainers as a means of improving mutual understanding and planning for the upcoming construction and facilitating the successful transfer and understanding of the operability comments by the PDT. The operability review should include a check of all commissioning requirements, transfer and handover documentation requirements, and warranty requirements and plans.

  The Operations PDT Member or Project Manager will be responsible for the operability review and will ensure that all comments are appropriate and within scope.

- Environmental Review. Review of the compliance of the project's design, construction, and operation with all applicable environmental laws and regulations, including Environmental Operating Principles (EOPs) in ER 200-1-5, is included in BCOES reviews. The environmental review will address the project's compliance with all applicable local, state, and Federal environmental regulations and requirements, including National Pollutant Discharge Elimination System (NPDES) permits, required permits for earth disturbance, stormwater management, etc., and reports or requirements for any asbestos, lead paint, and other hazardous materials handling, removal, and disposal. Archeological, historical, hazardous, toxic, and radioactive waste (HTRW), and military munitions concerns that may impact the project's execution during the acquisition and construction phases are also addressed during this review. The District's environmental, regulatory, operations, and construction staffs should be engaged in this review.

  The Environmental Analysis Branch PDT Member will be responsible for the environmental review and will ensure that all comments are appropriate and within scope.

- Sustainability Review. Review of the sustainability of the project to be acquired must include a good understanding and detailed consideration of the Federal Guiding Principles for High Performance Sustainable Buildings (if applicable) and compliance with other applicable laws, regulations, polices, standards, codes and criteria for sustainability related to facilities and infrastructure. The review should include, but is not limited to application of integrated design principles; energy performance optimization; water protection and conservation; indoor environmental quality; and the environmental impact of materials (including green purchasing and diverting wastes from landfill); facility siting and orientation; building size and layout;

stormwater runoff during and after construction; sourcing and durability; transportation; and certification of facility performance regarding sustainability. The sustainability reviewers should include engineering, operations and construction staff members.

The assigned operations Reviewer will be responsible for the sustainability review and will ensure that all comments are appropriate and within scope.

The BCOES Certification provided in ATTACHMENT 6 shall be finalized after successful completion of BCOES, as outlined in this RP.

C. AGENCY TECHNICAL REVIEW (ATR)

ATR is undertaken to "ensure the quality and credibility of the government's scientific information" consistent with EC 1165-2-217 and the Quality Manual of the responsible MSC. All Civil Works products will undergo necessary and appropriate ATR, as well as DQC. This level of review will also cover a comprehensive review of the conclusions to ensure that the results and decisions are clearly supported by the information presented and are in compliance with current agency policy and procedures. Any necessary NEPA documents, other environmental compliance products, in-kind services provided by local sponsors or their A-Es, and other supporting documents are also part of the ATR. The level of review should be commensurate with the significance of the information being reviewed, which should be determined in a risk-informed manner. ATR will not serve as a substitute for DQC. The role of ATR is to perform an assessment of DQC, validate PDT decisions, bring up important issues, concerns, and lessons learned. The ATR Team is not to make project decisions; the PDT is responsible for the product/design. The PDT must assess each ATR comment and then can either implement the comment or provide a logical, well-thought-out response as to why not to implement the comment. The ATR Team will document any significant concerns or any unresolved comments for draft products in the ATR Certification. The objective is for ATR to be involved as appropriate throughout the project life cycle at an appropriate, scalable level based on the complexity, size and level of risk associated with the project. The total anticipated ATR Review cost is $12k.

Each step of the ATR process will be documented and stored in Projectwise.

1. DEVELOPING THE ATR TEAM

Each ATR will be conducted by a qualified team of senior highly experienced experts in the type of work being reviewed who are from outside of the home district and are not involved in day-to-day production of the project/product. To ensure independence, the ATR Team Lead will be from outside the home MSC as selected by the RMO. The disciplines represented on the ATR Team should generally mirror the significant disciplines involved in the accomplishment of the work. The ATR Team will be established shortly after the PDT is established. ATR efforts will include the necessary expertise to address compliance with applicable published policy. The ATR Team member should be senior USACE personnel with expertise in the subject area being reviewed. ATR Teams will be assigned by the RMO and comprised of senior USACE personnel who have been vetted and certified by their respective CoP for their specific areas of expertise. The goal of ATR Team selections should be to find the most experienced subject matter experts available whose qualifications are commensurate with the complexity of the product(s) being reviewed. ATR Teams may be supplemented by experts outside of USACE, as long as the experts are endorsed by the respective technical sub-CoP Leader. For several major disciplines, the following paragraphs identify the CoP or sub-CoP that maintains a list of experts approved as ATR reviewers.

- The Engineering and Construction (E&C) CoP utilizes the Corps of Engineers Reviewer Certification and Access Program (CERCAP) as the process for the nomination, review and certification of ATR reviewers. To serve as an E&C reviewer on an ATR Team, USACE personnel must be listed in CERCAP. CERCAP can be accessed at https://maps.crrel.usace.army.mil/apex/f?p=105:LOGIN:15561893545473.

- The Cost Engineering MCX trains and maintains a list of qualified cost reviewers. The Cost Engineering MCX ATR coordinator will assign a qualified reviewer who is knowledgeable in the types of applied engineering and construction solutions.

- The Real Estate CoP (CEMP-CR) also maintains a list of approved reviewers.

The significant disciplines involved with the development of this project that the PDT believes should also be represented on the ATR Review, include the following:

- Electrical engineering – shall have experience in wiring and schematics for electromechanical control systems involved with the movement of mechanical gates.
- Mechanical engineering (Expert) –shall have experience in gearing and pinion design, machine rehabilitation and familiarity with design of mechanical gates.

After coordination with the RMO, the ATR team members have been determined and provided in ATTACHMENT 5.

2. ATR PROCESS

Prior to MSC Commander approval, the PDT will provide the ATR team with a Projectwise link to the RP. At that point, the ATR Team will assess whether a site visit will be needed to complete the ATR Review and the resource loaded schedule will be updated by the Project Manager to reflect the decision.

The Technical Lead will upload the review documents into the appropriate folder in Projectwise and will distribute the review documents to the reviewers by sending an email that, at a minimum, contains the following:

- Link to the appropriate Projectwise folder which contains the review documents (external to USACE reviewers should be provided the review documents via email or other approved file transfer system)
- Whether the review documents were prepared in-house, by an A-E or both
- Start and end dates for the Review
- Project Review Name in DrChecks

The RMO will work with the ATR Lead to setup a DrChecks review which will be used for documentation of all review comments.

The ATR Team will provide a written summary of its actions and written specific concerns to the PDT through the RMO. Upon receipt of the ATR comments, the PDT will develop responses to the specific concerns and coordinate those responses with the ATR team through the RMO. Technical responses will be made by product author or by an individual experienced in that discipline area. Responses will acknowledge and specifically address the comments, indicating resolution steps taken or to be taken. 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. The RMO should be engaged by the ATR Team Lead if issues arise between a reviewer and the PDT that cannot be fully resolved. When resolution is not readily achievable, the RMO should engage the PCX/RMC or MSC SMEs to help facilitate resolution, and they in turn may choose to engage HQUSACE SMEs. When policy and/or legal concerns arise during ATR efforts that are not readily and mutually resolved among the PDT members and the reviewers, the district will seek issue resolution support from the MSC and HQUSACE consistent with the dispute resolution guidance in EC 1165-2-217. Unresolved comments involving disagreement between the ATR Team and the PDT will be closed with the notation that the comment has been elevated for resolution. Any such issues will be explicitly listed on (or attached to) the ATR certification form prior to being routed for signature.

The ATR Team will identify significant issues that they believe are not satisfactorily resolved and will note these concerns in the Statement of Technical Review Report/Certification documentation. Review reports will be considered an integral part of the ATR documentation process. The ATR documentation in DrChecks will include the text of each ATR concern, the PDT response, a brief summary of the pertinent points from discussions, including any vertical coordination, and the agreed upon resolution.

The ATR Team Lead must complete a statement of technical review for all final products and final documents. For each ATR event, the ATR Team will examine relevant DQC records and previous ATR reports, and will provide written comment in the Statement of Technical Review Report as to the apparent adequacy of the DQC effort for the associated product or service. This report includes a summary of each unresolved issue, the Charge questions, a brief resume of ATR reviewers, and a printout of all DrChecks comments with resolution in order for the process to be certified as complete. The ATR Team Lead, project manager, RMO, and the chief(s) of the function will certify that the issues raised by the ATR Team have been resolved, or have been escalated for resolution. By signing the ATR certification, the district leadership certifies policy compliance of the document and also that the DQC activities were sufficient and documented. Before the ATR certification is completed, the PDT will ensure that all agreed upon changes have been incorporated into the final product. A sample Statement of Technical Review (ATR Completion) and Certification of ATR is included in ATTACHMENT 6.

D. INDEPENDENT EXTERNAL PEER REVIEW (IEPR)

Independent External Peer Review (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. Any work product, report, evaluation, or assessment that undergoes DQC and ATR may also be required to undergo IEPR under certain circumstances.

The Water Resources Development Act of 2007 (WRDA 2007) includes two separate requirements for review by external experts. The first, Section 2034, requires Independent Peer Review (IEPR), hereafter called Type I IEPR, of project studies under certain conditions. The second, Section 2035, requires a Safety Assurance Review (SAR), also referred to as Type II IEPR, of “the design and construction activities for hurricane and storm damage reduction and flood damage reduction projects.” USACE has extended this policy for Type II IEPR to all projects with life safety issues. Therefore, Districts/MSCs must consider life safety implications of the design of other projects and make a risk-informed determination whether a Type II IEPR would be beneficial. Sections 2034 and 2035, besides having different foci, also differ significantly in legislative language. This necessitates some variation in the scope and procedures for IEPR, depending on the phase and purposes of the project under review. For clarity, IEPR is divided into two types, Type I is generally for decision documents and Type II is generally for implementation documents. The differing criteria for conducting the two types of IEPR can result in work products being required to have Type I IEPR only, Type II IEPR only, both Type I and Type II IEPR, or no IEPR. The Water Resources Reform and Development Act of 2014 (WRRDA 2014) includes two changes from requirements stated above for review by external experts. The first, Section 1044, amends Section 2034 of WRDA 2007 to raise the threshold value from $45,000,000 to $200,000,000. The second, Section 3028, amends Section 2035 of WRDA 2007 to make the Federal Advisory Committee Act (5 U.S.C. App.) not applicable for a SAR.

Type I IEPR is a review of decision (feasibility phase) documents only and does not apply to the PED Phase. Therefore, only Type II IEPR (SAR) was considered in this RP.

1. CHIEF’S ASSESSMENT

The Detroit District’s Chief, Engineering & Construction Office (who also serves as the Levee & Dam Safety Officer) has completed an assessment of the scope of this project along with the inherent issues/risks provided within this document and determined the following:

- The project does not pose significant threat to human life associated with failure of the project or proposed projects.
- The project does not involve the use of innovative materials or techniques.
- The engineering is not based on novel methods.
- The engineering does not present complex challenges for interpretations.
- The engineering does not contain precedent-setting methods or models.
- The engineering does not present conclusions that are likely to change prevailing practices.
- The project design does not require redundancy, resiliency, and robustness.
- The project does not have 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 delivery systems.

The Chief, Engineering & Construction Office performed the assessment and issued the Type II IEPR decision by email message dated 18 January 2019. The Chief, Engineering & Construction Office's assessment of the project concluded that a Type II IEPR (SAR) will not be required.

ATTACHMENT 1

REVIEW PLAN REVISIONS

REVIEW PLAN REVISIONS

Revision Date	Description of Change	Page / Paragraph Number

ATTACHMENT 2

ACRONYMS & ABBREVIATIONS

ACRONYMS & ABBREVIATIONS

Term	Definition
A-E	Architect-Engineer
AS3	Army Source Selection Supplement
ATR	Agency Technical Review
BCOES	Biddability, Constructability, Operability, Environmental & Sustainability
CADD	Computer Aided Drafting & Design
CERCAP	Certification & Access Program
CoP	Community of Practice
DDR	Design Documentation Report
DQC	District Quality Control
E&C	Engineering & Construction
EC	Engineer Circular
ECIFP	Engineering Considerations & Instructions to Field Personnel
EOP	Environmental Operating Principals
ER	Engineering Regulation
HQUSACE	Headquarters, U.S. Army Corps of Engineers
HTRW	Hazardous, Toxic & Radioactive Waste
IEPR	Independent External Peer Review
IGE	Independent Government Estimate
LEED	Leadership in Energy & Environmental Design
MCX	Mandatory Center of Expertise
MSC	Major Subordinate Command
N/A	Not Applicable

Term	Definition
NAS	National Academy of Science
NEPA	National Environmental Policy Act
NPDES	National Pollutant Discharge Elimination System
O&M	Operation and maintenance
OMB	Office of Management & Budget
OMRR&R	Operations Maintenance Repair, Replacement & Rehabilitation
P&S	Plans & Specifications
PCX	Planning Center of Expertise
PDF	Portable Document Format
PDT	Project Delivery Team
PED	Preconstruction Engineering & Design
PgMP	Program Management Plan
PM	Project Manager
PMP	Project Management Plan
QA	Quality Assurance
QC	Quality Control
QCP	Quality Control Plan
QMP	Quality Management Plan
RFP	Request for Proposal
RMC	Risk Management Center
RMO	Review Management Organization
RP	Review Plan
SME	Subject Matter Expert
TL	Technical Lead
USACE	U.S. Army Corps of Engineers
VE	Value Engineering
WRDA	Water Resources Development Act

ATTACHMENT 3

ROLES & RESPONSIBILITIES

REVIEW PLAN PROCESS - ROLES & RESPONSIBILITIES

- **HOME DISTRICT/OFFICE RESPONSIBLE FOR PROJECT**
  - During the Project Kickoff Meeting, the PDT will work together to develop and document risks and related issues for the project in order to make risk-informed decisions on the level of review that is appropriate.
  - The Project Manager will set up a P2 activity for initial MSC review and approval of the review plan.
  - The PDT coordinates the Type II IEPR risk-based analysis with the District Chief, Engineering & Construction Office. The Chief, Engineering & Construction performs the assessment and issues the Type II IEPR decision by email to the Technical Lead and Project Manager. The Technical Lead will store the email in the "Quality Management Documents" folder in Projectwise.
  - The Technical Lead (TL) will formally draft the RP in accordance with EC 1165-2-217 and will coordinate with the design center (if applicable)/ATR Team Lead (if applicable)/RMO.
  - The project manager will create a resource loaded schedule with adequate funds for all necessary reviews and the project schedule will provide sufficient time for all reviews, and at the appropriate points in the schedule (as required in the Review Plan).
  - The Technical Lead will route the RP to District Counsel, the RMO, District Commander and the MSC. The PDT will assess any comments that are received to determine if changes are needed to the RP. RMO/MSC comment resolution/documentation will typically be completed using Projnet.
  - After RP approval by the MSC Commander, the Technical Lead will post the RP on the Detroit District website with the RMO endorsement and MSC approval memo. The Project Manager will store the RMO endorsement and MSC Approval Memo in the "Quality Management Documents" folder in Projectwise.
  - The PDT will assess any public comments that are received to determine if changes are needed to the RP.
  - The Project Delivery Team (PDT) will update the RP to reflect minor changes as they occur without the need for re-approval. Re-approval of RPs by the MSC will be required when there are significant changes, such as in the level of review (i.e., Type II IEPR is added to or deleted from the RP). Other situations requiring RMO re-endorsement and MSC re-approval should be very limited but could include significant changes in study/project scope (e.g., adding or subtracting a purpose, etc.). All minor and major changes made to the RP after the initial MSC Commander's approval get documented in ATTACHMENT 1.
  - The Project Manager is responsible for ensuring implementation of all requirements of the RP.

- **REVIEW MANAGEMENT ORGANIZATION (RMO)**
  - Coordinate all RPs, including reaching agreement on scope and details of effort
  - Endorse RPs and Updates
  - Assign ATR Team and ensure that ATR Team Lead is outside home MSC
  - Obtain services of the Cost Engineering MCX for review and certification of cost estimates
  - Work with ATR Team Lead to manage the ATR: for Type II IEPR, contract with an A/E contractor or arrange with another government agency to manage Type II IEPRs
  - Prepare Charge questions for reviewers
  - Coordinate model review and prepare recommendations for model certification or approval
  - Develop and maintain Standard Operating Procedures for the conduct of ATR and IEPR and model reviews

- **MAJOR SUBORDINATE COMMAND (MSC)**
  - Establish Quality Management Plan (to include discussion of how DQC will be conducted and documented in districts) and execute procedures.
  - Approve all RPs (and updates), assuring RMO has provided an endorsement letter, and vertical team concurrence.
  - Support the district for ATR issue resolution.

- Approve final Agency Response to Type II IEPR review reports.
- Provide QA process to include the adequacy and capability of the DQC teams and supplementing the team members from outside the district when necessary.
- Execute QA role and responsibility.

- **HQUSACE**
  - Complete policy reviews.
  - Participate in issue resolution.
  - Complete Congressional notification requirements.
  - Web-postings with links to RPs on District's websites.

- **ALL**
  - Conduct Quality Assurance.
  - Uphold professional standards.
  - Communicate well and often.
  - Learn from prior reviews.
  - Share lessons learned with the Community of Practice.

ATTACHMENT 4

SCHEDULE & RISK REGISTER

ATTACHMENT 5

POINTS OF CONTACT

PROJECT DELIVERY TEAM (PDT)		
NAME		**PHONE**

VERTICAL TEAM		
NAME	**FUNCTION/DISCIPLINE**	**PHONE**

DISTRICT QUALITY CONTROL (DQC) REVIEWERS		
NAME	**FUNCTION/DISCIPLINE**	**PHONE**

BCOES REVIEWERS		
NAME	**FUNCTION/DISCIPLINE**	**PHONE**

AGENCY TECHNICAL REVIEW (ATR) TEAM		
NAME	**FUNCTION/DISCIPLINE**	**PHONE**

ATTACHMENT 6

SAMPLE REVIEW CERTIFICATIONS

COMPLETION OF DISTRICT QUALITY CONTROL

As the Technical Lead for the TAINTER VALVE MACHINERY REHAB project, I certify that the District Quality Control requirements have been completed in accordance with the approved Review Plan, EC 1165-2-217, other USACE guidance and industry standards, if applicable. I certify that the Design Documentation Report (including write-up and computations), drawings and specifications meet the customer requirements, if applicable. For items previously designed by others and included as the design basis shown herein, I certify that I have verified the work for adequacy, completeness, and accuracy. I certify that the following DQC Review components have been properly documented and archived in Projectwise:

- Quality Review comments and their resolution
- PDT Review – Completed DQC Checklists
- Computation Checks
- Graphic/Plan Checks

I certify the work is based on:

- Appropriate assumptions, methods, procedures, computations (including quantities) and materials used in the analyses
- Appropriate data and level of data
- Reasonable results that meet the customer's needs consistent with law and existing USACE policy.

SIGNATURE _____ _____

Name Date
INDC Technical Manager Lead

I certify that DQC has been properly completed and concur with the findings of the Technical Lead:

SIGNATURE _____ _____

Name. Date
DQC Review Lead
CELRE-EC

SIGNATURE _____ _____

Name Date
Project Manager
Office Symbol

SIGNATURE _____ _____

Name Date
Supervisor (of the Technical Lead)

STATEMENT OF TECHNICAL REVIEW

COMPLETION OF AGENCY TECHNICAL REVIEW (ATR)

This Statement of Technical Review has been completed by the ATR Team for the TAINTER VALVE MACHINERY REHAB project, see attached summary of unresolved issues and future commitments, the Charge questions, a brief resume of ATR reviewers, and a printout of all DrChecks comments with resolution. The ATR was conducted as defined in the project's RP to comply with the requirements of EC 1165-2-217. 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 USACE 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 either been resolved or have been elevated and are attached. All comments in DrChecks are closed.

SIGNATURE _____ _____

Name Date
ATR Team Leader

SIGNATURE _____ _____

Name Date
Project Manager (home district)
Office Symbol

SIGNATURE _____ _____

Name Date
Review Management Office Representative

CERTIFICATION OF AGENCY TECHNICAL REVIEW

Significant concerns and the explanation of the resolution are as follows: *Describe the major technical concerns and their resolution and specifically list any agreed-upon deferrals to be completed in the next phase of work or state "There are no significant concerns or any unresolved comments"..*

As noted above, all concerns resulting from the ATR of the project have been fully resolved or have been elevated and documented with this certification.

SIGNATURE _____ _____

Name, P.E. Date
Chief, Engineering & Construction
CELRE-EC

[1] Only needed if some portion of the ATR was contracted

COMPLETION OF BCOES REVIEW

Name of Project: TAINTER VALVE MACHINERY REHAB

<NOTE: DELETE IF PIH WAS CONDUCTED>
A Plan-In-Hand Review waiver was granted for the subject project due to the following reasons:

- <insert reasoning>

_____
Chief, Engineering & Technical Services

I, Name, certify that all statutory & regulatory requirements for Value Engineering have been addressed/completed for this procurement action as required by ER 11-1-321 Army Programs Value Engineering (Change 1 or latest version), specifically compliance with Public Law 111–350 §3, Jan. 4, 2011, 124 Stat. 3718 (41 USC 1711)- Value Engineering and OMB Circular A-131.

[INSERT ONE OF THE FOLLOWING]

- This project did not require VE to be addressed since it was below the statutory and regulatory threshold.

- A Value Management Plan (VMP) was completed on (date) by the appropriate legal authority indicating <(Low Opportunity (LO)/Bridge/Scan) on (date); or Value Study on (date); or Waiver on (date)> and is documented in project records.

[IF A VALUE STUDY WAS EXECUTED INCLUDE THE FOLLOWING]

A Value Study was performed on (date) and all documentation has been completed & implementation validated on (date); and all rejected VE proposals indicating potential savings of over $1,000,000 have been resolved with approval of the MSC Commander.

_____ _____
Assigned Project Manager Value Engineering Officer

Real estate <is/is not available> to accommodate the work proposed in the plans and specifications, including the execution of all required relocation contracts.

_____
Chief, Real Estate

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 & Construction Chief, Real Estate

_____	_____
Chief, Environmental Analysis Branch	Chief, Operations/Area Engineer

CELRE-E DATE:

MEMORANDUM FOR RECORD

SUBJECT: TAINTER VALVE MACHINERY REHAB

As the Chief of Engineering & Technical Services, my signature below indicates my approval of the contract document (e.g. drawings, technical specifications, and other documents prepared and issued for the subject project). All requirements of the MSC Commander approved Review Plan have been completed and the contract documents are now ready for advertisement.

Name, P.E.
Chief, Engineering &
Technical Services Division

CF:
CELRE-EC (Quality Manager)
CELRE-ECG (Project File)